

Assessment of the Impact of a Digital Intervention on Public Attitudes to Vaccination

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**Assessment of the Impact of a Digital Intervention on
Public Attitudes to Vaccination**

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ABSTRACT

Since 1980, vaccination coverage has been lower than the recommended level set by the World Health Organisation for all vaccines included in the National Immunisation Schedule. The focus of this thesis is *vaccine resistance*. We focus, in particular, on the measles-mumps-rubella (MMR) vaccine, due to a history of resistance to this in the United Kingdom. Much previous work has focused on *adult* perceptions of vaccination, and interventions aimed at adults have shown limited effect on attitudes towards vaccination. Moreover, few studies have investigated vaccination attitudes held by *teenagers* and *young adults*, who form an important target group when we consider future intentions to vaccinate their own children. Digital interventions have previously been successful in affecting teenagers' attitudes towards important health issues. The aim of this research, therefore, was to determine the impact of a variety of interventions on teenagers' attitudes towards vaccination.

We developed and evaluated an educational digital-based resource for infectious disease epidemiology. This began with the development of an attitudinal survey, using a range of qualitative methods (including interviews) in order to establish the range of views held by local young people and focus groups in Greater Manchester, UK. The findings from the interviews were used as the basis for the design of an attitudinal intervention, which used both "traditional" (presentation-based) and "digital" modes of delivery. The intervention was trialled with GCSE Biology students (n=63), using three groups (presentation, digital and control). This study showed no significant difference in post-trial change in attitudinal scores across the three groups immediately after the intervention ($p=0.115$), or after a six-month period ($p=0.116$). In addition, no difference in resource engagement between the two intervention groups was observed. Although the first result may appear somewhat surprising, it is entirely consistent with previous related studies involving adults.

The main novel contributions of this research are: (1) a detailed assessment of current attitudes of teenagers towards vaccination, (2) a fully-evaluated and novel form of software-based attitudinal intervention, and (3) a detailed analysis of the impact of this form of intervention on attitudes towards vaccination in young people. Our fundamental conclusion will, we hope, inform the development of future healthcare interventions concerning young people and vaccination.

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DECLARATION

The author certifies that the work presented in this thesis is her own, and that contributions made by others have been acknowledged in the text.

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CHAPTER 1: INTRODUCTION

This thesis focuses on the evaluation of a digital intervention for vaccination attitudes held by young people. The study has three main phases: 1) Assessment of the *range of attitudes* towards vaccination held by local young people; 2) Development of a *data collection instrument* to assess attitudes towards vaccination; 3) Development, testing and delivery of a *digital educational resource* for vaccination attitudes, and the subsequent evaluation of its impact on young people.

This Chapter provides an introduction to this research, including the main hypothesis, research questions, aims and objectives. Chapter 2 provides a review of literature relevant to this research. Chapter 3 describes the research methodology used in this research. Chapter 4 describes the development of the initial prototype digital intervention, which forms the basis of subsequent work. The following Chapters describe work related to the attitudinal study itself: Chapter 5 describes the background research conducted on young peoples' attitudes towards vaccination. This generated a range of *themes* that were used in both the development of a data collection instrument (discussed in Chapter 3) and the intervention materials (described in Chapter 6). In Chapter 7, the results are described and discussed and conclusions are drawn about the main findings, and offer some recommendations for future work.

1.1 Background

Vaccination coverage in the United Kingdom is currently below the level recommended by the World Health Organisation (World Health Organisation 2012). When vaccination coverage is insufficient, outbreaks of infectious diseases may occur (Jansen *et al.* 2003). Locally, in Manchester, a significant outbreak of measles occurred between October 2012 and September 2013, and it is estimated that 9.45% of 16 year olds in Greater Manchester were susceptible to measles in 2013 (Public Health England 2013). While vaccination coverage has improved since 1988, in 2015 coverage of the first dose of the measles-mumps-rubella

(MMR) vaccine declined in the United Kingdom for the first time since 2008 (Health and Social Care Information Centre 2014). The reasons for this decline may be explained, in part, by personal choice on the part of individuals and parents, and it is therefore crucial to understand both the motivation to vaccinate, and barriers to vaccination in the United Kingdom (that is, vaccination resistance).

Attitude and *behaviour* are often linked (Ajzen 1991). This has been reflected in the decline in uptake of the MMR vaccine, after it was falsely linked to autism in children (Wakefield *et al.* 1998). In fact, a study of parental attitudes towards the MMR vaccine (Brown *et al.* 2012), ten years after the spurious link to autism was made, showed that there *still* existed uncertainty about the connection, despite it having been categorically disproven (Anjali Jain *et al.* 2015). This demonstrates that established attitudes can have a long-lasting effect on behaviour; the relationship between attitude and behaviour is discussed in more detail in Chapter 2.

In order to place this work in context, it is important to first consider the effectiveness of previous interventions aimed at improving vaccination rates. Several interventions have had limited success in the United Kingdom; for example a MMR vaccine promotion campaign using a cuddly toy to promote a website with facts about the MMR vaccine was found to have limited effectiveness (Porter-Jones *et al.* 2009). Examples of previous vaccination interventions are discussed in more detail in Chapter two. Previous vaccination interventions aimed at adults have also had limited effectiveness, and can actually *decrease* intent to vaccinate (Nyhan *et al.* 2014). For this reason, the age group that would form an alternative target population for investigation was considered; this project, therefore, focussed on the vaccination attitudes of teenagers. This group was selected for two main reasons: (1) They will be the next generation to make vaccination decisions about their own children, and (2) Teenagers have previously expressed interest in receiving more information about vaccination before making vaccination decisions (Gowda *et al.* 2012).

A number of factors are involved in the development of attitudes towards vaccination, and in the subsequent formation of vaccination decisions. These can include *perceptions of risk* of both vaccination and infectious diseases, *trust* in healthcare professionals, and *social concerns* (Brown *et al.* 2012; Gardner *et al.*

2010). In addition, some people have concerns about specific vaccines, such as the MMR and the pertussis (whooping cough) vaccines. These concerns are discussed in Chapter two (Section 2.1). While adult attitudes towards vaccination have been investigated in great detail previously (K. F. Brown *et al.* 2011; Gardner *et al.* 2010; Brown *et al.* 2012; Freed *et al.* 2010), there exists limited research on attitudes of young people towards vaccination. For this reason, in-depth qualitative interviews were initially used to provide an understanding of the *range* of attitudes towards vaccination in local teenagers. This research also provided insight to the attitudes of local teenagers towards vaccination *prior* to intervention.

The *range of formats* the intervention may take is also an important concern. These include leaflets, posters, radio and television broadcasts and educational interventions. Based on earlier work, decided that a digital-based educational intervention would be developed. 'Games for Health' is a growing area of research (Baranowski *et al.* 2013), and digital health interventions have been previously used successfully with. A notable example of a successful digital intervention is the 'Re-mission' game, a digital health intervention which has been shown to improve adherence to medical treatments, and knowledge and understanding of cancer in young adults and adolescents with cancer (Kato *et al.* 2008). This project, therefore, aimed to determine the effectiveness of a digital resource about vaccination on teenagers' attitudes towards vaccination, through comparison with a non-digital intervention. These are discussed in more detail in Chapter two.

1.2 Hypothesis

Based on previous research, the hypothesis for this research is as follows:

"Vaccination interventions have an effect on attitudes of young people towards vaccination". The Null hypothesis is, therefore: *"Vaccination interventions have no effect on attitudes of young people towards vaccination"*

1.3 Additional research questions

In addition to the main hypothesis, during the course of this research three additional points of interest were investigated:

1. What are the range of attitudes towards vaccination in young people from the local area?

2. Does exposure to vaccination interventions affect young people's perceptions of personal choice and information needs?
3. Do digital-based resources increase engagement in educational activities when compared with traditional presentation-based education activities?

The findings of these research questions are discussed in Chapter six.

1.4 Aims and Objectives

Aim: Determine if a digital intervention has any effect on attitudes towards vaccination in young people

Objectives:

- Development of an initial prototype software environment for epidemiology (later repurposed for specific use as an attitudinal intervention)
- Design of an interview schedule to identify key issues towards vaccination in teenagers
- In-depth interviews conducted with the target group to determine the range of attitudes towards vaccination
- Development of an attitudinal survey to assess attitudes towards vaccination in the target group
- Finalisation of attitudinal intervention
- Assessment of attitudes towards vaccination in target group before and after exposure to intervention tool and after six months as follow up
- Analysis of data from attitudinal surveys to determine any changes in attitudes towards vaccination in target group

1.5 Contributions to knowledge

The main novel contributions of this project are: (1) A detailed assessment of current attitudes of teenagers towards vaccination, (2) An evaluated novel form of software-based attitudinal intervention, and (3) A detailed analysis of the impact of this form of intervention on attitudes towards vaccination in young people. These are described in more detail below.

(1) A detailed assessment of current attitudes of young people towards vaccination

To date, there exists limited research investigating teenagers' attitudes towards vaccination. Previous research on attitudes towards vaccination generally focusses on adults (Gardner *et al.* 2010; Hak *et al.* 2005; Opel *et al.* 2011; Reiter *et al.* 2009; Dannerun *et al.* 2005; Brown *et al.* 2012; Brunson 2013; Downs *et al.* 2008; Kennedy *et al.* 2005; K. F. Brown *et al.* 2011; Tickner *et al.* 2006; Smith *et al.* 2007; Freed *et al.* 2010; Wright & Polack 2006; Bolton-Maggs *et al.* 2012). Using in-depth interviews and an attitudinal survey, this project will give an understanding of current attitudes towards vaccination in teenagers from Greater Manchester, UK.

(2) Development and evaluation of a novel form of software-based attitudinal intervention

Previous vaccination interventions in the United Kingdom have taken many forms, including patient education (Porter-Jones *et al.* 2009), GP education (Williams *et al.* 2011), decision aids (Jackson *et al.* 2010) and reminder strategies (Williams *et al.* 2011).

Software-based health interventions have been successful and effective in other areas of health (Kato *et al.* 2008; Baranowski *et al.* 2003; Brendryen & Kraft 2008), and the research group at Manchester Metropolitan University has previously developed epidemiology-based software for educational purposes (Verran *et al.* 2013). This project includes the development and evaluation of a novel form of software-based attitudinal intervention.

(3) Undertake a detailed analysis of the impact of this form of intervention on attitudes towards vaccination in young people.

This project will assess the impact of the software-based attitudinal intervention on attitudes towards vaccination in teenagers. Previous vaccination interventions have focused on adults (Porter-Jones *et al.* 2009; Jackson *et al.* 2010), and there is evidence that these strategies are not effective (Nyhan *et al.* 2014; Dube *et al.* 2015). This project is distinctive in that it focuses on teenagers.

CHAPTER 2: LITERATURE REVIEW

This literature review encompasses six main areas of relevance to this project. The first two Sections describe *current issues in vaccination uptake* in the United Kingdom: Section 2.2 covers vaccination in the United Kingdom and factors influencing vaccination decisions, in order to contextualise this research. As it is important to understand previous interventions, Section 2.3 gives an *overview of health interventions*, with a specific focus on vaccination interventions.

The subsequent Sections discuss potential solutions to the problem of suboptimal vaccination coverage in the United Kingdom: Section 2.4 describes *different types of interventions* that have been used previously for a wide range of health issues. Section 2.5 discusses *theories of attitude*, and provides the theoretical underpinning for this research. Section 2.6 describes *education-based interventions*, and Section 2.7 discusses the use of *digital technology in learning*.

2.1 Introduction

Vaccines are a method by which an individual can become artificially immunised against an infectious disease (Lombard *et al.* 2007). Vaccination involves the deliberate exposure of an individual to a dose of antigens, in order to stimulate the body to produce specific antibodies. If the antigen is encountered again by the body, antibodies bind to it, blocking its ability to bind to the host cell and cause disease (Slonczewski & Foster 2011). The World Health Organisation recommends vaccine coverage of over 95% for the measles, mumps, rubella, diphtheria, tetanus, polio and *Haemophilus influenzae* type b vaccines (World Health Organisation 2012; Health & Social Care Information Centre 2013).

“Herd Immunity” is the effect produced by a significant proportion of a population being immunised against an infectious disease (Fine *et al.* 2011).

Immunocompromised individuals cannot receive vaccines containing live or attenuated cells, and the vaccine can lead to the individual contracting an active infection (Madigan *et al.* 2009). Herd immunity is therefore important in the eradication and containment of serious infectious diseases, and in protecting those

who cannot be vaccinated, by creating a 'barrier' of immunised people (Fine *et al.* 2011). However, herd immunity can be compromised if the proportion of vaccinated individuals in a population drops below a critical threshold. Such a reduction in vaccination may often be explained by resistance on the part of individuals, which may, in turn, be partly explained by their attitudes towards vaccination.

Attitudes towards vaccination decisions are complex (Brown *et al.* 2012), and negative attitudes towards vaccines have previously been linked to decline of uptake (for example, in the MMR vaccine, after it was falsely linked with autism (Smith *et al.* 2007)). This is described in more detail in the next Section. A recent large-scale study of vaccination confidence in 67 countries (Larson, *et al.*, 2016) found that "vaccine-safety related sentiment is particularly negative in the European region". Issues specific to the UK are considered in the following Section.

2.2 Vaccination in the United Kingdom

Before considering how interventions might affect attitudes towards vaccination, it is important to first provide context for this research, including the current status of vaccination coverage in the United Kingdom and the factors influencing (parental) vaccination decisions.

The 2014/15 Childhood Immunisation Schedule (NHS 2014) includes vaccinations protecting against: Diphtheria; tetanus, pertussis; polio; *Haemophilus influenzae* type b; Pneumococcal (PCV) vaccine; Rotavirus; Meningitis C; measles, mumps and rubella (MMR combination vaccine); and influenza. Girls are additionally vaccinated against the human papillomavirus (HPV) at 12-13 years old. Since 1988, detailed records have been kept of children vaccinated in each area of the United Kingdom. Every three months these sets of data are collected and evaluated by COVER (Cover of Vaccination Evaluated Rapidly) (HPA 2011). They therefore give an up-to-date view of current vaccination rates, and any trends thereof.

National campaigns have improved vaccination rates in recent years: the vaccination coverage for most childhood vaccines has generally increased nationally, with 2012-13 recording the highest coverage of the MMR vaccine since

1988 (from 80% in 1988 to 92.3% in 2012/13) (Health & Social Care Information Centre 2013). Despite this, vaccination coverage in the United Kingdom remains lower than the target of over 95% set by the World Health Organisation (World Health Organisation 2012). In addition, in 2014-15, all areas of the United Kingdom (except for the North East) saw a decrease in MMR vaccine coverage for the first time in seven years (Health and Social Care Information Centre 2015).

2.2.1 Vaccine concerns in the United Kingdom

Before seeking to develop an intervention for vaccination, it is important to understand what factors have influenced vaccination decisions. Here, historical examples of previous concerns about vaccination are highlighted, in order to illustrate how these have affected perceptions and attitudes. Anti-vaccination advocates have highlighted specific concerns about the safety of vaccinations and links with certain health conditions and problems (Kata 2012). These include:

1. The pertussis (whooping cough) vaccine and neurological damage
2. The measles-mumps-rubella vaccine and autism
3. Thiomersal and autism
4. Sudden Infant Death Syndrome
5. Multiple Sclerosis

2.2.2.1 Pertussis (whooping cough) vaccine

Pertussis was vaccinated against using the whole-cell diphtheria-tetanus-pertussis (DTP) combination vaccine in the United Kingdom until 2004 (Amirthalingam *et al.* 2013). However, there were significant problems with the vaccine, such as fevers and seizures, and many case reports (between 1948 and 1960) linked the vaccine with serious complications such as encephalopathy, permanent neurological injury and death (Baker 2003). After a report (Kulenkampff *et al.* 1974) linked neurological damage to the DTP vaccine, the vaccine was brought under scrutiny. To address the concerns about the side effects of the vaccine, an acellular vaccine was developed using purified *Bordetella pertussis* haemagglutinins (filamentous haemagglutinin and leucocytosis-promoting-factor haemagglutinins). This was used first in Japan (Sato *et al.* 1984) before being used in other countries, including the United Kingdom (Gov.uk 1992). A study comparing countries where anti-vaccination movements were prevalent with countries that maintained high DTP vaccine coverage found that outbreaks of pertussis were 10-100 times lower

in countries *without* significant anti-vaccination movements (Gangarosa *et al.* 1998).

2.2.2.2 Measles-mumps-rubella (MMR) vaccine

The Measles-mumps-rubella (MMR) vaccine ‘controversy’ has had a long lasting effect on public perceptions of vaccination. The MMR vaccine, introduced in the UK in 1988, was falsely linked to autism and colitis by Andrew Wakefield in a paper published in medical journal *The Lancet* in 1998 (Wakefield *et al.* 1998). The paper was later retracted, as it was found to be fraudulent (2010). Several studies have since demonstrated that there exists no detectable link between the MMR vaccine and autism (Black *et al.* 2002; Taylor *et al.* 2002; Madsen *et al.* 2002). A recent major study of 95,000 children found no link between the vaccine and autism (Jain *et al.* 2015). Wakefield was struck off the medical register by the General Medical Council in 2010 (Meikle & Boseley 2010).

Despite this, the MMR vaccine remains insufficiently accepted - the UK vaccination coverage of MMR has been lower than the recommended level of 95% since 2000, with the lowest coverage in 2003/04 (80%) (Health and Social Care Information Centre 2014). It has been suggested that MMR vaccine coverage remains low due to persistent negative parental attitudes (Gardner *et al.* 2010) and that public perceptions of the MMR vaccine still need to be improved (Brown *et al.* 2012).

2.2.2.3 Thiomersal

Thiomersal is an organic compound of ethyl mercury which has been used as a preservative in vaccines in order to prevent microbial contamination (Doja & Roberts 2006). The use of thiomersal in vaccines was linked to autism by members of the public when its removal from vaccines in 1999 in the United States coincided with a rise in the number of cases of autism in the US (Larson *et al.* 2011). A paper published in 2001 suggested that autism was actually due to a form of mercury poisoning (Bernard *et al.* 2001). However, studies have since shown no proven link between the use of vaccines containing thiomersal and autism (Nelson & Bauman 2003; Parker *et al.* 2004; Price *et al.* 2010).

2.2.2.4 Sudden Infant Death Syndrome

Sudden Infant Death Syndrome (SIDS) is defined as the unexplained and unexpected death of an infant under the age of two (Jorch *et al.* 2007). The

majority of cases of SIDS occur between 2 and 4 months of age, which coincides with the start of infant immunisation. For example, the vaccine most commonly linked with SIDS is the diphtheria-tetanus-pertussis (DTP) vaccine (Hoffman *et al.* 1987). This link is often (incorrectly) made because most SIDS deaths occur within the time-frame in which the DTP vaccines are given to infants (World Health Organisation 2014).

Early research supported a link between SIDS and the DTP vaccine (Stewart 1979; Baraff *et al.* 1983). However, a more recent meta-analysis showed no link between the DTP vaccine and SIDS (Howson & Howe 1991). A number of individual studies have failed to show that, infant vaccination is a risk factor for SIDS (Hoffman *et al.* 1987; Jonville-Béra *et al.* 2001; Vennemann, Butterfass-Bahloul, *et al.* 2007), and it has been suggested that vaccination may even *lower* the incidence of SIDS (Mitchell *et al.* 1995). Indeed, recent research argues that vaccination halves the risk of SIDS and should be included in SIDS prevention campaigns (Vennemann, Höffgen, *et al.* 2007).

2.2.2.5 Multiple Sclerosis

Multiple Sclerosis (MS) is an autoimmune disease of unknown aetiology characterized by demyelination of the central nervous system and progressive paralysis (Shoenfeld & Aron-Maor 2000). In 1996, MS was linked with the hepatitis B vaccine, when around 200 cases of central nervous system demyelinating disorders were reported in France following hepatitis B vaccination (Fourrier *et al.* 2001). Other studies showed a link between the vaccine and the development of disorders, with symptoms similar to those of multiple sclerosis (Herroelen *et al.* 1991; Nadler 1993; Kaplanski *et al.* 1994). One study suggested a threefold increase in the risk of developing multiple sclerosis in the three years after receiving hepatitis B vaccination (Hernan *et al.* 2005).

However, more recent studies have shown no link between multiple sclerosis and the hepatitis B vaccine (Ascherio *et al.* 2001; DeStefano *et al.* 2003; Ozakbas *et al.* 2006; Mikaeloff *et al.* 2007), and the US Centers for Disease Control (CDC) state that “most published scientific studies do not support a causal relationship between hepatitis B vaccination and MS or other demyelinating diseases” (Centers for Disease Control and Prevention 2011).

2.2.3. Factors involved in vaccination decisions

If vaccination coverage is to be improved, it is important to understand how decisions are made about *intent* to vaccinate. Aside from concerns about specific vaccines described above, there exist several other factors that are involved in vaccination decisions. The following themes are commonly-observed in studies of factors affecting parental vaccination decisions:

1. Risk perceptions
2. Understanding of vaccination
3. Trust of health professionals
4. Information needs
5. Social pressures

Each of these factors are now discussed in detail.

2.2.3.1 Risk perceptions

When making vaccination decisions, parents balance the perceived risk of their child receiving a vaccine with the perceived seriousness of the infectious disease being vaccinated against (Brewer *et al.* 2007; Brown *et al.* 2012). Parents are generally more accepting of vaccination if the infectious disease being vaccinated against has serious complications associated with it (Gardner *et al.* 2010). This is important, because, as shown earlier, fears surrounding specific vaccines (such as MMR), influence vaccination decisions, despite claims of serious side effects since being disproven. There is evidence to suggest that some people do not perceive the risk of infectious diseases such as measles and mumps to be serious (Bolton-Maggs *et al.* 2012; Gardner *et al.* 2010).

2.2.3.2 Understanding of vaccination

Many parents have limited knowledge of the symptoms and complications of the infectious diseases that are included in the immunisation schedule (Bond & Nolan 2011). Also, many parents lack fundamental understanding of the way in which vaccines work (Downs *et al.* 2008). This demonstrates the need to disseminate clear information to parents about the infectious diseases included in the NHS immunisation schedule.

2.2.3.3 Trust

The level of trust a person holds in a source of information greatly influences their intent to vaccinate. There may often be a general distrust of official sources of

information (Gardner *et al.* 2010), whereas many parents trust their General Practitioner (Gust 2004) and act on their recommendations (Gust *et al.* 2008). Above all, many parents believe *other parents* to be less biased than official sources of information (Gardner *et al.* 2010), and may be heavily influenced by the views of those around them (Brunson 2013). This may suggest one possible reason why previous interventions have had limited effect in improving attitudes towards vaccination.

2.2.3.4 Information needs

A study of parents' views on the MMR vaccine found that many felt that no sources of information on vaccination were unbiased (Brown *et al.* 2012). In addition, parents felt that information provided to them was often badly timed and lacked sufficient detail (Brown *et al.* 2012). It is important to give parents information about *both* the risks of *not* vaccinating and the *benefits* of vaccination (Leask *et al.* 2012); parents that were more aware of the serious effects of measles, mumps and rubella had a more positive view of MMR vaccination (Gardner *et al.* 2010). As with trust, it is possible that bad timing of vaccination interventions, and the belief that information provided is biased, may affect the impact of previous vaccination interventions.

2.2.3.5 Social pressures

In addition to fears surrounding the health implications of vaccination, parents may be concerned about damaging their *reputation* within their social groups – some parents feel that acceptance of the MMR vaccine is an action by which others may judge them in terms of intelligence, parenting ability and morals (Brown *et al.* 2012).

Parents have also suggested that they feared removal from GP's patients lists, in order to improve the percentage of immunised children registered with a practice (Casiday 2007). Social barriers to vaccination are therefore important, and should be carefully considered, although it may be difficult to reduce the feeling of social pressure parents felt when making vaccination decisions (Brunson 2013). The effect of social pressures on vaccination decisions is important as it demonstrates the complexity of vaccination attitudes.

2.1.3 Determinants of vaccine refusal

Studies have investigated links between vaccine refusal and demographic determinants such as religion, ethnicity and income. It is important to understand determinants of vaccine refusal, in addition to the attitudinal factors discussed above, when seeking to understand how vaccination decisions are made.

2.1.3.1 Religion and ethnicity

A study of HPV acceptance in British teenagers found that those with religious backgrounds were less likely to vaccinate than those without a religious background, that Asian British participants were less likely to vaccinate than White British participants, and that participants whose first language was not English were less likely to vaccinate than those whose first language was English (Marlow *et al.* 2009). A separate study showed that schools with a higher proportion of girls from ethnic minority backgrounds had lower uptake of the HPV vaccine (Brabin *et al.* 2008). However, it should be noted that HPV acceptance by parents may additionally be affected by concerns about sexual health issues, due to the sexual nature of HPV transmission (Brabin *et al.* 2008). These insights may not, therefore, be applicable to all vaccines.

2.1.3.2 Socio-economic determinants

The impact of income on vaccine acceptance has also been discussed as a factor connected with vaccine resistance. In the United States, children from higher income families are less likely to be vaccinated than those from lower income families, which is thought to be due to information provided to low-income mothers about government-subsidized health programs (Kim *et al.* 2007).

In the United Kingdom, vaccinations are provided by the NHS so factors such as disposable income may be expected to have less impact on vaccine uptake than in countries without free healthcare (that is, where vaccinations must be paid for by parents/patients). Despite this, a study of young people in Liverpool found that children from the most socioeconomically deprived communities still had the lowest MMR vaccine uptake (Hungerford *et al.* 2016). Another study showed that low MMR vaccination coverage was most closely linked to deprived areas (Polack *et al.* 2006).

The impact of education on parental vaccination decisions has also been examined. A study in the Netherlands showed that negative attitudes towards

vaccination were associated with higher levels of education (Hak *et al.* 2005). A study of mothers in the United States found that individuals with high school education or less were more likely to delay (but still accept) or have no doubts about vaccination, than to completely refuse vaccination (Gust *et al.* 2008). Interestingly, studies have shown that in the United Kingdom, there was less decline in MMR vaccine coverage in areas with higher numbers of poorly qualified people (Polack *et al.* 2006).

2.2 Previous interventions for vaccination uptake: strategies

Before attempting to develop a vaccination intervention, it is important to evaluate the effectiveness of interventions that have already been explored, in order to confirm (or otherwise) that a new approach is needed. There are several types of strategies that have been previously used, including patient-based, practitioner-based and multi-strategy approaches.

2.2.1 Primary care strategies

Primary care is often the first point of contact between a patient and a health care system, and usually occurs with General Practitioners (GPs) and practice nurses. Several different strategies have previously been employed by primary care practitioners in order to try to improve vaccination rates. The literature provides examples of both *patient-based* and *practitioner-based* interventions. There exists limited literature focusing on strategies used in the United Kingdom, so studies from other countries are included while noting that the results may not be wholly transferable, due to differences in demographics, healthcare systems, and culture.

2.2.1.1 Patient based

2.2.1.1.1 Reminder and recall

The Cochrane review of “reminder and recall” strategies for vaccination found that all types of reminders used by primary care providers (postcards, letters, telephone and auto-dialler calls) were effective in improving immunisation rates (Jacobson Vann & Szilagyi 2009). However, vaccination reminders were not effective for *urban adolescents* when delivered by the primary care provider (Szilagyi *et al.* 2006). The researchers subsequently found that *centralised* systems, using mailed reminders, were more effective for adolescents (Szilagyi *et al.* 2013). The improvement in vaccine uptake by adolescents in the study was

relatively low (4-9% increase). However, a study of reminder and recall in adolescents in private US practices found that reminder and recall was significantly effective in improving immunisation of adolescents (Suh *et al.* 2012). This shows the importance of further research into methods of improving uptake of adolescent vaccination, as the evidence is conflicting.

2.2.1.1.2 Education

There is limited evidence of the effectiveness of patient education provided by primary care providers. A study using a promotional teddy bear with a link to an educational website about the MMR vaccine (Porter-Jones *et al.* 2009), and a study where parents were given an interactive graphic card and verbal explanation about vaccination (Stille *et al.* 2001) showed no significant impact on vaccination coverage. In addition, a review of face-to-face education on vaccination found that education interventions had limited effectiveness, and previous studies did not provide enough evidence to support the efficacy of parent education about vaccination (Kaufman *et al.* 2013).

2.2.1.1.3 Patient-held records

One study demonstrated no statistical difference in vaccination uptake between mothers that used patient-held record booklets for their children (thus emphasising "ownership" of the vaccination process) and a control group (Lakhani *et al.* 1984). However, subsequent studies have shown that patient-held records *did* improve vaccination coverage (McCormick *et al.* 1981; McElligott & Darden 2010), especially in groups more likely to under-immunise. It is possible that patient-held records allow parents to organise vaccination more effectively and serve as a reminder to vaccinate.

2.2.1.1.4 Vaccination decision aids

Decision aids are tools "intended to help people participate in decisions that involve weighing the benefits and harms of treatment options often with scientific uncertainty" (Stacey *et al.* 2014). Decision aids have been used to assist in the vaccine decision-making process, and have been shown to reduce conflict in parents who are deciding whether or not to vaccinate their children with the MMR vaccine (Jackson *et al.* 2010; Shourie *et al.* 2013). Although it cannot be said that decision aids specifically increase vaccination coverage, they *have* assisted in the process of decision making, reduced anxiety about the MMR vaccine and

increased knowledge of the MMR vaccine. The use of decision aids is supported by a study that suggests that giving parents information about vaccination is not enough to increase vaccination (Connolly & Reb 2012); people need *support* when making decisions about vaccination, and decision aids are a useful technique for providing this.

2.2.1.2 Practitioner-based interventions

2.2.1.2.1 Practitioner reminder and recall

Reminder strategies have been shown to be effective in reminding *practitioners* to offer vaccinations at appointments. A study of an intervention to prompt practitioners found that a practitioner reminder system increased vaccination rates in children under 24 months (Minkovitz *et al.* 2001). This is supported by a review of practitioner reminder strategies, which found that computer prompts for vaccination increased vaccination rates by 15% on average (Dexheimer *et al.* 2008).

2.2.1.2.2 Education

Studies have shown that when practitioners have an improved knowledge of vaccination they are able to disseminate this information to their patients and create more confidence in vaccination in patients in their surgery (Uskun *et al.* 2008). Conversely, a study evaluating the effectiveness of a peer-education program on childhood immunisation levels (where qualified physicians were trained to deliver educational material about childhood immunisations and then delivered this information to other physicians and healthcare professionals at local practices) showed no significant impact on vaccination uptake after 1 year (Boom *et al.* 2010). A different peer-education program also found no significant impact on vaccination uptake (D. J. Gould *et al.* 2007).

2.2.1.2.3 Provider Assessment

In the United Kingdom, Primary Care Trusts (PCT) feedback information on vaccination uptake to GPs. Historically, practices which have had less than 60% uptake of vaccines are offered support and agreed on an action plan to improve their vaccine uptake. This has helped to improve vaccine uptake in a London PCT (uptake of the 5-in-1 DTaP/IPV/Hib vaccine at one year old increased from 78% to 89%, 5-in-1 DTaP/IPV/Hib vaccine at two years from 69% to 90% and MMR at two years from 78% to 80%) (NHS 2009). In comparison, in other countries such as

the United States, practitioners are offered financial incentives for increased vaccination uptake. This has not been shown to have a significant effect on vaccine coverage, and where vaccine coverage has improved this was thought to be due to improved documentation (Fairbrother *et al.* 1999; Giuffrida *et al.* 1999).

2.2.2 Multi-strategy approaches

An example of a successful primary care multi-strategy approach is a reminder and education intervention to improve HPV vaccine rates in pre-teen girls (Cassidy *et al.* 2014). Those who received the intervention were 22.5 times more likely to complete the recommended number of doses of HPV vaccine. This shows the direct benefit of vaccination interventions, but the findings are limited, as the study focused on a specific vaccine only given to adolescent girls. The effects of a similar intervention on boys and older teenagers are cannot, therefore, be predicted.

Another multicomponent social marketing strategy seeking to improve HPV vaccine uptake in adolescent boys in the USA found that using social marketing techniques such as radio advertisements, websites and posters increased intention to be vaccinated against HPV in areas receiving an intervention, compared with control counties (Cates *et al.* 2014). These results support the use of complex interventions for young people.

2.2.3 Limitations of previous interventions

As discussed in the previous Sections, many previous vaccination interventions have been aimed at parents. A study reviewing previous vaccination interventions showed them to have limited effectiveness in affecting parents' attitudes towards vaccination, and in some cases actually *decreased intent to vaccinate* (Nyhan *et al.* 2014). In addition, a recent meta-review of vaccination interventions found that no specific intervention currently available could be recommended to target vaccine-hesitant parents (Dube *et al.* 2015).

Attitudes towards health issues are often formed during adolescence (Macy *et al.* 2012). For this reason, targeting teenagers rather than adults may be more effective. Teenagers are interested in taking more responsibility for their own health and have expressed support for the development of interventions to increase their knowledge of vaccination before making vaccination decisions

(Gowda *et al.* 2012), so it may be more effective to target health interventions at this age group.

2.3 Previous health promotion interventions: formats

After establishing the target group and overall strategy, the *format* of an intervention should be considered. Several different types of intervention have previously been used in health promotion, with varying degrees of effectiveness. None of the types of intervention described below are without their limitations, and the benefits of one type of health intervention cannot be generalised to support their use for *all* health topics. The complexity of attitudes towards vaccination, discussed in Section 2.1, is important when deciding the format our intervention should take.

2.3.1 Leaflets

Leaflets can be used to promote health messages and provide information to the public. There are several advantages to using leaflets, including increasing *awareness* of a health issue (Steele *et al.* 2011), better *information retention* (Campbell *et al.* 2004), and reduction in repeat GP appointments for the *same issue* (Macfarlane *et al.* 1997). However, many health leaflets in the United Kingdom contain information that is difficult to understand, or give little information about the limitation of treatments (Winterbottom *et al.* 2007). In addition, leaflets require a good level of literacy (McCarthy *et al.* 2013; Raman *et al.* 2010), and so an alternative to leaflets is needed for those with lower literacy skills.

2.3.2 Posters

Posters are often used in GP waiting rooms to deliver health information to patients, and it has been shown that they do pay attention to these posters (Ward & Hawthorne 1994). Successful interventions involving posters include hand-washing campaigns to reduce the spread of infectious diseases (Jenner *et al.* 2005; Gould *et al.* 2007; Stone *et al.* 2012). However, posters can sometimes leave the reader with “more questions than answers”, because they can only provide limited information, and often increased anxiety about a health issue (Montazeri & Sajadian 2004). Another study based in the United Kingdom found that posters were ineffective in affecting public knowledge of and attitudes towards antibiotic use (McNulty *et al.* 2010). This suggests that, for some health

campaigns, posters are an effective method of encouraging positive health behaviours but for others they can be less effective. It is possible that posters are not a suitable format of intervention for more complex health issues.

2.3.3 Telephone services

Telephone services are used as helplines for certain health topics. Anti-smoking campaigns have been particularly successful, and have been effective in encouraging smoking cessation (Zhu *et al.* 2002; Miller *et al.* 2003; Creed *et al.* 1997; Zhu *et al.* 2000). Additionally, crisis hotlines for suicide (for example, the Samaritans in the United Kingdom) have been effective in reducing suicide intent, and led to improvements in mental state (De Leo *et al.* 2002; King *et al.* 2003; M. S. Gould *et al.* 2007; Mishara *et al.* 2007). However, studies on helplines are limited in that the effectiveness of these interventions has often focused on short-term outcomes.

2.3.4 Television advertisements

Television advertisement campaigns have been effective in encouraging smokers to quit smoking in America, the United Kingdom and Australia (McVey & Stapleton 2000; Pierce *et al.* 1990; Biener *et al.* 2000; Sims *et al.* 2014; Farrelly *et al.* 2007). Radio broadcasts have been effective in encouraging smoking cessation (Farrelly *et al.* 2007; Durkin & Wakefield 2010). Radio broadcasts are more cost-effective than television broadcasts, but media broadcasts are still generally very expensive to produce (Austin & Husted 1998; Farrelly *et al.* 2007).

2.3.5 Educational websites

Educational websites are effective in communicating information about various health issues, including dementia (Farrow 2013), diabetes (Yu *et al.* 2014), pre-surgery information (Hering *et al.* 2005) and weight loss (Funk *et al.* 2010; Svensson *et al.* 2014), although a web-based intervention to encourage physical activity found no difference in physical activity with use of the website (Hansen *et al.* 2012). In the United Kingdom, the 'Talk to Frank' drug information website is very popular with teenagers and young adults, but there is limited evidence of its effectiveness in reducing drug use (Bennett & Holloway 2010). This suggests that, for several health issues, websites are effective in disseminating health information and encouraging behavioural change, but such interventions are often not appropriate.

2.3.6 Digital games as interventions

Digital games can be effective and have a positive impact on health behaviours, including healthy eating (Baranowski *et al.* 2003), adherence to medical treatments and knowledge and understanding of cancer in adolescents with cancer (Kato *et al.* 2008), and rehabilitation (Salem *et al.* 2012). The “Right Way Café” game increased players’ knowledge of healthy diets, and increased self-efficacy and perceived benefits of healthy eating (Peng 2009). However, a disadvantage of developing health promotion games is that they can be expensive and time consuming (Baranowski *et al.* 2013). Despite this, teenagers are frequent users of digital technology (de Freitas 2006; Griffiths *et al.* 2004) and so a digital health intervention may be an effective way to deliver information about health topics to teenagers.

2.3.7 Non-digital games

Board games have also been used as health interventions, particularly to educate the player about a particular health issue, for example HIV and sexually transmitted diseases (Wanyama *et al.* 2012), and healthy eating in children (Amaro *et al.* 2006). Although the use of board games increases general enjoyment (Charlier & De Fraigne 2013), no evidence of their effectiveness in vaccine promotion could be found in the literature.

2.4 Theories of behaviour and attitude used to underpin intervention studies

This Section describes the theories of attitude and behaviour that underpin this research. First, the psychological concepts of *attitude* and attitude change are examined and discussed. Second, several theories and models of attitude and behaviour are introduced and compared. Finally, the “Health Belief Model” is discussed, as the primary model influencing this research.

2.4.1 Attitude

There exist several traditional and contemporary definitions of attitude. Jung defined attitude as *readiness of the psyche to act or react in a certain way* (Jung [1921] 1971: par: 687). Eagly and Chaiken defined an attitude as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour” (Eagly & Chaiken 1998, p1). More recently, attitude has been

defined as "a relatively enduring organization of beliefs, feelings, and behavioural tendencies towards socially significant objects, groups, events or symbols" (Hogg, & Vaughan 2005, p150).

Attitudes may develop and change through a person's experiences (Pratkanis *et al.* 2014). *Social learning theory* suggests that individuals *learn* attitudes through observation of other's behaviours, and then imitate this behaviour (Bandura & Walters 1963). *Social judgment theory* focuses on the effect of *past experiences* on attitudes and attitude change (Sherif *et al.* 1961).

Attitude is also described by Sherif, Sherif and Hovland (1961) as a spectrum with "latitudes of acceptance, rejection, and non-commitment" (p. 171), and that *moderate* persuasive arguments are more likely to be accepted by individuals than "more extreme" arguments; that is, a new position is more likely to be accepted if it is closer to a previously held attitude (Sherif *et al.* 1961). This research will avoid "extreme" arguments as the basis for the development of the intervention.

Previous vaccination interventions aimed at adults can actually decrease intent to vaccinate, particularly if they use "a dramatic narrative" (Nyhan *et al.* 2014, p6). It is, therefore, important that the intervention is not "extreme" in its position on vaccination.

2.4.2 Theories of attitude and behaviour change

An awareness of theories used in the development of health interventions is important, because interventions supported by a theory are more effective than those without a theoretical basis (Prestwich *et al.* 2014). This Section describes some commonly-used theories and models that underpin the development of interventions. A recent meta-analysis found a total of 83 different behavioural theories previously used in health intervention studies (Davis *et al.* 2014). The most commonly used theories were the *Theory of Reasoned Action/Theory of Planned Behaviour* (n=36) and the *Transtheoretical Model* (n=91). The *Health Belief Model* (n=9) was also included in the discussion, due to its specific use in studies exploring attitudes towards vaccination. In the following Sections, these theories are evaluated in terms of how they might best influence the development of the study intervention.

2.4.2.1 Theory of Reasoned Action

The Theory of Reasoned Action (TRA) is a model for the prediction of behaviour, developed by Fishbein and Ajzen (Fishbein & Ajzen 1975). The theory suggests that *attitude* and *normative beliefs* (i.e. “the likelihood that important referent individuals or groups approve or disapprove of performing a given behaviour” (Ajzen 1991, p195)) affect *behavioural intention*, and that this, in turn, dictates *behavioural outcomes* (Fishbein & Ajzen 1975) (Figure 1) The Theory of Reasoned Action has been used in the development of interventions; for example a game seeking to encourage healthy eating (in conjunction with the Health Belief Model) (Peng 2009), and a visualisation tool for alcohol risk (Bissett *et al.* 2013).

A major criticism of TRA is that it assumes the freedom to act *without limitation*, which is not true for many behaviours affected by limits such as cost, time and ability to perform an action (Sheppard *et al.* 1988). In addition, a meta-analysis has shown that behavioural intention is actually more closely associated with *past* behaviours than with future behaviours (Albarracin *et al.* 2001).

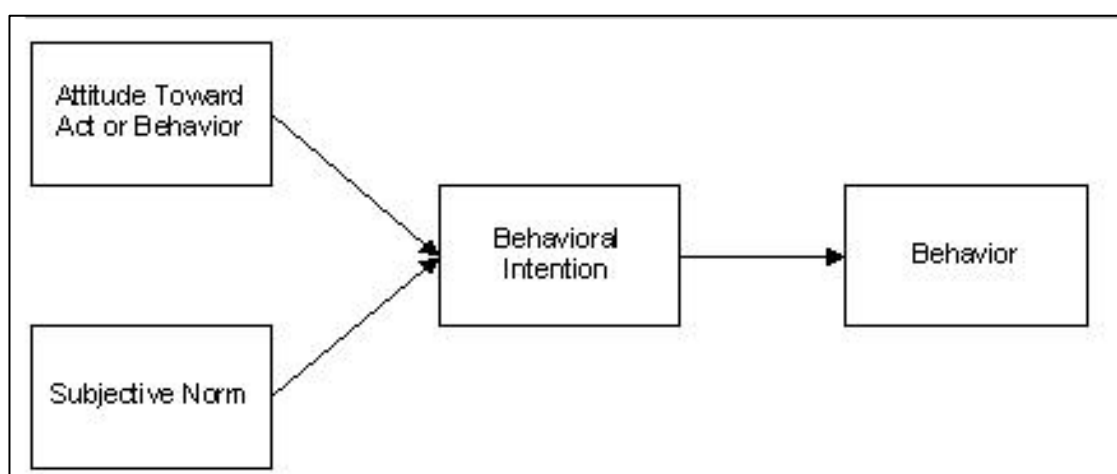


FIGURE 1 THE THEORY OF REASONED ACTION (FROM FISHBEIN & AJZEN 1975)

2.4.2.2 Theory of Planned Behaviour

Ajzen subsequently developed the *Theory of Planned Behavior* (TPB) (Ajzen 1991) to address the limitations of the Theory of Reasoned Action. This theory adds the concept of *perceived behavioural control* or ‘*self-efficacy*’ to the model (Figure 2). This is defined in terms of a person’s *confidence* in their own ability to complete a behaviour (Glanz & Rimer 2005). The Self-efficacy Theory (Bandura 1977) has been used to explain behaviours in several areas, including physical activity and health promotion (Strecher *et al.* 1986; Marks *et al.* 2005). The Theory

of Planned Behaviour has also been used in interventions, such as a study of breastfeeding attitudes after an educational intervention in rural Appalachian students (Seidel *et al.* 2013), and an intervention seeking to increase consumption of fruits and vegetables (Kothe *et al.* 2012).

However, TPB is still limited as it overlooks the importance of *emotional influences*. Several studies show that emotional factors (such as worry, regret, fear) influence health behaviours (Chapman & Coups 2006; Peters *et al.* 2006; Denberg *et al.* 2006). As with the TRA, perceived behavioural control and behavioural intention may be more closely associated with past behaviours than future behaviours (Albarracin *et al.* 2001).

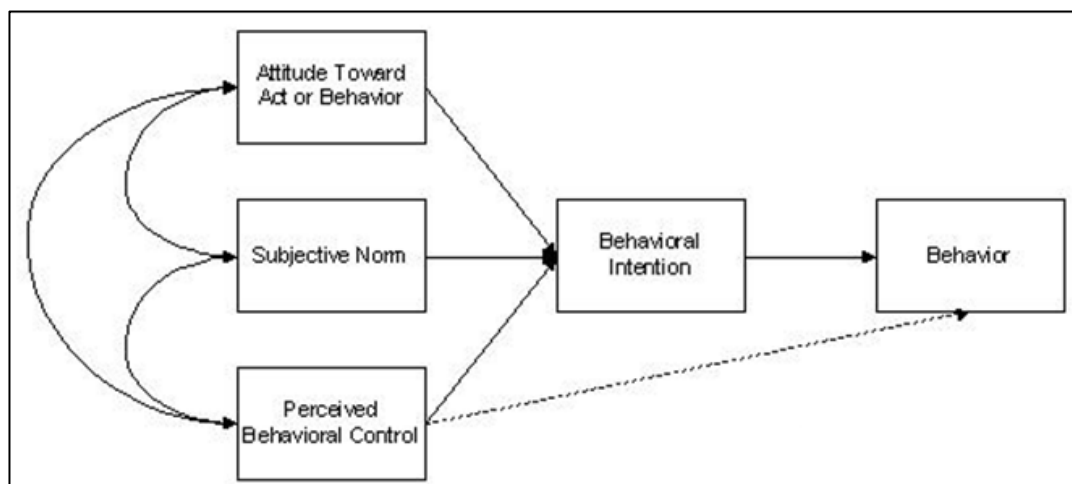


FIGURE 2 THE THEORY OF PLANNED BEHAVIOUR (FROM AJZEN 1991)

2.4.2.3 The Transtheoretical Model

The Transtheoretical Model (TTM) is a theoretical model of behaviour change which is one of the most commonly-used theories (Davis *et al.* 2014) in the development of health interventions (Velicer *et al.* 1998). The core of the model is the six 'Stages of Change' (Lenio 2006).

There are six stages of change described in the model (Prochaska 2013):

1. Pre-contemplation (No intention to take action within the next 6 months)
2. Contemplation (Intention to take action within the next 6 months)
3. Preparation (Intention to take action within the next 30 days)
4. Action (Changed overt behaviour for less than 6 months)

5. Maintenance (Changed overt behaviour for more than 6 months)
6. Termination (No temptation to relapse and 100% confidence)

The Transtheoretical Model also focuses on *processes of change* individuals need to experience for change (Prochaska 2013), including:

- Consciousness raising (increasing awareness)
- Dramatic relief (experiencing negative emotions related to an unhealthy behaviour)
- Self-revaluation (The realisation that change is an important part of self-image)
- Environmental re-evaluation (realising negative impact of unhealthy behaviour/ positive impact of a healthy behaviour on social or physical environment)
- Self-liberation (Making a commitment to change)
- Helping Relationships (seeking social support for healthy behaviour)
- Counter conditioning (substitution of unhealthy behaviours for health behaviours)
- Stimulus control (removing triggers of unhealthy behaviours and adding triggers for healthy behaviours)
- Social liberation (realising the social norms of the healthy behaviour)
- Benefits and Disadvantages of changing
- Self-efficacy

The Trans-theoretical Model has been used successfully in several health-related areas, including smoking cessation, where the relationship between the stages of change and the processes of change were explored (Fava *et al.* 1995), and physical exercise (Gorely & Gordon 1995). However, it has also been criticised for the limited evidence of its effectiveness in health interventions (Bridle *et al.* 2005), lack of validity (Taylor *et al.* 2006), the arbitrary time limits on each stage (West 2005), and the fact that it assumes that individuals make clear plans for changes in health behaviours (West 2005).

2.4.2.4 Health Belief Model

The Health Belief Model (HBM) (Janz Becker, M. H. 1984) has been used to predict and explain health-related behaviours, including intent to vaccinate (Smith *et al.* 2011; Reiter *et al.* 2009; Kennedy *et al.* 2005). It has also been used to explore health-related issues such as attitudes towards weight management in African-American women (James *et al.* 2012), and in the development of an intervention for the HPV vaccine (Marlow *et al.* 2009).

There are seven concepts included in the Health Belief Model (Janz Becker, M. H. 1984) (Figure 3):

1. Perceived *susceptibility* (a person's subjective belief in the likelihood of contracting a condition/disease)
2. Perceived *severity* (a person's perceived seriousness of a condition or disease varies from person to person, and this can include self-evaluations of likelihood of medical consequences such as death, disability and pain)
3. Perceived *benefits* of taking action (belief in the effectiveness of courses of action)
4. Perceived *barriers* to taking action (such as pain, cost, inconvenience or length of time to complete and action)
5. *Modifying variables* (for example age, sex, ethnicity, religious beliefs, level of education)
6. *Self-efficacy* (the self-belief in the ability to successfully complete an action)
7. *Cues to action* (actions that stimulate a person to take action e.g. symptoms or a reminder from GP)

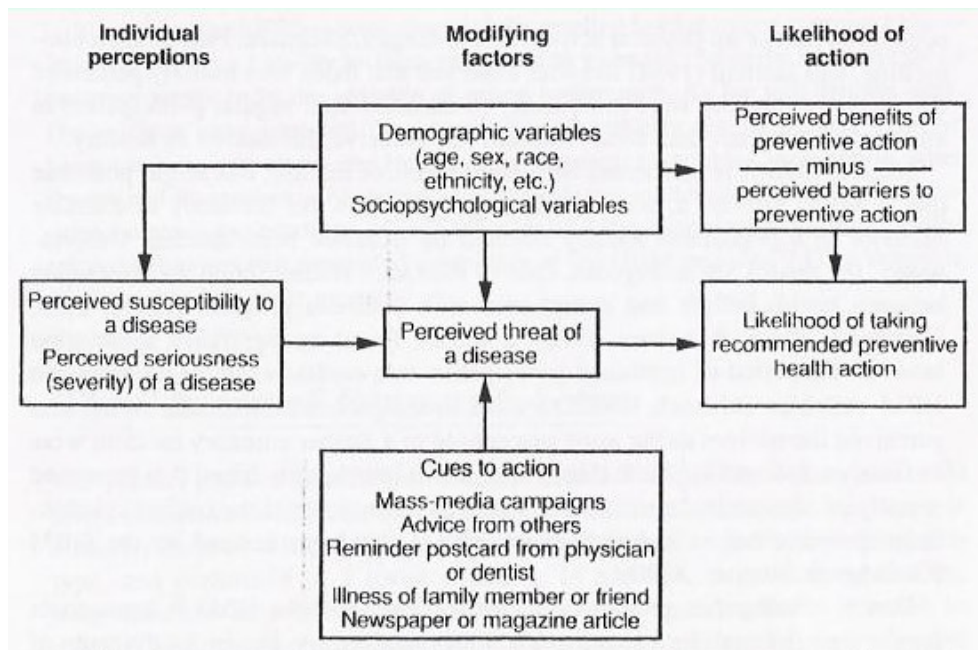


FIGURE 3 CONCEPTS OF THE HEALTH BELIEF MODEL AND THE RELATIONSHIP BETWEEN THEM

The HBM can be useful, as it focuses on understanding the effect of attitudes on health behaviours (Taylor *et al.* 2006) . It has been widely used in the development of health interventions (Albada 2011) and in studies assessing attitudes towards a health topic (Zimet *et al.* 2005). It can also underpin the development of strategies to be developed (Glanz & Rimer 2005) to address issues surrounding a health topic (Figure 4).

A recent meta-analysis of the Health Belief Model suggested that the *direct effects* version of the HBM (that is, that constructs of the HBM can provide a ‘direct pathway’ to predict behaviour) should not be used to *longitudinally predict* behaviour, but *perceived benefits* and *perceived barriers* were the strongest predictors of future behaviour (Carpenter 2010).

Concept	Definition	Potential Change Strategies
Perceived susceptibility	Beliefs about the chances of getting a condition	<ul style="list-style-type: none"> • Define what populations(s) are at risk and their levels of risk • Tailor risk information based on an individual's characteristics or behaviors • Help the individual develop an accurate perception of his or her own risk
Perceived severity	Beliefs about the seriousness of a condition and its consequences	<ul style="list-style-type: none"> • Specify the consequences of a condition and recommended action
Perceived benefits	Beliefs about the effectiveness of taking action to reduce risk or seriousness	<ul style="list-style-type: none"> • Explain how, where, and when to take action and what the potential positive results will be
Perceived barriers	Beliefs about the material and psychological costs of taking action	<ul style="list-style-type: none"> • Offer reassurance, incentives, and assistance; correct misinformation
Cues to action	Factors that activate "readiness to change"	<ul style="list-style-type: none"> • Provide "how to" information, promote awareness, and employ reminder systems
Self-efficacy	Confidence in one's ability to take action	<ul style="list-style-type: none"> • Provide training and guidance in performing action • Use progressive goal setting • Give verbal reinforcement • Demonstrate desired behaviors

FIGURE 4 SUGGESTED STRATEGIES FOR EACH CONCEPT OF THE HEALTH BELIEF MODEL (FROM GLANZ & RIMER 2005).

The HBM has been criticised for its focus on the attitudes and beliefs of individuals, for the fact that it does not account for *emotional influences* on health behaviours (Janz Becker, M. H. 1984), and that it does not “address the important roles of impulsivity, habit, self-control, associative learning, and emotional processing” (Michie *et al.* 2011, p3). However, it has been used successfully in the development of health interventions, including understanding attitudes surrounding intent to vaccinate (Smith *et al.* 2011; Reiter *et al.* 2009; Kennedy *et al.* 2005). A study of vaccination behaviour for the Hepatitis B vaccine in men that have sex with men (MSM) found that the concepts of the Health Belief Model were more closely linked with vaccine uptake than those of the Theory of Planned Behaviour (De Wit *et al.* 2005).

2.4.3 Comparison of advantages and disadvantages of behavioural models

A literature-based cross-evaluation of various models was performed in order to assess their suitability for providing a framework for the development of our vaccination intervention. The results are summarised in Table 1.

TABLE 1 COMPARISON OF THE ADVANTAGES AND DISADVANTAGES OF BEHAVIOURAL MODELS

Theory/ Model	Advantages	Disadvantages
Theory of Reasoned Action (TRA)	<ul style="list-style-type: none"> - States that attitudes affect behaviour - Has been commonly used in the development of interventions for health behaviours 	<ul style="list-style-type: none"> - Assumes freedom to act without limitation (i.e. no barriers to taking action) - Behavioural intention is shown to be more closely related to past behaviours than future behaviours – not applicable to this project - Does not include concepts important to vaccination attitudes, including perceptions of susceptibility and severity
Theory of Planned Behaviour (TPB)	<ul style="list-style-type: none"> - States that attitudes affect behaviour - Has been commonly used in the development of interventions for health behaviours - Discusses the benefits of changing behaviour 	<ul style="list-style-type: none"> - Overlooks emotional influence on attitude - Behavioural intention and perceived behavioural control shown to be more closely related to past behaviours than future behaviours – not applicable to this project - Does not include concepts important to vaccination attitudes, including perceptions of susceptibility and severity
Transtheoretical Model (TTM)	<ul style="list-style-type: none"> - Commonly used in development of health interventions - Discusses the benefits of action on ‘environment’ (i.e. could be related to vaccination protecting others through herd immunity) 	<ul style="list-style-type: none"> - Lack of evidence of validity - Lack of evidence of effectiveness - Arbitrary time limits on each stage - Focus on changing previous behaviour that is not applicable to this project – teenagers do not have previous experience of choosing whether to vaccinate. - Does not include concepts important to vaccination attitudes, including perceptions of susceptibility and severity - More applicable to those with addictions e.g. smokers
Health Belief Model (HBM)	<ul style="list-style-type: none"> - Focus on importance of attitude on behaviours - Focuses on attitudes and beliefs on individual level - Has previously been used in studies including a study on intent to vaccinate - Benefits and barriers have been shown to be good predictors of future behaviour 	<ul style="list-style-type: none"> - Should not be used to predict long-term behaviour - Does not focus on emotional influences of behaviours - Does not include behavioural intention

2.4.4 Focus on the Health Belief Model

Unless a *longitudinal study* is conducted, a researcher cannot know if an intervention has been effective in affecting a certain behaviour, especially when the aim is to change a behaviour that will not be expressed until after a long period of time (McEachan *et al.* 2011). For this reason, many studies have used theory to *predict* future behaviours based on attitude and behavioural intent. A major criticism of predicting behaviour is that it *assumes* the freedom to act without limitation, which is not true for many behaviours affected by limits such as cost, time, and ability to perform an action (Sheppard *et al.* 1988).

The current project focuses on assessing attitudinal change towards vaccination. Although the HBM considers how attitudes affect behaviour (and this project does not focus on future behaviour), the HBM provides a framework within which to develop an intervention about attitudes. The core concepts of the HBM are therefore used in the development of the intervention and supporting materials, including the development of an interview schedule and attitudinal survey.

As previously described, this model is appropriate for use in this research because previous studies have shown its suitability for use with vaccination attitudes and intent to vaccinate. It will be used in this project in an *exploratory* way to investigate teenagers' attitudes towards vaccination through interviews and attitudinal surveys.

Table 2 describes how previous studies have used the Health Belief Model. Several studies have used the Health Belief Model in an *exploratory* way to identify attitudes and beliefs (Hanson & Benedict 2002; Kennedy *et al.* 2005; Reiter *et al.* 2011; Brown *et al.* 2011; Smith *et al.* 2011; James *et al.* 2012; Shaw 2016), whereas others have based *interventions* on the Health Belief Model (Marlow *et al.* 2009; Mehta *et al.* 2013).

TABLE 2 PREVIOUS STUDIES USING THE HEALTH BELIEF MODEL

Citation	Study details	Outcome(s)
Hanson & Benedict (2002). Use of the Health Belief Model to Examine Older Adults' Food-Handling Behaviours.	<i>n</i> =266; Mean age=68; Gender=73% female Mail survey to explore relationship between HBM constructs and good handling behaviours	HBM was a useful framework for exploring food handling behaviours in older adults
Kennedy, <i>et al.</i> (2005). Vaccine beliefs of parents who oppose compulsory vaccination.	<i>n</i> = 1527 Reasons for the opposition to compulsory vaccination in parents were explored using the HBM.	Vaccines were found to be of low importance to parents opposed to compulsory vaccination, and vaccine-preventable diseases were not considered severe. The constructs of the HBM were used to explain the findings of this study.
Marlow, <i>et al.</i> , (2009). Predictors of interest in HPV vaccination: A study of British adolescents.	<i>n</i> =367; Gender=female; Age= 16-19 Participants were given information about HPV, including information about the link between HPV and cervical cancer, transmission and prevalence of HPV and treatment of abnormal cells.	Interventions based on the HBM may encourage HPV vaccine acceptance in adolescents.
Reiter, <i>et al.</i> , (2009). Parents' health beliefs and HPV vaccination of their adolescent daughters.	Parents of girls aged 10-18 (<i>n</i> =889) Participants were interviewed using the constructs of the HBM in relation to HPV vaccination, to explore parents' beliefs about HPV vaccination.	HBM concepts correlated with vaccination acceptability, and researchers suggest that the HBM is a useful framework for studying vaccination behaviours.
Brown, <i>et al.</i> (2011). Breaking the barrier: The Health Belief Model and patient perceptions regarding contraception.	<i>n</i> =71 (female), 23 (male) Participants were given a survey based on HBM concepts.	A correlation was observed between patients' perceived benefits as education level increased.
Smith, <i>et al.</i> (2011). Parental delay or	<i>n</i> =11206 parents of children aged 24-35 months.	Parents who refused or delayed vaccination were more likely to

refusal of vaccine doses, childhood vaccination	Data from the 2009 National Immunisation Survey (US) was analysed using constructs of the HBM to explore reasons for delay or refusal of vaccination.	have concerns about the safety of vaccination and perceive fewer benefits associated with vaccination.
James, <i>et al.</i> , (2012). Using the Health Belief Model to Develop Culturally Appropriate Weight-Management Materials for African-American Women.	n=50 African-American women Focus groups were held using the HBM as the theoretical framework to explore how weight management materials should be developed.	The HBM allowed the researchers to use the themes from each construct of the HBM to develop intervention materials.
Mehta, <i>et al.</i> (2013). Model-Based intervention to increase intent of HPV vaccination among college males.	n=90 College-aged men aged 18-35 (US) A randomised controlled trial compared a HBM based intervention with a traditional knowledge-based intervention.	The HBM intervention was effective in creating positive changes in HPV vaccine acceptability, and showed that perceived severity, self-efficacy, and perceived barriers were predictors of vaccine acceptability.
Shaw, K. (2016). Exploring beliefs and attitudes of personal service practitioners towards infection control education, based on the Health Belief Model.	n=5 (in-depth, qualitative exploratory interviews). Constructs of the HBM were used (through interviews) to explore attitudes of personal service practitioners towards infection control.	The HBM was successfully used to explore attitudes and beliefs of the target group, and allowed barriers to receiving education to be examined.

2.5 Education-based interventions

Due to the age group of the target population, it is important to consider lessons from educational research, as this project will primarily be conducted in school environments. This Section discusses learning theory and learning through digital technology, in order to provide a basis for the development and delivery of an educational digital-based intervention.

2.5.1 Learning theory

Relationships often exist between knowledge and attitude; for example, the relationship between knowledge *of* science and attitude *towards* science (Allum *et al.* 2008; Evans & Durant 1995). Several studies have examined the relationship between knowledge of important health issues and attitude towards these issues (Wolff *et al.* 1996; Cooper *et al.* 2003; Mooney *et al.* 2006).

A common conception of learning is that it is the acquisition of new (or reinforcement of already acquired) *knowledge*, behaviours, skills or values (Pritchard 1998). It is therefore important to first consider *how* people learn, in order to provide a theoretical basis for the use of digital technology in health education. There exist many theories that consider the process of learning. This Section describes four notable theories that relate to learning: Cognitivism, Behaviourism, Constructivism, and Humanistic learning (Ormrod & Davis 2004). A brief overview of each is provided in the following sub-sections.

2.5.1.1 Behaviourism

Behaviourism is a learning theory based on a 'stimulus-response' process of learning (Skinner 1976), in which learners are passive participants in the learning process, responding to external stimuli (Ertmer & Newby 2008). A key feature of behaviourism is *operant conditioning*, the use of positive and negative reinforcement in order to change behaviour (Skinner 1938). Behaviourism suggests that only stimuli and responses are observable: the *structure* of the learner's knowledge and the underlying *mental process* are not studied (Ertmer & Newby 2008).

In education, behaviourism places responsibility for the learning process onto the *teacher* as opposed to on the learner (Ormrod & Davis 2004). Activities associated with a behaviourist approach may include repetition, instructional cues and practice (Ertmer & Newby 2008), and may also include rewards for completing

tasks (such as stickers or 'fun' activities), punishments, or the withholding of rewards for not completing activities (such as extra homework or detentions) (James 2006).

2.5.1.2 Cognitivism

Cognitivism is a learning theory that describes the learner as an 'information processor' (Ertmer & Newby 2008), and, unlike behaviourism, treats learners as *active* rather than passive participants in learning (Ertmer & Newby 2008). A key feature of cognitivism is that it focuses on how information is received and processed by the learner (Ertmer & Newby 2008).

In education, the role of the teacher is to present information in a manner that is both meaningful to the learner and which emphasises the importance of information storage and recall (Ertmer & Newby 2008). Learning activities associated with cognitivism include mnemonics, outlines, 'chunking' information, analogies, and concept mapping (Pritchard 1998).

2.5.1.3 Constructivism

Constructivism holds that learning is an active and *socially constructive* process (Duffy & Cunningham 1984; Piaget 1973). Constructivist teaching approaches argue that learners should take an active role in process of learning, and that responsibility for learning lies with the learner as opposed to the teacher (Ormrod & Davis 2004). The role of the teacher is to *facilitate* learning, as opposed to the view taken by behaviourism, in which the teacher takes the *main responsibility* for the learning process (Ormrod & Davis 2004).

Constructivist theory argues that learning should be engaging to the learner, and that activities should be interactive and student-based. In addition, constructivism suggests that knowledge is developed through the learner's own experiences (Duffy & Cunningham 1984), and that what is learnt should have some meaningful relevance to the learner's experience of the world (that is, learners should not simply learn the 'correct answers'). Social learning is also a key component of constructivism (Duffy & Cunningham 1984).

In education, learning activities associated with the constructivist approach include experiments and exploration, field trips, research projects and class discussions, modelling, problem-based learning, and learning through play (Roussou 2004; Piaget 1973; Chimalakonda & Nori 2008; Brooks & Brooks 1999).

Critics of the Constructivist approach argue that there are some areas in which learner's own meanings are irrelevant. For example, in the 1990s, a mathematics text book based on constructivist approach was heavily criticised during the "Math Wars" (Klein 2007). Although not a criticism of constructivism *per se*, 'pure-discovery' techniques have been criticised, as it has been argued that they can cause misconceptions in learners, or that they can be confusing for learners (Alfieri, 2011). Moreover, it has been suggested that constructivism can be 'misused' in this way (Mayer 2004).

2.5.1.4 Humanistic approach/Student-centred Learning

The Humanistic approach argues that learning should be learner-focused and individualised to the learner (Weinstein & Fantini 1970). It posits that all people have both the potential to learn and the desire to direct their own learning, and that learners should be 'empowered' to take control of the learning process, with the teacher acting only as a facilitator (Rogers 1970). The Humanistic approach provides a 'holistic approach to learning' (Valett 1977), and activities associated with the humanistic approach include group activities, discussions, experiments, problem solving, and simulation (Chimalakonda & Nori 2008; Khatib *et al.* 2013)

It has been argued that the humanistic approach might increase the prevalence of in-class misbehaviour, and that learners might be more likely to become distracted (Bennett 2013). In addition, there exists less evidence to support this approach to learning in comparison to other approaches; research has focused on the *psychological benefits* of humanistic/student-centred learning rather than the academic benefits (Din & Wheatley 2007). In practice, development of individual learning packages and resources can also be time consuming (Myers 2012).

2.5.1.5 Teaching approaches relevant to a vaccination intervention

Teaching approaches based on behaviourism and cognitivism are not suitable for our work, due to the nature of the subject area – attitudes towards vaccination are complex, and a 'correct or incorrect' approach towards exploring vaccination with trial participants would be inappropriate, as it may introduce researcher bias (Hammersley & Gomm 1997). As discussed in Section 2.4.1, "extreme" positions on vaccination have previously proven to be ineffective, and therefore a more moderate approach will be taken.

While the humanistic-based approach may offer a suitable framework for an individualised approach, and would allow for exploration of the complexity of understanding of vaccination and attitudes in trial participants, it is not possible to provide learner-based individualised resources in a short time-frame over a single session.

Although there is value in most of the learning theories examined, it was concluded that this project is most closely-aligned with the *constructivist* approach to learning. This will allow learning that is encouraged by the educational resource to be discussed in the context of the 'real world' issue of vaccination, and how it impacts on the experience of individual learners.

2.5.2 Previous educational interventions

We consider a number of previous educational interventions in important areas of health. A telephone-based educational intervention for patients with *hypertension* showed that those patients receiving the educational intervention demonstrated an increase in self-reported medicine adherence, compared to the control group (Fonslow *et al.* 2013). An educational intervention to change nurses' *attitudes towards self-harm* showed that those receiving the intervention demonstrated reduced (by 20%) antipathy towards patients that self-harm (Patterson *et al.* 2007). A brief educational intervention increased college students' knowledge of the *Human Papilloma Virus*, and this knowledge was sustained for three months (Lambert 2001). In addition, an educational intervention for *breastfeeding* found that fathers who attended educational sessions on breastfeeding were more likely to be encouraging and supportive of their partners breastfeeding than a group receiving an infant care only (no breastfeeding education) session (Wolfberg *et al.* 2016). These studies suggest that education can be successful in affecting attitudes towards important health concerns.

2.6 Learning through digital technology

This Section discusses the evidence for learning through digital technology, the advantages and disadvantages of using digital technology in learning, and previous digital resources that have been developed for vaccination.

2.6.1 Evidence for learning through digital technology

There exists evidence to suggest that learning is enhanced through the use of digital technology. A study of student learning outcomes after using game-based learning resource about methamphetamine use found that using the game increased knowledge of neuroscience, and increased negativity towards methamphetamine use (Cheng & Annetta 2012). In addition, a study of first year university biology students showed that learner knowledge of fish species was improved using digital video clips when compared with traditional teaching methods (Pfeiffer *et al.* 2012). A study comparing learning outcomes of a game for teaching human immunology found that learners using the game had both a higher level of knowledge and greater satisfaction (Cheng *et al.* 2014). Finally, a meta-analysis of the use of educational technology in mathematics has found a positive (but modest) impact on achievement in the subject when educational applications are used (Cheung & Slavin 2013).

However, other studies show that learning is *not* significantly enhanced by the use of digital technology. A study of college students showed no difference in retention of information between groups receiving an educational game and a group receiving no game (Cameron & Dwyer 2005). In addition, a meta-analysis of the impact of mathematics games on student achievement, showed that English-speaking students who played mathematics games every day showed significantly *lower* achievement in mathematics than students who did not. Conversely, the same study showed that students with English as a second language scored higher after playing mathematics games, suggesting that learner characteristics should be considered before implementing digital educational tools (Kim & Chang 2010).

While there is limited evidence on the link between *academic performance* and the use of digital technology for learning, it is thought that learning with digital technology does increase *motivation and enjoyment* of the subject matter (Wastiau *et al.* 2009). A study of students using a mathematics game to learn maths concepts found that participants found the game motivating, and that the participants liked the game (Wijers *et al.* 2010). In addition, a study conducted in Scotland found that using games in the classroom increased learner motivation and engagement (Groff, 2010). A study focusing on students' subject interest found that this was enhanced by the use of computer simulation using worked

examples (Yaman *et al.* 2008). Finally, a survey found that the learners with specific literacy and numeracy needs found games and simulations more useful and motivating for learning than traditional methods (de Freitas 2006). It has also been suggested that using a *combination* of digital technology and traditional teaching methods could be beneficial (Pfeiffer *et al.* 2012).

2.6.2 Advantages and disadvantages of using digital technology in learning

There are several advantages underpinning the use of digital technology in learning. Some concepts can be better explained through visual demonstration, as opposed to non-digital methods of teaching (Selwyn 2011). As previously described, digital resources may be considered more 'fun' or 'interesting' than traditional methods of learning, and therefore may increase motivation to learn about the topic (Groff *et al.* 2010). Digital technology may also be more easily accepted by younger individuals, due to the ubiquity of digital technology; however, this is still the subject of some debate (Warmelink & Mayer 2011; Palfrey & Gasser 2013).

There also exist disadvantages of the use of digital resources and games in health education, and *barriers to use* that should be considered. Digital technology can create problems in terms of inclusivity for users with disabilities such as sight problems, dyslexia and other learning difficulties (Seale 2013). However, there exist several options to facilitate the use of digital technology for these users, including coloured screen overlays, transcripts of on-screen text, and audio description software (Bühler & Fisseler 2007).

Digital resources can be too expensive for some schools to purchase, which limits the ability of schools with less funding to access resources, and some learners may not have access to computers at home (Reinhart *et al.* 2011). Open Educational Resources allow schools (and learners) with less funding to access educational resources (Caswell *et al.* 2008). In addition, some teachers consider digital resources to be a distraction from learning (Conole *et al.* 2008), and some teachers do not see educational games as tools that enhance their job performance (Bourgonjon *et al.* 2013). Lack of time and technical issues are also barriers to the use of educational games in the classroom (Bourgonjon *et al.* 2013).

2.6.3 Digital resources for vaccination

Digital health interventions have been effective in teenagers, but a digital intervention targeted towards vaccination attitudes/behaviour in teenagers has not previously been studied. Although there exist games and resources concerning infectious diseases which are aimed at teenagers, they have different learning objectives to those of this project. Previous resources have focused on education about good hygiene or antibiotics (e.g. e-bug (E-bug.eu 2015)), have "negative" goals such as the *destruction* of the world (e.g. Plague (Ndemic 2015)), focus on more general education about infectious disease outbreaks (e.g. the CDC game "Solve the Outbreak" (CDC 2015), or the University of Cambridge infectious diseases games (Cambridge 2015)), or focus on the *history* of vaccine development (e.g. 'Illsville' by historyofvaccines.org (Historyofvaccines.org 2015)).

For these reasons, a more targeted resource was developed, focusing on the use of vaccination as a method to control outbreaks of infectious diseases through herd immunity.

2.7 Conclusions

Vaccination coverage in the United Kingdom remains below the recommended level set by the World Health Organisation. Many complex (and often interrelated) factors influence parental vaccination decisions, and so it is often difficult to change attitudes towards vaccination. Previous interventions to encourage vaccination have been aimed at adults, usually parents close the point of making a vaccination decision concerning their children. There are several reasons why previous interventions may have been ineffective. Parents may be overwhelmed by the conflicting information available, or influenced by social pressures. Many parents have a lack of trust in official sources of information, and so interventions developed by government sources may be rejected on this basis.

Although some interventions have helped to increase vaccination coverage in the United Kingdom, the level is still not adequate, and thus a new approach is needed. Because interventions aimed at adults have been largely unsuccessful, and attitudes towards health issues are often formed during adolescence, this project proposes that targeting teenagers rather than adults may be more

effective. In order to do so, a digital intervention is proposed, which is well-grounded in established theories of learning.

This project is aligned with the constructivist paradigm of learning and teaching. Evidence suggests that digital technology increases motivation for learning, and it has been successfully used in education in a number of areas. This project will use an education-based digital intervention, delivered in schools. A detailed review of the literature has highlighted a number of advantages and disadvantages to using digital technology in learning, and this has provided an awareness of potential pitfalls that may occur during this research.

In determining the form that this project's intervention should take, several types of health intervention were investigated. While there are benefits and limitations of each type of intervention discussed, the effectiveness of a digital intervention for vaccination aimed at teenagers *has not yet been tested*.

While this study is not seeking to predict future behaviour, the Health Belief Model will influence the development of study materials, such as interview schedule and attitudinal survey, and is used to explore the attitudes of the target group towards vaccination. 'Effectiveness' will be determined by assessing attitudes before and after exposure to the intervention, in line with the evaluation criteria of other interventions seeking to affect attitudes towards a health topic.

CHAPTER 3:

RESEARCH METHODOLOGY

This Chapter describes the research methodology used in this research project, and how it has guided the collection and analysis of data. The first Section describes the theory underpinning this work. The second Section describes the development of data collection materials and intervention materials. The subsequent Sections describe the data collection phases of this study, concluding with the approach used for analysis of the data collected.

3.1 Theoretical basis of the research

The purpose of this research was to evaluate the impact of the digital intervention (described in Chapter 4) on attitudes towards vaccination in young people. It is, therefore, important to understand how these types of interventions have been evaluated in the past, and to appreciate the difficulties in evaluating the effectiveness of health interventions. It is also important to have an awareness of theories supporting the use of interventions in health, because interventions that are supported by theory are demonstrably more effective than those lacking such a theoretical basis (Prestwich *et al.* 2014).

3.1.1 Theories underpinning interventions for attitudinal change

As discussed in Chapter two, unless a longitudinal study is conducted, the researcher cannot know if an intervention has been effective in encouraging a certain behaviour, especially when seeking to change a behaviour that may not be expressed until after a long period of time (McEachan *et al.* 2011).

This project focuses on *assessing* attitudinal change, rather than attempting to predict and change *future behaviour*. The Health Belief Model is particularly useful for interventions seeking to understand the impact of attitudes and beliefs about a topic on behavioural intentions (Smith *et al.* 2011). The Health Belief Model (HBM) focuses on understanding attitudes towards a health topic (Janz Becker, M. H. 1984), by investigating the impact of 'concepts' on health beliefs (see Chapter 2).

While the HBM had been criticised for its focus on the attitudes and beliefs of individuals, and for the fact that it does not account for emotional influences on health behaviours (Janz Becker, M. H. 1984), it has been used in the development of health interventions, including understanding attitudes surrounding intent to vaccinate (Smith *et al.* 2011; Reiter *et al.* 2009; Kennedy *et al.* 2005). The rationale for using the Health Belief Model is discussed in more detail in Section 2.4.

3.1.2 Theoretical basis for use of vaccination messages in attitudinal interventions

There exists strong evidence of a link between levels of knowledge of science and attitudes towards science in general (Allum, et al, 2012), i.e. those with higher levels of knowledge of science tend to have more favourable views *towards* science. In addition, an IPSOS MORI survey showed that well-educated people were more likely to have positive attitudes towards science and have few concerns about either scientists or the relationship between science and the government (Ipsos Mori 2011).

There also exists evidence that increasing knowledge about health-related issues improves attitudes towards that health issue. For example, an educational intervention to change nurses' attitudes towards self-harm showed that those receiving the intervention demonstrated reduced (by 20%) antipathy towards patients that self-harm (Patterson et al. 2007). An educational intervention for *breastfeeding* found that fathers who attended educational sessions on breastfeeding were more likely to be encouraging and supportive of their partners breastfeeding than a group receiving an infant care only (no breastfeeding education) session (Wolfberg *et al.* 2016). These studies suggest that education can be successful in affecting attitudes towards important health concerns.

Educational messages *have* been used previously in vaccination interventions (Spleen, 2013; Gillsepie, 2011; Kennedy, 2011), although, as previously stated, interventions aimed at adults have had limited success (Nyhan, 2015). Evidence suggests that vaccine-resistant individuals tend to have lower levels of knowledge of vaccination (Leask, 2012). In addition, young people have stated that they would like to receive more information about vaccination (Gowda *et al.* 2012).

For these reasons, an education-based intervention in this study, incorporating important vaccination messages. The specific vaccination messages used in this study are discussed in further detail in Section 6.2.1 “Development of a digital-based intervention”.

The data collection and analysis methodology used in this research are considered in the following Sections.

3.1.3 Mixed methods research

This is research that includes both quantitative and qualitative data collection and/or analysis (Robson 2011). There are several advantages of using this approach, and, according to Bulsara (2014), mixed methods research:

1. Provides variation in data collection methods, which leads to greater validity.
2. Answers the research question from a number of perspectives.
3. Ensures that there are no ‘gaps’ to the information / data collected.
4. Ensures that pre-existing assumptions from the researcher are less likely.
5. Can be useful when one methodology does not provide all the information required.

The mixed methods approach has been used in previous studies to develop complex interventions (Lewin *et al.* 2009), including evaluation of the acceptability and effectiveness of a Cognitive Behavioural Therapy-based intervention for depression (Finucane & Mercer 2006), and in an intervention for smoking cessation in adolescents (Dalum *et al.* 2015).

Attitudes (and those towards vaccination) are multifaceted – previous studies have shown there are numerous factors surrounding attitude towards vaccination (Brown *et al.* 2012; Gardner *et al.* 2010; Hilton *et al.* 2013). In addition, previous interventions have had limited success in changing attitudes towards vaccination in adults (Nyhan *et al.* 2014) (See Chapter 2). If the interventions trialled during this project also have limited effect on attitudes towards vaccination in the target group, a mixed methods approach may give insight in to the reasons why that might be. Conversely, if it was found that this intervention does have an effect on attitudes towards vaccination in the target group, it will be important to explore why this particular intervention had such an effect.

It is also important to explore participants' experiences both of the trials themselves and of vaccination, and using a mixed methods approach will allow these to be examined using qualitative methods. In this research, initial interviews were used to develop an understanding of *current attitudes* towards vaccination in teenagers, with questionnaires and written feedback as the main data collection method in trials of the intervention itself. Focus groups were used to collect additional qualitative data about participants' experiences.

3.2 Ethical considerations

Several ethical considerations were taken into account in the planning of this research. The target age range for the project was 14-18 years. To meet ethical considerations (BERA, 2011), participants were provided with a detailed information sheet and consent form prior to participation, and the researcher (Carolan) had a full Disclosure and Barring Service (DBS) check performed (including working with children). This was clear, and Carolan therefore holds the appropriate certification. During trials, the researcher was not left alone with participants at any point.

The participants were not personally known to the researcher, and were recruited through a 'gatekeeper' (Head teacher/Head of Science or similar). Consent was obtained from participants prior to involvement in the study, participants could choose not to answer any question they wished, and could withdraw from involvement at any time.

Sensitive information was separated out during data collection, and participants were not indirectly identifiable through this information. Participant names were not recorded, so participants were completely anonymous. Data and details of participants were not shared with others. Data were safely stored and managed by being kept on a memory stick kept in a locked cabinet.

Ethical approval for this research was granted through the University's Ethical Approval Procedure (Appendix 10).

3.3 Phase 1: Development of intervention

This Section describes the development of a data collection instrument and additional materials used in trials. The data collection instrument initially included a short attitudinal survey (used to "triage" basic core attitudes prevalent in the target audience), a knowledge survey, and additional questions regarding personal choice and information needs.

3.3.1 Attitudinal survey

The development of the attitudinal survey proceeded over several stages. These encompassed in-depth interviews (discussed in detail in Chapter 5), selection of survey items, selection of a scale, validation of the questionnaire and the use of statistical analysis to refine the survey into an eight item questionnaire. These stages are discussed below.

3.3.1.1 Interviews

Interviews were conducted (initial set, n=6; latter set, n=8) with members of the target group. The development of the interview schedule is described in more detail in Chapter 5. The interviews generated *six themes* that were commonly associated with attitudes towards vaccination in teenagers. These were: (1) *trust* (of doctors, healthcare professionals and scientists); (2) *effectiveness* of vaccination; (3) perceived *risk of infectious diseases*; (4) *safety* of vaccination; (5) *personal choice* to vaccinate; and (6) *information needs*. The prevalence of these themes is supported by previous research on attitudes towards vaccination (Gardner *et al.* 2010; Brown *et al.* 2012; Bond & Nolan 2011), including a qualitative study of Scottish teenagers' understanding towards and views of vaccination (Hilton *et al.* 2013).

After establishing the six common themes, eight further interviews were conducted to data saturation (Guest 2006). In this process, after initial interviews are conducted, the interview recording is transcribed and then analysed. Using Nvivo software, a software package used in social science research to analyse qualitative data, responses to each question were analysed and given a 'code' indicating the content of each line (appendix 5), for example, "*Just doesn't really*

affect me in my everyday life. I don't see it as much of a risk" was given the code "low risk".

Codes were then grouped into related "themes", for example: Although "*Just doesn't really affect me in my everyday life. I don't see it as much of a risk*" (Low risk) and "*Because they are life threatening*" (High risk), demonstrate different views on the risk of infectious disease, they were grouped within the 'risk of infectious disease' theme.

After initial interviews, interviews were conducted and then analysed in the same way, to 'data saturation' - the point at which no new themes are being generated. "Data saturation" is used to inform the interview process, when a researcher uses an "iterative process" to develop "themes" surrounding attitudes". Due to the time-consuming nature of conducting in-depth exploratory interviews and analysis of large amounts of qualitative data, this allows the researcher to be confident that a range of attitudes have been explored, whilst not wasting time conducting too many interviews. In fact, a meta-analysis of the frequency of themes generated from interviews showed that saturation point is usually reached within 12 interviews, with no new information generated after another 48 interviews, and basic elements of themes for data saturation were generated with as few as six interviews (Guest, 2006).

The interview findings are discussed in detail in Chapter 5.

3.3.1.2 Selection of survey items

The themes generated by the interviews informed the design of the attitudinal survey, with five items selected for each of the six themes in order to ensure a representative range of items. This gives a total of 30 items included in the first draft of the attitudinal survey (Table 3). Criteria for item selection were based on a literature review of previous studies on attitudes towards vaccination (Gardner *et al.* 2010; Brown *et al.* 2011; Ritvo *et al.* 2003; Hilton *et al.* 2013).

TABLE 3 THE ORIGINAL 30 STATEMENTS USED IN THE DEVELOPMENT OF THE SURVEY

1. More children should be vaccinated against infectious diseases
2. People that don't vaccinate themselves or their children put others at risk
3. Diseases like measles are dangerous
4. I am not at all concerned about the spread of infectious diseases
5. Infectious diseases are less serious than the potential side effects of vaccination
6. I would trust my doctor's opinion on vaccination
7. Doctors will tell us to get vaccinated, even if I don't need it
8. Parents should make their own decisions about vaccination rather than leaving it to doctors and other professionals
9. The government would not let people get vaccinated if it was not safe
10. If my family were against vaccination, I wouldn't get vaccinated
11. Vaccination can have serious side effects like causing disabilities in otherwise healthy people
12. Vaccines are carefully tested for their safety
13. I think that vaccines are safe
14. Vaccines contain unsafe ingredients
15. A vaccine can give you a serious case of the disease you are trying to prevent
16. Vaccination helps to prevent outbreaks of infectious diseases
17. Someone who isn't vaccinated is likely to catch the infectious disease
18. Good hygiene is just as important as vaccination in stopping someone catching measles
19. It is important to get vaccinated to prevent the spread of infectious diseases through my community
20. Vaccines are effective at stopping people from catching infectious diseases
21. Doctors, not parents or their children, should have the final say about if a child is vaccinated
22. Children should have more say than their parents should when it comes to their own vaccinations.
23. It is nobody else's business if I am vaccinated
24. Someone under 16 who is well informed should be able to choose to be (or not be) vaccinated without their parent's consent
25. I have religious views that make me not want to vaccinate
26. I know all I need to know about vaccination and how it works
27. More information about vaccinations should be given to me
28. There are many reliable sources of information about vaccination available to me
29. My doctor and the school nurse are biased when it comes to vaccination
30. I have not received enough information about vaccination (before being vaccinated)

3.3.1.3 Selection of scale

This attitudinal survey used a Likert scale to collect data. A five point Likert scale provides participants with a series of items, and asked to choose, for each item, if they 'Strongly disagree', 'Disagree', 'Neither agree nor disagree', 'Agree', or 'Strongly agree' (Likert 1932). The Likert Scale is commonly used to assess attitudes, particularly in studies assessing attitudes towards health (Cassidy *et al.*, 2014; Dempsey *et al.* 2006; Kato *et al.*, 2008; Kennedy, *et al.*, 2005; Mishara *et*

al., 2007; Opel *et al.*, 2011). An informal 'straw-poll' was conducted on (n=311) on a popular online statistics forum (reddit.com/r/samplesize), and this was used to inform the preferred number of points on a Likert scale when used with teenagers. The results suggested that a 5-point scale was most popular with respondents (n=162).

However, using a five-point Likert scale can cause "central tendency bias" or "midpoint response bias". This occurs when participants tend to select a 'neutral' option, if one is offered (Podsakoff *et al.* 2012). Some researchers have suggested removing the midpoint to reduce this bias, but this can 'force' genuinely ambivalent participants to respond negatively (Weijters *et al.* 2010). For this reason, the attitudinal survey used a five-point Likert scale, while recognising the possibility of some central tendency bias.

Acquiescence bias can also occur using Likert scales. This occurs when participants tend to (passively) agree with all items (Welkenhuysen-Gybels *et al.* 2003). To prevent this bias, a mixture of positive and negative items were used. Positive items were scored with 1 point for responding 'strongly disagree' and 5 points for 'strongly agree', with negative items scored inversely (Albirini 2006). This allows an attitudinal score for each theme to be calculated, in order to allow for analysis of individual factors, and a *total* attitudinal score can also be calculated for each participant.

3.3.1.4 Questionnaire validation

In order to ensure that the questionnaire was suitable for the target group, the following methods were used.

Face validity (Robson 2011) was established by experts from Microbiology and Education within the University reading through the questionnaire. Changes made were based on their feedback; for example, the questions were re-worded to be more suitable for the age group.

Initially, the Flesch Reading Ease score (Flesch 1948) was calculated using the Flesch-Kincaid scale available through Microsoft Word. This gave a score of 79.5 indicating that the questionnaire was suitable for 13-15 year olds. A think-aloud readability test (Robson 2011) was conducted with subjects from the target age group (n=9). Participants were recruited through a "gatekeeper" at a local youth group. Participants were 16 years old; three were male, and six were female. After

a brief introduction by the researcher on the purpose of the readability test, participants received a copy of the survey, and were asked to give feedback on the terminology used in the survey, as well as general opinions and thoughts about the survey. Four participants said that the questionnaire was readable as it was. One participant felt that two items were “too childish” (“I trust my doctor’s advice on vaccination” and “Doctors will tell us to get vaccinated, even if I don’t need it”). Based on this feedback, the survey was re-written to consider the comments given.

In order to further refine the survey, pilot data were collected. The survey was delivered to anonymous participants online using Google Forms. The survey was posted to an online forum ([reddit.com/r/SampleSize](https://www.reddit.com/r/SampleSize)) and to [facebook.com](https://www.facebook.com) groups. Residents of the United Kingdom (of any age) were asked to complete the survey. Forty-six responses were collected, and the data were analysed to allow finalisation of the survey.

Eight items referring to ‘personal choice’ and ‘information needs’ (Section 3.2.3: Selection of additional questions) were considered separately from the attitudinal survey. This was because, on reflection, it was impossible to classify these items as either ‘positive or negative’ when scoring the questionnaire without introducing researcher bias (Hammersley & Gomm 1997).

Validating the survey

Discriminant analysis calculations (Robson 2011) were used to find those survey items that failed a “tolerance test”. This is a statistical test that identifies items that are too similar to other items in the survey (that is, they provide no unique information (Klecka 1980)). As a result, eight survey items were removed (statements 1, 4, 8, 12, 13, 15, 16, and 18).

Correlation Analysis (Robson 2011) was then used to find survey items that were highly correlated. Items with a Pearson correlation value above 0.7 were removed, in order to avoid duplication (Statements 5, 7, 10 and 20). This yielded the final draft of the attitudinal survey.

Cronbach’s alpha calculation for reliability (CA) was then applied to the final draft. This is a measure of internal consistency (Robson 2011). The CA value for the

final survey was 0.865, which suggests a high level of internal consistency (Tavakol & Dennick 2011).

The final attitudinal scale (Table 4) includes eight items from the original 30 statements, using a Likert scale, covering four themes of attitude towards vaccination: trust (of doctors and healthcare professionals), risk of infectious diseases, safety of vaccination, and effectiveness of vaccination (Appendix 1).

TABLE 4 FINAL ATTITUDINAL SURVEY

1. Vaccination can have serious side effects like causing disabilities in otherwise healthy people
2. The government would not let people get vaccinated if it was not safe
3. I would trust my doctor's advice on vaccination
4. Vaccines contain unsafe ingredients
5. Diseases like measles are dangerous
6. It is important to get vaccinated to prevent the spread of infectious diseases through my community
7. Someone who isn't vaccinated is likely to catch the infectious disease
8. People that don't vaccinate themselves or their children put others at risk

The additional questions regarding personal choice and information needs were considered separately in order to prevent researcher bias (as discussed in Section 3.3.2). Data analysis (using the Tolerance test in SPSS) resulted in four items being removed (items 25, 28, 29 and 30), as they were too similar to other items. This provided six questions regarding personal choice and information needs.

The final set of additional questions (Appendix 1) included in the questionnaire therefore included six questions about information needs and personal choice, in order to address the importance of these as established by the interviews. This gave a total of 14 questions in the survey.

3.3.2 Development of a knowledge questionnaire

As the target group of the intervention is teenagers, and the intervention will be delivered in an educational setting, the accompanying knowledge survey was mapped onto the UK national curriculum. This allowed the intervention to also be assessed for its educational value. Specifications (Table 5), past papers and mark schemes were examined to find where vaccination knowledge has previously been

tested (Table 6). The first draft of a short quiz and accompanying mark scheme (with a maximum score of ten) was developed in order to assess participant knowledge of learning objectives identified from the specifications (Table 7).

Questions were developed by considering questions from AQA GCSE Biology past papers and re-written by the researcher, as questions directly taken from past papers could not be used due to copyright restrictions.

TABLE 5 COVERAGE OF VACCINATION IN GCSE BIOLOGY PAST PAPERS BY YEAR

	AQA	Edexcel	OCR Biology	OCR Twenty First Century	WJEC
2012 Jan	X			X	
2012 Jun	X				
2013 Jan	X				X
2013 Jun					X
2014 Jun	X				X

TABLE 6 COVERAGE OF VACCINATION IN GCE A LEVEL BIOLOGY PAST PAPERS BY YEAR

	AQA	Edexcel	OCR Biology	WJEC
2011 Jan	X			
2011 Jun			X	
2012 Jan				
2012 Jun				
2013 Jan				X
2013 Jun	X			
2014 Jun	X			

TABLE 7 INITIAL KNOWLEDGE QUESTIONNAIRE AND MARK SCHEME

Question	Mark Scheme
When a person is vaccinated, what are they injected with? (2 marks)	Weakened/inactive/attenuated/dead (1 mark) Pathogen/infectious disease/antigen/protein (1 mark)
If a person comes into contact with an infectious disease they have been vaccinated against, why don't they become ill? (3 marks)	White blood cells produce antibodies (1 mark) Antibodies produced (1 mark) Antibodies destroy/kill the pathogen/microorganism/infectious disease OR Antibody/antigen reaction described (1 mark)
What is the benefit of vaccinating a large percentage of a population? (1 mark)	Herd immunity/Less chance of contact between unvaccinated with infectious disease Less chance of epidemics/outbreaks Also accept eradication of infectious disease
Why can't some people be vaccinated? (1 mark)	Too young/immunocompromised/too ill/weak/reference to AIDS, HIV, cancer/on immunosuppressant drugs
Why are vaccine 'boosters' sometimes required? (1 mark)	Immune response/memory weakens over time
Why can't a permanent vaccine against the influenza virus be developed? (1 mark)	Flu virus mutates/protein coat/antigens change
Why is vaccination not completely risk free? (1 mark)	Side effects/ Allergic reactions/ Genetic differences in people/ Different levels of immunity
Total marks available: 10	

3.3.2.1 Knowledge survey validation

As with the attitudinal survey, the *knowledge* survey was validated using face validity and readability testing, in order to ensure suitability of the survey for the target group.

As with the attitudinal questionnaire, the knowledge questionnaire questions were examined for face validity (Robson 2011) by MMU experts from Microbiology and Education. Questions were re-worded to be more suitable for the age group, based on their feedback.

Using the group described in Section 3.3.1.4.2 (n=9), the knowledge questionnaire was also tested for readability, and any other feedback solicited. Two questions

were considered “confusing” by four of the participants (“Why do you think some people can’t be vaccinated?” and “Can you think of any risks of vaccination?”). One participant felt that a question from the knowledge questionnaire was “too longwinded”, and one participant suggested that the use of the term “serious” was confusing and required clarification. The items that participants indicated were problematic were re-worded for clarity; for example “Why do you think some people can’t be vaccinated?” was changed to “Can you think of any medical reasons a person would not be able to be vaccinated?”

The final knowledge questionnaire had seven questions, covering a range of important concepts surrounding vaccination knowledge (Figure 5**Error! Reference**

1. Can you describe what is injected into you when you are vaccinated?
2. Can you explain why a person won’t get ill if they have been vaccinated?
3. What do you think is a benefit of vaccinating a large percentage of people?
4. Can you think of any medical reasons a person would not be able to be vaccinated?
5. Can you explain why ‘booster’ vaccinations are sometimes needed?
6. Why can’t a vaccine be made against some types of viruses like flu?
7. Can you think of any potential risks of vaccination?

FIGURE 5 FINAL KNOWLEDGE QUESTIONNAIRE

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3.3.3 Selection of additional questions

As previously described, qualitative interviews with the target group emphasised the importance to the target group of both information needs and personal choice. For this reason, questions addressing these issues were included in the full survey, but were considered separately to the attitudinal survey in order to prevent researcher bias (as discussed in Section 3.3.2). Data analysis (using the Tolerance test in SPSS) resulted in two items being removed, as they were too similar to other items.

3.3.3.1 Final additional questions

The final set of additional questions (Appendix 1) included in the questionnaire included six questions about information needs and personal choice, in order to address the importance of these as established by the interviews. This gave a total of 14 questions in the survey.

CHAPTER 4: DEVELOPMENT AND EVALUATION OF AN EDUCATIONAL RESOURCE FOR INFECTIOUS DISEASE

This Chapter provides a description of an educational resource that was developed, and then reworked in order to provide the basis of the digital intervention in the current study. The resource is described in the following paper, which is supplied in Appendix 2, and which was the journal's most-read paper of 2014:

Verran, J., Crossley, M., **Carolan, K.**, Jacobs, N. & Amos, M. (2013) Monsters, microbiology and mathematics: the epidemiology of a zombie apocalypse. *Journal of Biological Education* **48**:2, 98-104. doi: 10.1080/00219266.2013.849283.

As discussed in Chapter 2, public understanding of the spread of infectious disease is an important public health issue (World Health Organisation 2012; Health & Social Care Information Centre 2013). The use of digital resources in educational environments is increasing, with digital technology now an integral part of education (Selwyn & Cooper 2015) (Chapter 2). A digital educational resource was developed by the current author and others, in order to deliver important messages to GCSE and A Level students about the spread of infectious diseases, and how they might be controlled.

SimZombie, an agent-based software simulation tool was previously developed by Matthew Crossley, as part of his undergraduate studies at Manchester Metropolitan University (Crossley & Amos 2011). Agent-based modelling is a “computational method that enables a researcher to create, analyze, and experiment with models composed of agents that interact within an environment” (Gilbert 2008). SimZombie simulates the spread of infection through an animated population of individuals, using an individual-based version of a standard

susceptible/infected/recovered (SIR) model (Munz *et al.* 2009), and graphically depicts different categories of individual over time.

SimZombie shows how 'monster infections' (zombies, werewolves and vampires) spread through a population at different rates and allowed uninfected agents to 'fight back' against the monsters to fight the spread of the monster 'diseases'.

Within SimZombie, different patterns of disease spread emerge, depending on the parameter values used. The tunable parameters available within the SimZombie package include:

- Number of agents within the simulation that are initially infected
- Speed of movement of infected agents when active and inactive
- Time period of activity for the monster
- Probability of an infected agent infecting a non-infected agent
- Probability of a non-infected agent killing an infected agent
- Probability that an infected agent will kill a non-infected agent
- Incubation period of the infection
- How soon it takes for the population to realise there is an outbreak (and, after an outbreak is recognised, the subsequent probability of infection and infected agents being killed by non-infected agents)

SimZombie and its associated activities have engaged a wide range of audiences through a number of different delivery events, including University staff and students, adults, families and young people (Verran, *et al.* 2013). An overview of the activities was delivered at a teacher CPD session, and was very well received. The versatility of the activity was commended, particularly the potential for cross-subject work (literature, microbiology, mathematics). A year 8 class were similarly enthusiastic (Verran, *et al.* 2013).

Important learning outcomes regarding disease epidemiology can be demonstrated and explored using SimZombie in an engaging and unusual context (Verran, *et al.* 2013). In biology courses, SimZombie can be used to demonstrate the epidemiology of real disease outbreaks (Verran, *et al.* 2013). The important health issues of infection spread and behaviour (Department for Education 2013) can be considered in PSHE (personal, social, health and economic studies) activities using SimFection (Verran, *et al.* 2013).

This work has shown that that simulations can be used as an effective tool to deliver information about microbiology and infectious diseases to children, teenagers and families. The majority of the feedback collected from each event was positive, and several different methods of delivering the information have been developed, delivered and evaluated. The package was also used at the highly successful "immersive theatre" 'Deadinburgh' event. ¹

SimZombie has been successfully used at public engagement events, including the Cheltenham Science Festival, the Manchester Science Festival, and the Manchester Children's Book Festival. Due to the success of SimZombie in engaging teenagers and families about the spread of infectious diseases, SimZombie was adapted to target it specifically at teenagers, to include detailed information to educate about real infectious disease, and to simulate the spread and control of four infectious diseases. Development and testing of the resulting SimFection educational resource was supported, in part, by a grant from the Society for Applied Microbiology.

This Chapter discusses the stages involved in the development of SimFection, and its deployment and evaluation as an educational resource (Figure 6). The educational resource described in this Chapter was later refined for use as an attitudinal intervention for vaccination, as described in Chapter 6. The impact of the digital resource as an attitudinal intervention is discussed in Chapter 7.

4.1 SimFection development phases

The phases in the development of the SimFection learning package are depicted in Figure 6. The process of development took an 'iterative' approach, which involves a cyclical process of prototyping, testing, analysis and further refinement of a product, and is commonly used in the development of computer games (Zimmerman 2014). At each stage, following feedback collected from focus groups and trials, improvements were made to both the software and the accompanying materials. Based on this research, it is suggested that an iterative approach is good practice in the development of educational resources.

¹ Review of Deadinburgh at <http://www.scotsman.com/lifestyle/culture/theatre/theatre-review-deadinburgh-edinburgh-1-2904166>

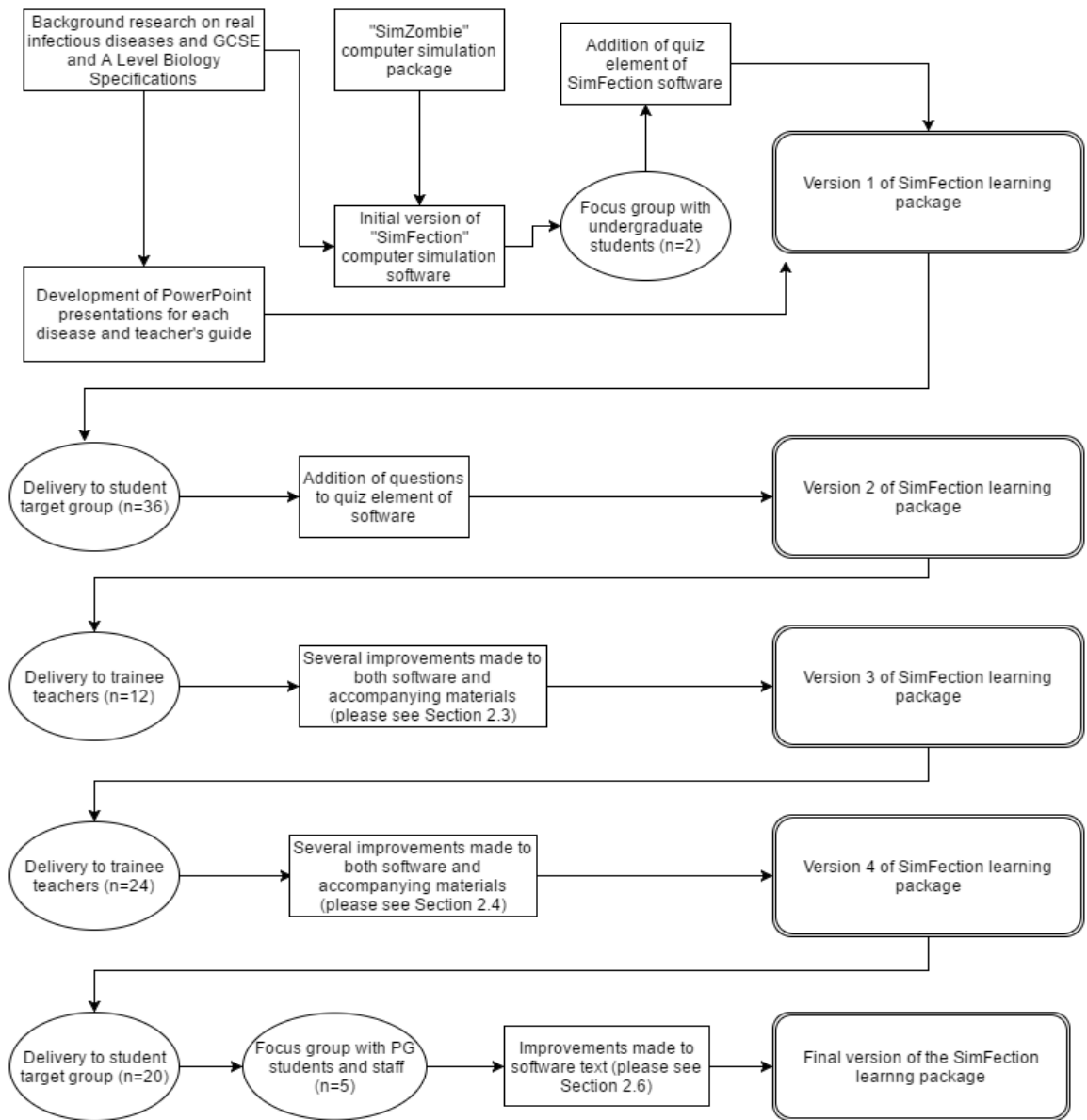


FIGURE 6 STAGES OF DEVELOPMENT OF THE SIMFECTION LEARNING PACKAGE

4.1.1 Initial development

The SimZombie software package was modified by Dr Matthew Crossley at Manchester Metropolitan University to address the epidemiology of diseases of global importance, in order to relate it to the national curriculum and demonstrate different elements of epidemiology. The infectious diseases included were *measles*, *influenza*, *mumps* and *smallpox*. Each disease may be used to highlight specific epidemiological concepts:

- The measles simulation demonstrates the need for *herd immunity* to prevent the spread of infectious disease.
- The influenza simulation shows the effects of *infectivity* and *mortality rates*.

- The mumps simulation shows the effect of *migration* of people from an area of high vaccination coverage to one of low vaccination coverage.
- The smallpox simulation shows how *ring vaccination* may be used to contain and eliminate outbreaks of infectious diseases.

These concepts are linked to the current GCSE and A Level Biology curriculum. At GCSE, information about the spread of infectious diseases and vaccination is covered by AQA, Edexcel, OCR and WJEC (AQA 2014b; Edexcel 2014; OCR 2016; WJEC 2012) and included in A Level specifications for AQA, OCR and WJEC (AQA 2014a; OCR 2013; WJEC 2010).

Data for each infectious disease were collected (Table 8) and used to set the default parameters of SimFection. In order to make the software engaging for users, parameters may be modified by users in the following ways:

- The measles simulation allowed the percentage of individuals immunised in a population to be changed (Figure 7a)
- The smallpox simulation allowed users to change the speed at which agents moved (Figure 7b). The aim of the smallpox simulation was to use ring vaccination to prevent the spread of smallpox. Increasing the speed at which agents move made it more difficult for users to prevent the spread of smallpox.
- The influenza simulation allowed users to change infectivity and virulence of the influenza virus in order to investigate the effects of these changes (Figure 7c).
- The mumps simulation allowed users to 'pick up' and move groups from one population with high vaccination coverage to one of low vaccination coverage (from low to high susceptibility) (Figure 7d)

The user interface was designed to be simple and easy to use (Figure 8). The software included information about each infectious disease and instructions on how to run each simulation with a slider to change parameters, as described above (Figure 9).

The tool itself is structured as follows: within each simulation there are six classes of agents (individuals): *immunised*, *carrying*, *susceptible*, *recovered*, *infected* and *dead*. Each agent is represented by a dot, which is coloured to indicate its class

(for example immunised agents are coloured blue, and infected agents coloured dark green). The agents move round the simulated space at random, and come into contact with other agents, with outcomes based on input parameters. For example, if an infected agent comes into contact with a susceptible agent, the susceptible may also become infected, depending on how infectious the disease is.

TABLE 8 INFORMATION ABOUT VIRUSES USED IN THE SIMFECTION PROGRAM

	Measles	Mumps	Influenza (H1N1)	Influenza (H5N1)	Smallpox
Incubation period (average)	10 days (NHS 2013a)	17 days (NHS 2013c)	2 days (CDC 2010a)	8 days (Beigel <i>et al.</i> 2005)	12 days (CDC 2004)
Infectious period	9 days (NHS 2013a)	7 days (CDC 2009b)	7 days (CDC 2010a)	10 days (CDC 2010b)	20 days (CDC 2004)
Length of symptoms	10 days (NHS 2013b)	10 days (CDC 2009b)	3-4 days (CDC 2009a)	10 days (CDC 2010b)	20 days (CDC 2004)
Case-fatality rate	0.2% (CDC 2012)	0.01% (World Health Organisation 2003)	0.026% (Donaldson <i>et al.</i> 2009)	60% (Flu.gov 2013)	30% (CDC 2004)
Infectivity (R ₀ value*)	18 (CDC 2001)	7 (CDC 2001)	1.6 (Fraser <i>et al.</i> 2009)	0.01% [†] (Yang <i>et al.</i> 2007)	7 (CDC 2001)

*R₀ = basic reproduction number. This is the number of cases generated by one case of an infectious disease over the infectious period. † Human to human transmission of H5N1 is very low and so a percentage chance of transmission is given rather than a R₀ number.

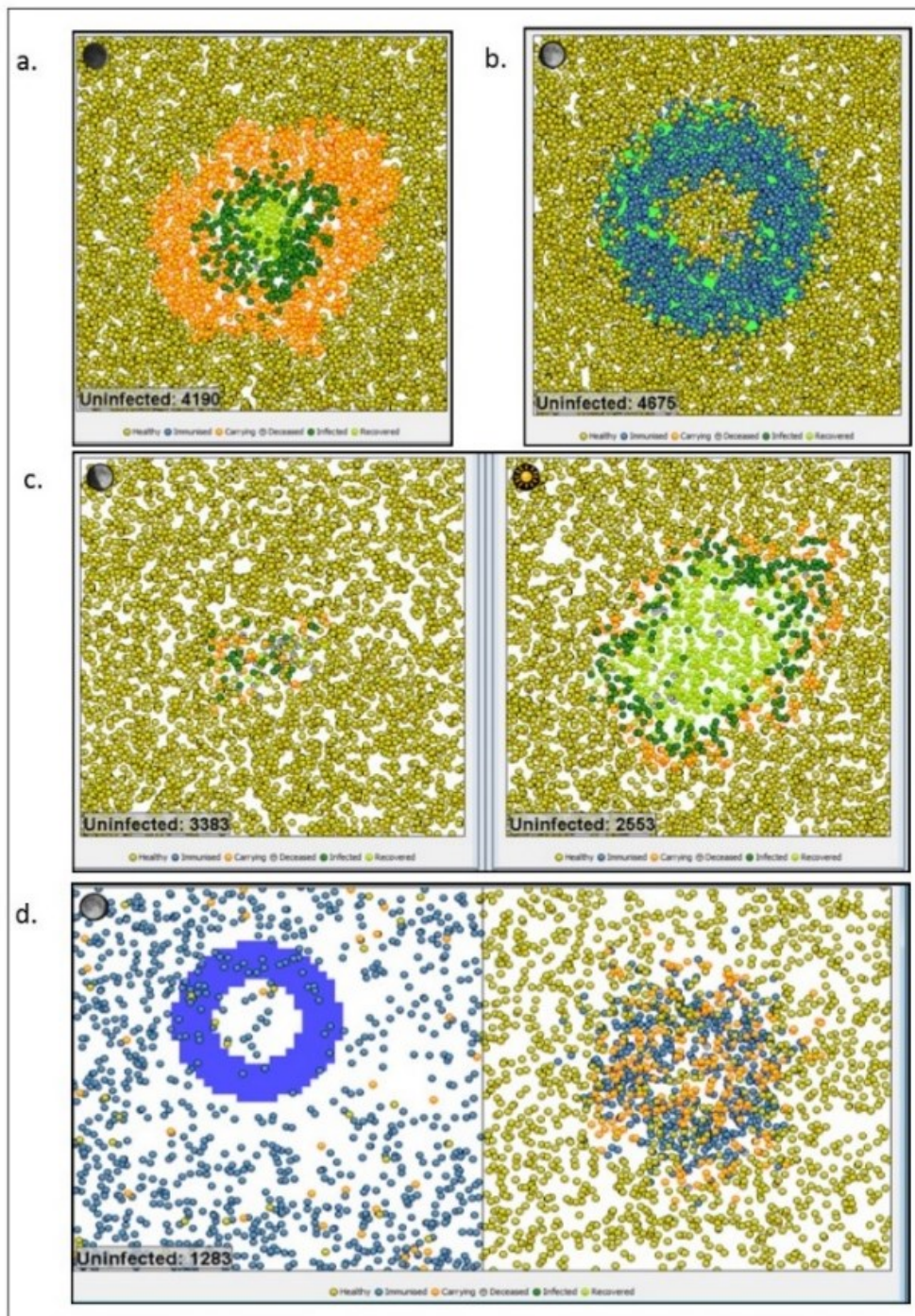


FIGURE 7 A) MEASLES SIMULATION SHOWING THE SPREAD OF INFECTIOUS DISEASE AT A LOW LEVEL OF VACCINATION COVERAGE B) SMALLPOX SIMULATION DEMONSTRATING RING VACCINATION C) INFLUENZA SIMULATION D) MUMPS SIMULATION DEMONSTRATING THE EFFECTS OF MOVING INDIVIDUALS FROM AN AREA OF HIGH VACCINATION COVERAGE (ON THE LEFT) TO A POPULATION WITH LOW VACCINATION COVERAGE ON THE RIGHT



FIGURE 8 HOMEPAGE OF SIMFECTION SOFTWARE

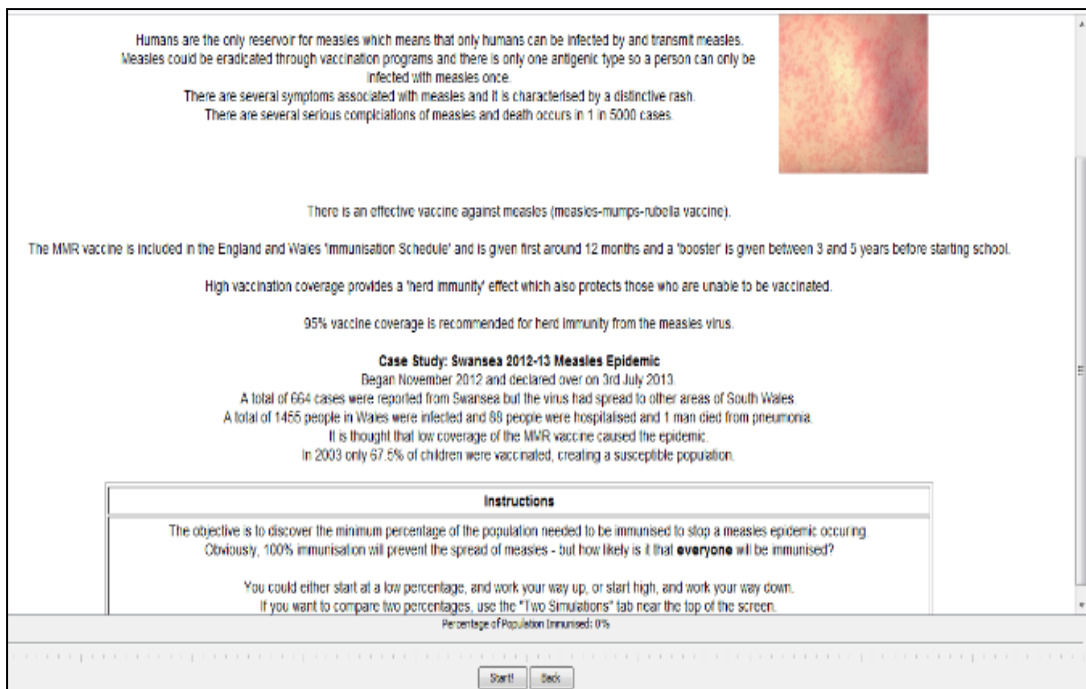


FIGURE 9 THE INFORMATION PAGE FOR MEASLES

In addition to the software package, five PowerPoint presentations were prepared for delivery alongside the simulation software. These included an introductory “Viruses and Vaccination” presentation that provided general background information on viruses and how vaccination may be used to control their spread, and an individual presentation for each of the four infectious diseases. These included background information, symptoms, treatment and prevention and a case study of an outbreak of each disease (for example the 2012 outbreak of measles in Swansea, Wales). In addition, a teacher’s guide was prepared to assist teachers in using the learning package.

After the initial development of the software, a small informal focus group (n=2) was held with undergraduate biology students at the University. The participants were given the software and asked to give their thoughts and comments on the software. The participants were generally positive about the software, but gave some useful suggestions.

A *competitive quiz* was added, to be used at the end of a presentation session. The questions used were based on the information provided in the PowerPoint presentations. A quiz session requires two teams; one team plays as the ‘Infection team’ and the other the ‘Population team’. The aim for the ‘Infection team’ is to infect or kill the most people, whereas the aim for the ‘Population team’ is to prevent the spread of infectious disease or to reduce deaths. Each question answered correctly gives an opportunity for a certain parameter in the simulation to be changed by the answering team; for example increasing the mortality rate, or immunising 50 people (Figure 10). This changes the way in which the simulation progresses, allowing one team to win after a number of rounds (when their objective has been achieved).

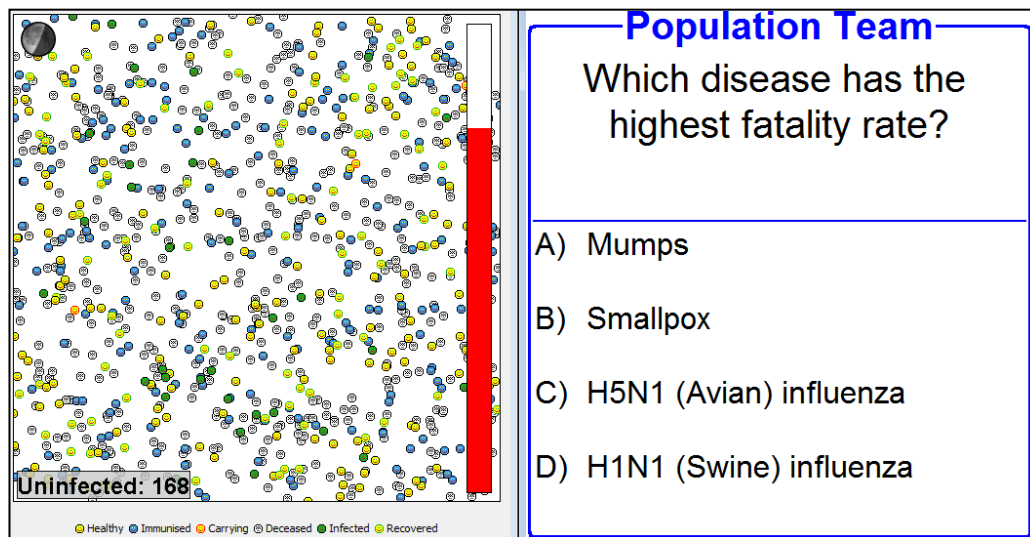


FIGURE 10 A SCREENSHOT OF THE SIMFECTION QUIZ, SHOWING AN EXAMPLE QUIZ QUESTION. ANSWERING THE QUESTION CORRECTLY ALLOWS PLAYERS TO CHANGE A PARAMETER OF THE SIMULATION, FOR EXAMPLE INCREASING THE PERCENTAGE OF IMMUNISED INDIVIDUALS IN THE POPULATION

4.2 Delivery to target group

SimFection was delivered to the target group (n=36) in June 2014 in order to assess the usability and acceptability of the software. The target group consisted of 16 and 17 year old Biology students at a local sixth form college. The two hour session began with a brief introduction to both SimFection and infectious diseases in general. The bulk of the session involved a short presentation, followed by use of the SimFection software for each infectious disease. Each student had access to a laptop, and was able to work through the activities individually. After each infectious disease had been explored, the class was divided into two groups to complete the competitive quiz round, with the students answering the majority of the questions correctly.

The participants were largely attentive and participated in the sessions well, answering questions and engaging with group discussion about the topics. Feedback was collected by questionnaire (Appendix 3).

The feedback was mostly positive, and suggests that the software is informative, user-friendly and acceptable to the target group:

- 100% of the participants said they found SimFection *informative* (36).
- 89% said that that they had *learnt something new* (32).

- 77% said that SimFection was a “*good way* to learn about infectious diseases” (28).
- 61% said they found the software *easy to use* (22).
- 55% said they thought the software was *well designed* (20).

Following qualitative feedback from the student participants, some improvements were made to the quiz, including increasing the length of time provided to users to answer questions, and more questions were added to the question bank. The ability to select sets of questions to answer was also added, so that teachers or facilitators could include or exclude certain questions based on which infectious diseases they had explored.

4.3: Delivery to trainee teachers

SimFection was then delivered to trainee science teachers (n=12) in January 2015, in order to gauge its reception with educators. This project targets teenagers, and delivering the intervention in an educational setting will allow wide distribution of the intervention to the target group. For this reason, it was important to assess the views of teachers on the educational content of the software, and the likelihood of them actually using it. Feedback was collected using a questionnaire using a Likert scale (Appendix 4):

- 6 of the participants found the *language* used to be appropriate for KS4 and KS5 students.
- 6 found that the *content* was suitable for GCSE and A Level Biology.
- 1 of the participants said they liked the *design* of the software.
- 3 said they *would* use the whole resource in their own teaching.
- 7 found the software *user friendly*.
- 7 found the *instructions for use* clear.

Open-ended written feedback was also collected, and participants made several suggestions for improvement, including: adding the ability to print/export graphs and data (5 participants), adding the ability to change simulations in real time (4), addition of a summary screen after simulation runs (3), adding more graphs (2), improving the appearance of software (2), adding the ability to pause and rewind simulations (1) and adding the ability to make own disease (1). Suggested

improvements to the overall package included providing worksheets (2), a wider range of viruses (1) and providing more information (1).

Based on the curriculum and subject specifications, it was felt that the number of infectious diseases included and the level of information provided was sufficient for both GCSE and A Level students. The ability to change simulations in 'real-time's and the ability for a user to create their own infectious disease were not added, due to the complexity of allowing epidemiological concepts to be clearly demonstrated. Due to the nature of the smallpox and mumps simulations, it was not possible to add graphs for these simulations.

Based on feedback received, the following changes to the overall educational resource were made:

- Addition of suggested extension activities to teachers' guide and a brief 'cheat sheet' (an A4 basic guide to the SimFection resource and its use).
- Changes to design of SimFection software, including changes to colour scheme and addition of images.
- Added ability to export data, ability to pause simulations, added 'click through' information screens and new colourful buttons.
- Improvements to PowerPoint presentations, including consistency across presentations, and addition of images and design scheme.
- A counter was added to the simulation to show the number of 'uninfected' individuals in the simulation.

4.4: Delivery of modified software to trainee teachers

After the modifications described above were made, the SimFection resource was delivered to a different cohort of trainee teachers (n=24) in April 2015. The teachers were asked to work through the software, and were provided with printed copies of the supporting documents. Feedback was collected using a questionnaire at the end of the session (Appendix 4).

The majority of the feedback collected was positive:

- 80% found the language suitable for KS4 and KS5 students (19).
- 87.5% found the content suitable for GCSE and A Level Biology lessons (21).

- 25% liked the “design” of the software (the way the software looks) (6).
- 92% said they would use the whole resource (22).
- 71% found the software user friendly (17).
- 67% found the instructions clear (16).

THE FEEDBACK FROM BOTH GROUPS OF TEACHERS WAS CODED BASED ON THEIR WRITTEN RESPONSES TO EACH QUESTION (TABLE 9; TABLE 10;

TABLE 11; TABLE 12;

Table 13; Table 14). For example, for the question “How appropriate is the language used”, if a teacher responded positively, this was given the code “1”, if they responded negatively, it was given the code “2” and if they did not provide a response, this was given the code “3”. This allowed the differences in responses between the two different groups of trainee teachers to be analysed in SPSS.

TABLE 9 RESPONSES OF TEACHERS TO THE QUESTION "HOW APPROPRIATE IS THE LANGUAGE USED?"

Q1. How appropriate is the language used?

Response (SPSS Code)	Frequency	
	Group 1 (n=12)	Group 2 (n=24)
Appropriate (1)	6	19
Not appropriate (2)	5	3
No answer (3)	1	2
Total	12	24

TABLE 10 TEACHER RESPONSES TO THE QUESTION "HOW SUITABLE IS THE CONTENT?"

Q2. How suitable is the content?

Response (SPSS Code)	Frequency	
	Group 1 (n=12)	Group 2 (n=24)
Suitable (1)	5	18
Not suitable (2)	6	4
No answer (3)	1	2
Total	12	24

TABLE 11 TEACHERS RESPONSES TO THE QUESTION "WHAT IS YOUR OPINION ON THE WAY THE SOFTWARE LOOKS?"

Q3. What is your opinion on the way the software looks?

Response (SPSS Code)	Frequency	
	Group 1 (n=12)	Group 2 (n=24)
Good (1)	1	6
Needs improvement (2)	11	17
No answer (3)	0	1
Total	12	24

TABLE 12 TEACHER RESPONSES TO THE QUESTION "DOES THE WHOLE RESOURCE APPEAL TO YOU AS A TEACHER?"

Q4. Does the whole resource appeal to you as a teacher?

Response (SPSS Code)	Frequency	
	Group 1 (n=12)	Group 2 (n=24)
Yes (1)	5	19
No (2)	6	1
No answer (3)	1	4
Total	12	24

TABLE 13 TEACHER RESPONSES TO THE QUESTION "HOW USER FRIENDLY DO YOU FIND THE SOFTWARE?"

Q5. How user friendly do you find the software?

Response (SPSS Code)	Frequency	
	Group 1 (n=12)	Group 2 (n=24)
User friendly (1)	5	17
Not user friendly (2)	7	6
No answer (3)	0	1
Total	12	24

TABLE 14 TEACHER RESPONSES TO THE QUESTION "WERE THE INSTRUCTIONS FOR THE SIMFECTION SOFTWARE CLEAR?"

Q6. Were the instructions for the SimFection software clear?

Response (SPSS Code)	Frequency	
	Group 1 (n=12)	Group 2 (n=24)
Yes (1)	7	16
No (2)	4	6
No answer (3)	1	2
Total	12	24

Although there was an improvement in responses to all questions after improvements were made to the resource (Figure 11), using Mann-Whitney U-test analysis, there was no significant difference in scored before and after improvements were made to the resource (Table 15).

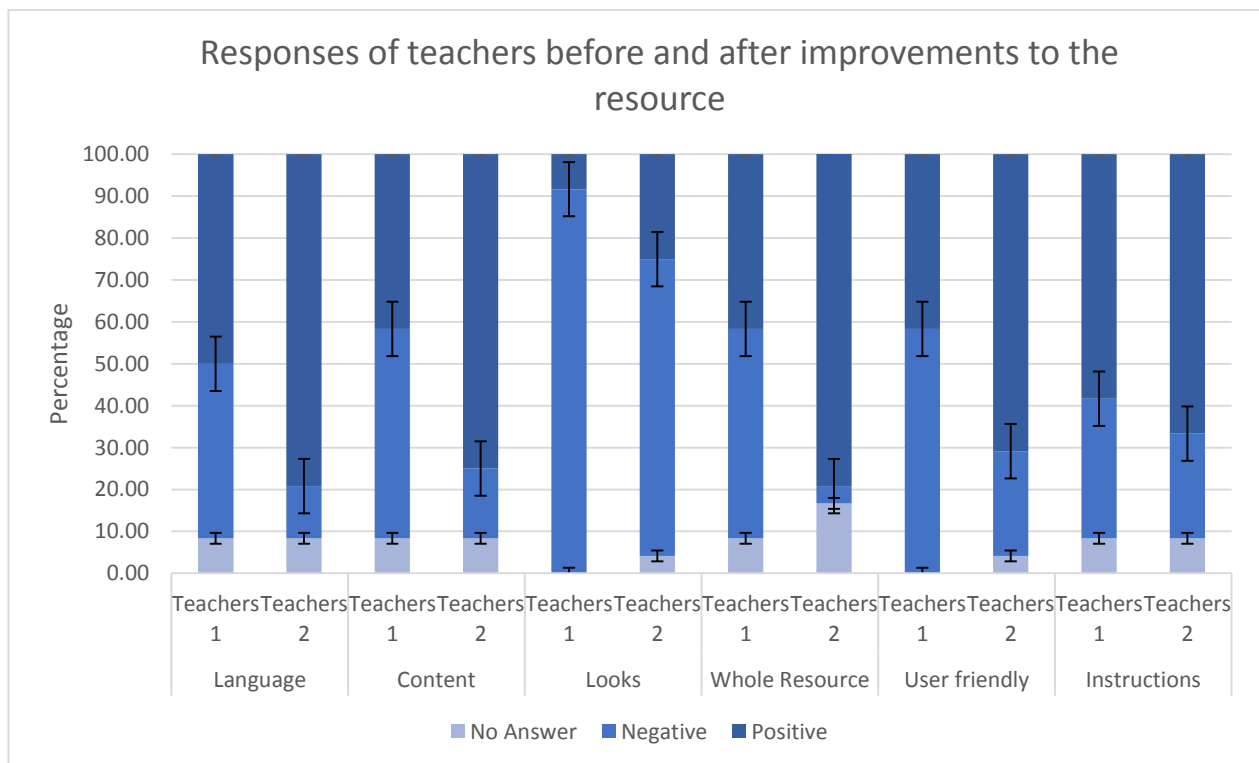


FIGURE 11 RESPONSES OF TEACHERS BEFORE AND AFTER IMPROVEMENTS TO RESOURCE

TABLE 15 STATISTICAL ANALYSIS OF TEACHER RESPONSES

Question	Significance	Degrees of Freedom
Q1. How appropriate is the language used?	=0.110	1
Q2. How suitable is the content?	=0.081	1
Q3. What is your opinion on the way the software looks?	=0.390	1
Q4. Does the whole resource appeal to you as a teacher?	=0.087	1
Q5. How user friendly do you find the software?	=0.129	1
Q6. Were the instructions for the SimFection software clear?	=0.663	1

Participants again made several suggestions for how the educational resource may be improved. Suggestions relating to the software included adding more images (14 participants), improving the design of the software (13 participants), addition of axis labels on graphs (4 participants), adding the ability to change the background and font colours (2 participants), addition of a quiz at the end of a slideshow, to check knowledge before moving on to the simulation (2 participants), changing the colours of the dots (1 participant), changing the graph lines to match dot colours (1 participant), and the addition of a tally next to simulation/Summary screen (1 participant).

Suggested improvements to the overall learning package included the addition of worksheets to fill out or more activities (7 participants), providing more information on computer simulations and mathematics of simulations in the Teachers' guide (1 participant), explaining how the quiz is designed to be fair (1), stating explicitly the sections of the curriculum to which the resource relates (1 participant), more information about the infectious diseases (1 participant), and links to websites embedded in software (1).

Some of the changes suggested could not be implemented due to technical limitations (such as users being able to change font and background colours to their own preferences, quizzes at the end of each set of information screens), and some because they would require regular updates (such as specifying curriculum location). Improvements subsequently made to the appearance of the software included addition of axis labels to graphs alongside simulations, increasing the size of agents in the simulation (i.e. larger 'dots'), adding the ability to toggle classes of agents on and off, improvements to the design of sliders, and updating

graph line colours to match simulation colour scheme. Dark red and blue buttons were used throughout the software to match the 'SimFection' logo.

More detailed instructions were added to the Teacher's Guide for the use of the software, additional information about the computer simulations and mathematics used in SimFection, and explanations of the way the quiz is balanced. More free-to-use (Creative Commons) images were added to the software information screens, teachers' guide and PowerPoint presentations, in order to improve both the appearance and information content of these resources. Improvements were made to the design of the teachers' guide, such as implementation of a design scheme. Links to several websites (for example, www.WHO.int) and possible extension activities (such as research project topics) were added to the teachers' guide. Finally, all of the information from the PowerPoint presentations was added to the software information screens. This allows the software to be used as a "stand-alone" educational resource, giving added versatility (teachers may lead a class with the PowerPoint presentations and use elements of the software in front of the class, or students could be allowed to work through the software on their own or in pairs, with less input from the teacher).

4.5: Delivery of modified software to students

The software was delivered to KS4 students from a local school (n=20) in December 2015. The session began with a brief introduction, and then students were asked to work through the activities contained in the software. Feedback was collected using the same questionnaire (Section 4.2) used by the previous group of students trialling the software.

The majority of feedback collected was positive:

- 100% found the session informative (20).
- 95% found the session interesting (19).
- 60% found the software "fun" (12).
- 90% said they learnt something new from SimFection (18).
- 85% felt that SimFection is a good way to learn about infectious diseases (17).
- 85% found the software easy to use (17).
- 85% said that the software was well designed (17).

The responses were coded from 1-5 (Strongly disagree – 5; Disagree – 4; neither agree nor disagree – 3; Agree – 4; Strongly Agree – 5) to allow differences between the two different groups of students to be analysed using SPSS (Table 16; Table 17).

TABLE 16 FREQUENCY OF RESPONSES TO FEEDBACK QUESTIONNAIRE FROM SCHOOL 1 (N=36)

	School 1 (n=32)					
	No answer	Strongly disagree	Disagree	Neither	Agree	Strongly Agree
Q1. I found SimFection informative					31	5
Q2. The workshop was interesting	1		1	7	23	4
Q3. I thought that the workshop was fun			1	18	14	3
Q4. I learnt something new by using SimFection			1	4	24	7
Q5. SimFection was a good way for me to learn about infectious diseases				8	21	7
Q6. I found the resource easy to use			3	11	19	3
Q7. SimFection is well designed			3	13	19	1

TABLE 17 FREQUENCY OF RESPONSES TO FEEDBACK QUESTIONNAIRE FROM SCHOOL 2 (N=20)

	School 2 (n=20)				
	Strongly disagree	Disagree	Neither	Agree	Strongly Agree
Q1. I found SimFection informative				13	7
Q2. The workshop was interesting			1	14	5
Q3. I thought that the workshop was fun			8	8	4
Q4. I learnt something new by using SimFection			2	12	5
Q5. SimFection was a good way for me to learn about infectious diseases		1	2	14	3
Q6. I found the resource easy to use		2	1	11	6
Q7. SimFection is well designed			3	15	2

Mann-Whitney U-test analysis was used to compare feedback from students before and after modifications to the software were made. While levels of agreement with each statement generally increased (Figure 12), only responses to question 2 “The workshop was interesting” ($p=0.37$, $df=1$), question 6 “I found the resource easy to use ($p=0.28$, $df=1$) and 7 “SimFection is well designed” ($p=0.016$, $df=1$) were significantly higher after improvements were made (Table 18).

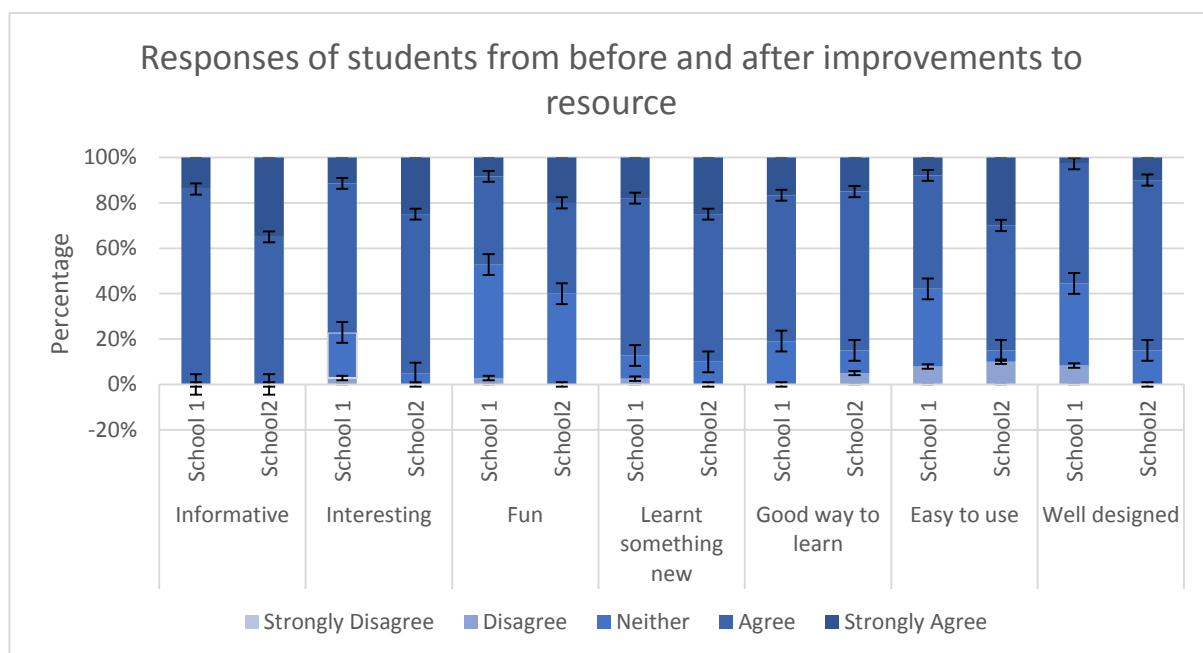


FIGURE 12 RESPONSES OF STUDENTS FROM BEFORE AND AFTER IMPROVEMENTS TO RESOURCE

TABLE 18 STATISTICAL ANALYSIS OF FEEDBACK FROM STUDENTS

Question	Significance	Degrees of Freedom
Q1. I found SimFection informative	=0.068	1
Q2. The workshop was interesting	=0.037	1
Q3. I thought that the workshop was fun	=0.218	1
Q4. I learnt something new by using SimFection	=0.547	1
Q5. SimFection was a good way for me to learn about infectious diseases	=0.929	1
Q6. I found the resource easy to use	=0.028	1
Q7. SimFection is well designed	=0.016	1

4.6: Finalisation of educational resource

A focus group session (n=5) was held with postgraduate science students and staff at the University to identify any final changes to the SimFection resource that might be needed. The feedback from the focus group suggested that some changes were required, including simplification of instructions for the mumps and smallpox activities, minor typographical changes, and the addition of general instructions within the software.

The design of the software was finalised. Using the measles information screens and simulations as an example, the Figures below show the improved design of the software (Figure 13; Figure 14; Figure 15; Figure 16).



FIGURE 13 THE START SCREEN OF THE SIMFECTION SOFTWARE



FIGURE 14 AN INFORMATION SCREEN WITHIN SIMFECTION

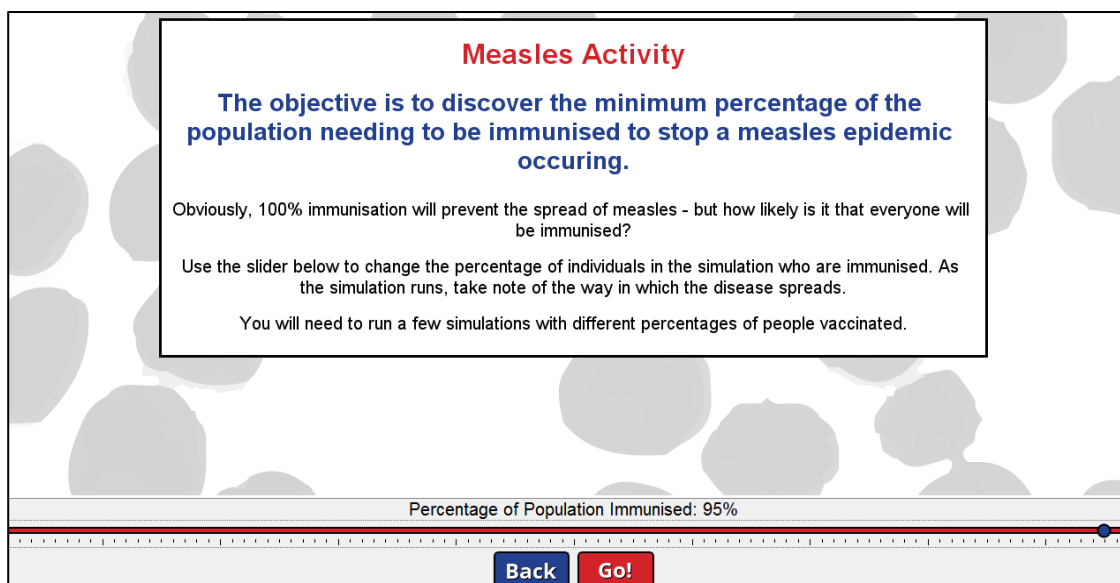


FIGURE 15 THE IMPROVED ACTIVITY SCREEN

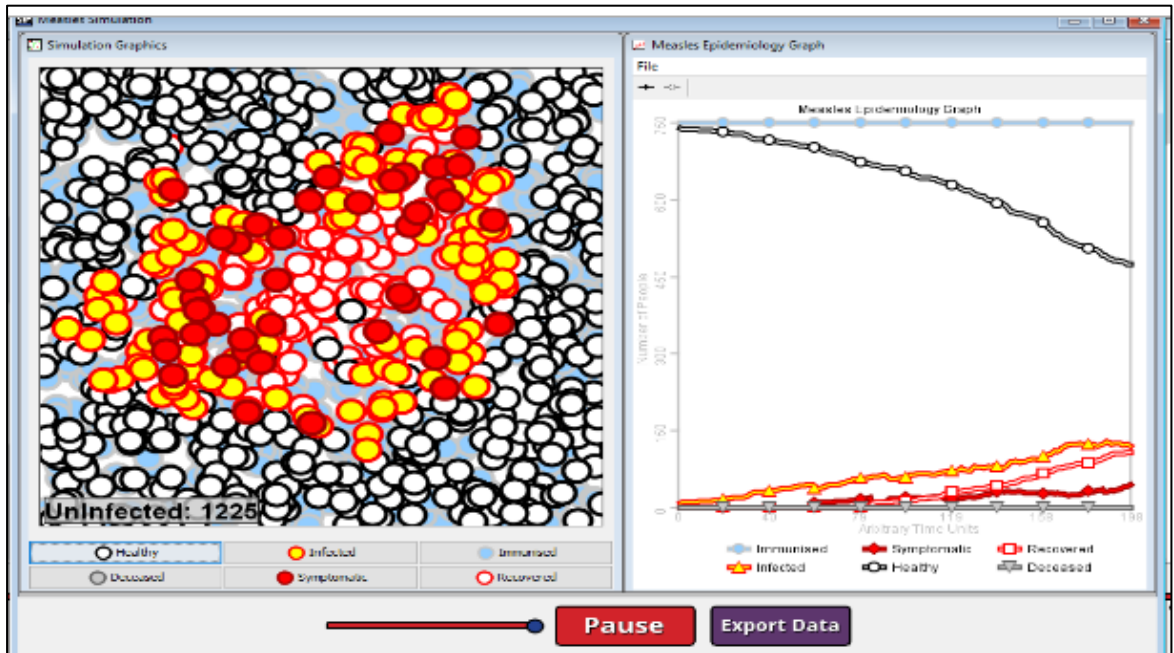


FIGURE 16 AN EXAMPLE SIMULATION SHOWING THE UPDATED COLOUR SCHEME FOR SIMULATIONS, GRAPHS AND BUTTONS.

4.7 Conclusion

The aim of this phase of the research was to develop an educational resource for the spread and control of infectious diseases. A complete educational resource, 'SimFection', was developed, and feedback from various user groups has been positive. Feedback suggests that the educational resource (both as a stand-alone software tool and the overall resource, including PowerPoint presentations) is acceptable and useful to both students and teachers.

The feedback collected after modifications in the second round of trials showed several improvements in responses from both teachers and students, and the resource was well received by both groups. The resource was finalised and launched as an educational resource in July 2016.

CHAPTER 5: EXPLORING THE RANGE OF ATTITUDES TOWARDS VACCINATION IN YOUNG PEOPLE

As previously described, although adult attitudes towards vaccination have been previously investigated in detail (Gardner *et al.* 2010; Hak *et al.* 2005; Opel *et al.* 2011; Reiter *et al.* 2009; Dannelun *et al.* 2005; Brown *et al.* 2012; Brunson 2013; Downs *et al.* 2008; Bennett & Smith 1992; Kennedy *et al.* 2005; Brown *et al.* 2011; Tickner *et al.* 2006; Smith *et al.* 2007; Freed *et al.* 2010; Wright & Polack 2006; Bolton-Maggs *et al.* 2012), there has been limited research on the attitudes of *young people* towards vaccination. Therefore, it was important to develop an understanding of these before any intervention could be designed.

This Chapter describes the design, conduct and analysis of 14 in-depth interviews that were carried out with young people from the local area. This process generated several key themes that were important in attitudes of young people towards vaccination. These themes were perceptions of (1) Risk of infectious disease, (2) Trust, (3) Safety of vaccination, and (4) Effectiveness of vaccination. Information needs and personal choice were also found to be important. Misconceptions about vaccination and barriers towards vaccination were also explored. These themes formed the basis for the development of the data collection instrument described in Chapter 6 and were also used to tailor the educational resource used in the intervention (also described in the next Chapter).

5.1 Research methods

This Section describes the methods used in the design of the interview schedule, the interview procedure, and data analysis techniques. Interviews were specifically used to collect information about attitudes of young people towards vaccination

because they allow for a greater depth of exploration and probing with regards to attitudes, compared to simple questionnaires (Cohen, *et al.*, 2007).

5.1.1 Interview design

An interview schedule was developed to explore the full range of attitudes towards vaccination in teenagers. The interview schedule used open questions, and was semi-structured, with prompts for each question (Appendix 5). The interview schedule was reviewed by experts in Microbiology and Education research to ensure that the questions were not leading, and used introductory questions to "settle" participants and ensure they were at ease before the main body of the interview.

The interview schedule was designed around the following concepts, which are supported by the Health Belief Model (Janz Becker, 1984).

- Perceived susceptibility to infectious diseases included in the immunisation schedule
- Perceived seriousness of the infectious diseases
- Perceived benefits of vaccination
- Perceived barriers to vaccination
- Intent to vaccinate in the future
- Sources of information in vaccination decisions

Three practice interviews were carried out with participants outside the target group in order to ensure that the questions were clear and easy to understand, before interviews were conducted with the target group. The practice interviews included two female and one male participants. The male participant was Muslim, one female participant was Christian, and one was not religious. All of the participants were 22 years of age, British and Biomedical Science undergraduates at Manchester Metropolitan University. The practice interviews confirmed that the interview schedule was clear and easy to understand.

5.1.2 Participants and procedure

The *snowball sampling* method was used for participant recruitment (Goodman 1961), as offers a convenient way of reaching a sufficient number of participants within the same target group. Participants were recruited through advertisements on social media, and they, in turn, then recruited others to be interviewed. As the

findings will not be generalised, representative sampling (Robson 2011) was not used. Six semi-structured one-to-one interviews were initially conducted with participants. Later, a further eight participants were recruited in the same manner, giving a total of fourteen participants. Participant demographics are shown in Table 19. Interviews were held at the participants' homes, at their request, (with parents/guardians present) and were voice recorded.

TABLE 19 DEMOGRAPHICS OF INTERVIEW PARTICIPANTS

	N	Percentage
Gender		
Male	9	64.29
Female	5	35.71
Age		
13	1	7.14
15	1	7.14
16	7	50.00
17	2	14.29
19	3	21.43
Ethnicity		
White	13	92.86
Asian	1	7.14
Religion		
Christian	4	28.57
Jewish	1	7.14
None	9	64.29

5.1.3 Data analysis

The interviews were voice recorded and transcribed using Express Scribe software, and the transcripts analysed using QSR Nvivo 10 software. Thematic analysis (Guest *et al.* 2012) was conducted to establish themes concerning attitudes towards vaccination extracted from the initial six participant responses.

Thematic analysis was used because it is systematic to apply, and outcomes may be used in questionnaire generation (Guest, *et al.*, 2012). An exploratory and iterative approach was used in the development of codes, i.e. specific codes were

not predetermined (Guest, *et al.*, 2012). Interviews were conducted and transcribed by the author, and each line of the transcript was given a code based on the phrases and language used by the interviewee (for example, if a participant said “*the injection could go wrong*”, this would be coded with “concerns about safety of needles”). This process is described in more detail in Section 3.3.1.1.

5.2 Main findings

The main findings of this phase of the research encompassed six themes that were considered important in attitudes of young people interviewed towards vaccination (Section 5.2.1), potential barriers to vaccination (Section 5.2.2) and misconceptions about vaccination (Section 5.2.3). As described above, these themes were used in the development of the data collection instrument and the intervention materials described in Chapter 6.

5.2.1 Attitudes towards vaccination

The initial interviews provided six attitudinal themes that emerged as important to the participants when considering issues surrounding vaccination:

1. Risk of infectious disease
2. Trust
3. Effectiveness of vaccination
4. Safety of vaccination
5. Information needs
6. Personal choice

Each of these are considered in detail in the following Sections.

5.2.1.1 Risk of infectious diseases

Participants in the small sample were not overly concerned about the spread of infectious diseases, because it was not something they had encountered themselves. For example:

“Just doesn't really affect me in my everyday life. I don't see it as much of a risk” (Participant 4, female, 19)

“I've never met anybody that's had any of them [infectious diseases]”
(Participant 5, female, 19).

However, when asked if they would vaccinate any future children, several participants said they *would* vaccinate their children because they didn't want their children to catch any of the diseases. For example:

"I would get it for them because I wouldn't want to make my children ill"

(Participant 1, Male, 14)

"I: If you decide to have children in the future, do you think that you will vaccinate them?"

P5: Yeah

I: What factors would influence that decision?"

P5: The risk of them getting an illness" (Participant 5, Female, 19)

This suggests that fear of infectious diseases is a motivator to vaccinate.

5.2.1.2 Trust

GPs were considered to be 'experts' and 'professionals', and thus more trustworthy than other groups (for example, friends and family). For example, Participant 4 described why she feels that the opinion of a doctor would influence her decision on whether or not to vaccinate. For example:

"They are healthcare professionals so I feel like their information's more reliable than one of my friends who doesn't really know much about vaccination." (Participant 4, female, 19)

The perception of GPs as "the experts" may also be intimidating to some teenagers. For example:

"They are the experts, so maybe, but they could trick me not to because they use the big words" (Participant 1, male, 14).

The use of the word "trick" here is interesting. This word implies a lack of trust, and "big words" demonstrates communication barriers between healthcare professionals and this participant. The use of "big words" may be overwhelming for younger people, and it is possible that teenagers may feel pressured to vaccinate. For example:

"Yeah, because they are a professional. I know that they know - I'm sure they'd try to influence me to get vaccinations properly" (Participant 2, male, 17).

This is further demonstrated by the use of the word “influence”. This suggests that, although the participant trusts a doctor because “*they are a professional*”, the doctor has a degree of persuasive power over them.

Some participants mentioned that they would seek advice from their family, and trust their opinion. For example:

“I wasn’t particularly educated on vaccination so I feel like my parents particularly know more about vaccinations than I do so if they suggested not to get it, for any reason, I probably wouldn’t.” (Participant 5, female, 19).

This is important as it demonstrates the influence family members can have on vaccination decisions and attitudes.

However, some participants explained that, although they would *consider* their family’s opinions, they would still make their own decision about vaccination. For example:

“I would take that on-board but I would look at other resources to make an informed decision for myself” (Participant 4, female, 19).

However, friends were seen as less trustworthy than family members or healthcare professionals. Participants did not believe that their friends’ opinions on vaccination would influence their attitudes towards vaccination, because they did not trust their judgement on health issues. For example:

“I don’t really value my friends’ opinions that much. Especially about vaccinations” (Participant 4, female, 19)

“I probably wouldn’t trust their opinion as much, because they are not as well informed” (Participant 6, female, 19).

Trust also related to sources of information. “The media” was not generally considered to be a trusted source. For example:

“You can never really trust the media” (Participant 1, male, 14)

“I do think there is a lot of media frenzy about stuff so I wouldn’t take too much on board because a lot of the time the media just say something bad. Like, wasn’t there one where with the children - they said something causes

Down's syndrome -and nobody wanted to get it anymore? So I would probably look at something more informed.” (Participant 4, female, 19).

5.2.1.3 Safety of vaccination

How safe vaccinations were perceived to be was also important to participants. When asked how safe they thought vaccination was, responses included “*Very safe*” (participant 6, female, 19), “*I think they are relatively safe*” (Participant 5, female, 19) and “*50/50*” (Participant 1, male, 14). The use of the word “relatively” here is interesting – this implies that the participant does not wholeheartedly believe in the safety of vaccination.

Some participants felt positive that vaccination is safe, because they perceive vaccines to have been well-tested. For example:

“It makes me more, like, happy to do it because I know that somebody has like – it’s been tested - so I know it’s not bad or anything, so I feel more confident” (Participant 1, male, 14)

“I feel that it’s all been tested quite a lot so they should be safe” (Participant 6, female, 19).

When asked about the risks of vaccination, some participants said they were not aware of any risks of vaccinating. For example:

“[I] don’t really think there is any” (Participant 2, male, 17)

“I’m not sure, I don’t really think there is risk” (Participant 3, female, 17).

However, participants were also concerned about the chance of vaccinations “going wrong”. For example:

“They could do the wrong, like, chemicals that they put inside you ... [because] many people make little mistakes like that” (Participant 1, male, 14).

“Your body not being able to fight it off - the vaccination - and becoming really ill” (participant 4, female, 19).

Participant 4 expanded on this by explaining that:

“I think they are safe for some people, but what if you were really weak and then you got vaccinated and it kills you?” (Participant 4, female, 19)

Views on safety of vaccination were related, to some degree, to how trusting a participant appeared to be. Participants that were more trusting seemed more confident that vaccination was safe and that it was only a good thing. For example:

“Because they are there to help so you don’t get anything in the future, because you are already immune to it, so they are just trying to help you”
(Participant 2, male, 17)

Participants that were less trusting displayed less certainty about the safety of vaccination. For example, a participant that felt vaccinations were “50/50” in terms of safety explained some of his fears surrounding the safety of vaccination:

“Either that the injection could go wrong, or your body could maybe make like, could get immune or resistant, like the bacteria or virus could overtake that” (Participant 1, male, 14).

5.2.1.4 Effectiveness of vaccination

Effectiveness of vaccination was mentioned by some participants as a motivator for vaccinating any future children of theirs. For example:

“Just because it’s a peace of mind that I can think ‘Oh, well they aren’t going to get this [infectious disease]’ so I know there’s less chance of them getting something” (Participant 2, male, 17).

Participants did not mention vaccination not being effective in the context of their own attitude towards vaccination, but when asked why they thought some people were against vaccination, some participants explained that they thought some people might not believe it works:

“They don’t believe it will help them get better” (Participant 3, female, 17).

Being able to ‘see’ the effectiveness of vaccination was also mentioned as something that would make a participant more confident about vaccination:

“It would make me more confident if the people - if I’d seen people that had had it - who’ve actually had the vaccination, not get that flu, but they could have had that chance but their body was immune to it” (Participant 1, Male, 14).

5.2.1.5 Information needs

Several sources of information were suggested by participants in terms of where they would or have accessed information about vaccination. These included school, their family doctor, online sources, and from their family. Some participants showed a good intuitive understanding of how to determine the reliability of a source of information:

“It’s to do with how the website looks and what references are on there and who the people are that actually wrote it. Like what their background is, what university they are from and if they have PhDs” (Participant 2, male, 17).

Other participants said that they would know that a source was reliable if lots of sources said the same thing. This is problematic, because misinformation can be spread quickly, particularly online, where several participants said they would look for information on vaccination. This issue was also linked to trust, in that some participants said they would ask their family for advice on vaccination because they trust their family, and one participant explained they would seek advice from their family because they believe their family would have a better understanding of vaccination:

“I wasn’t particularly educated on vaccination so I feel like my parents particularly know more about vaccinations than I do so if they suggested not to get it, for any reason. I probably wouldn’t” (Participant 5, female, 19).

Some participants felt that they did not have enough information about vaccination, and that having more information would make them feel more confident about vaccination:

“Probably if there was more information surrounding it, like leading up the cervical cancer jabs that we had in year nine there wasn’t much information, they basically just said ‘You’re getting injections so make sure get in for it’” (Participant 5, female, 19).

5.2.1.6 Personal choice

Personal agency, in terms of who is "allowed" to make decisions about vaccination, was also important to some participants. Several participants said that

they would not be influenced fully by family, friends or doctors, because they would make their own decision about vaccination:

“If I wanted it, I would get it because I feel like it's my life choice”
(Participant 1, male, 14).

For some, the lack of choice in vaccination decisions was problematic:

“I never really had a choice in whether I got vaccinated or not, my family just assumed that I would” (Participant 5, female, 19).

When asked if parents should be able to choose not to vaccinate their children, there were mixed responses, ranging from no choice:

*“P1: No, I don't think they should have a choice really.
I: So do you think it should be up to the doctor?
P1: Yeah or the child.”* (Participant 1, male, 14)

To complete responsibility:

“Because it's their kid, it's their decision” (Participant 6, female, 19).

5.2.2 Potential barriers to vaccination

A number of potential barriers to vaccination were also uncovered by the interviews. These included ethical concerns, fear of needles and dislike of group vaccination conducted in schools. Each are considered in turn below.

5.2.2.1 Ethical concerns

Animal testing was a concern to some participants, and would potentially prevent them being vaccinated:

“If it was made a thing that 'this thing [vaccine] has been tested on animals' and it's harmed them then I'd probably be less likely to do it” (Participant 5, female, 19).

However, of those participants who mentioned that testing on animals was a concern for them, some also explained that it would not necessarily prevent them choosing to vaccinate:

P: Yeah because obviously I don't want that stuff being done to animals but again, it's kind of okay because they've still got to test to make sure they

are okay for humans. Do you know what I mean? So, like, I don't like the thought of it...

I: So you don't like the thought of it, but it wouldn't prevent you vaccinating?

P: Yeah.

(Participant 2, male, 17)

5.2.2.2 Fear of needles

Fear of needles may be a barrier to vaccination in some teenagers. One participant was particularly concerned by their fear of needles, and this had actively prevented them being vaccinated in the past. Indeed, it was cited as a reason they did not ever want to get vaccinated. Another participant stated that they were “*terrified of needles*” (Participant 6, female, 19):

I: Is there anything else that worries you about vaccination?

P: Yeah. I genuinely think this is why I haven't been vaccinated. I think something bad is really going to happen to me because I never get needles for anything. I didn't even get the cervical cancer jab that everyone else got. I'm scared.

I: What do you think would make you feel more confident about vaccination?

P: I think that yeah, but I don't like needles so I still wouldn't do it (Participant 4, Female, 19)

5.2.2.3 Group vaccination

Another potential barrier to vaccination is that vaccination in school is conducted in *groups*. When asked to describe their memories of vaccination, several participants described group vaccination, and one participant explained that they felt that they might have felt more confident about vaccination if vaccinations were conducted in private:

“I know when I did it, they had like 50 kids (students) in the hall. That's the only thing that made me less confident about it. But other than that no, nothing really.” (Participant 2, male, 17).

5.2.3 Misconceptions about vaccination

Several misconceptions were identified in the initial interviews. One important issue that became apparent was a poor understanding of vaccination and how it works. Participants demonstrated limited knowledge of vaccination when asked if they knew what vaccination is, and to explain how it works:

“I don't know how to explain it but, like, I sort of know how it in a context but, like, I don't really know what it means. But I could sort of understand it. Err... I don't really know...I actually don't know how to explain it”
(Participant 1, male, 14),

“Like a needle or something” (Participant 3, female, 17) and

“Yes, it's, like, where they give you an injection of an illness to make you immune to it” (Participant 4, female, 19).

Several participants explained that their knowledge about vaccination came from learning about the subject as part of the school curriculum, or from their form tutor prior to receiving vaccinations at school. In addition, some participants said that they did not receive much information on vaccination prior to vaccination. This may explain the limited knowledge of vaccination displayed by participants.

Another misconception concerned the sterility of needles used in vaccination. For example:

“You don't know who else has been given the needle” (Participant 1, male, 14)

“Well I would like my needle - if someone injected me, I'd like it to be clean but, I'd assume it is” (Participant 4, female, 19).

5.3 Follow-up interviews

After the initial themes were extracted, eight additional interviews were conducted and analysed. No new themes were generated by the subsequent interviews, and the eight interviewees were generally positive about vaccination. For example:

“Well, I mean, nothing went wrong with our vaccination and I fully support vaccinations. I think they are really important to make sure that epidemics don't spread” (Participant 8, Male, 16)

In contrast to the initial interviews, the subsequent eight interviewees had generally good knowledge of vaccination and how it works. For example:

“It’s where a dead or weakened pathogen or version of the virus is injected into you to stimulate a reaction from your white blood cells so that they memorise it for when, when that actual virus comes and they need to get rid of it” (Participant 9, Male, 16)

“You are injected with a form of dead or inactive pathogen and your body - so it does no harm - but your body develops certain antibodies to fight it” (Participant 12, Male, 16)

These additional participants were GCSE students, so it is likely that they knew more about vaccination because of recent exposure to relevant taught material. The previous interviewees were not currently sitting GCSE exams. Some participants explained that this is where they had gained their knowledge of vaccination:

“P13: A vaccination is basically where you have an inactive form of a disease injected into you and that tells your body to make the antibodies to fight the disease and when it actually comes into your body you know how to fight it.

I: So where does that knowledge of vaccination come from?

P13: Biology lessons”

“I know a little bit about it, what I’ve been talking about, because of what we studied for our Biology unit one at GCSE AQA because that mentions stuff about pathogens and how they fight them” (Participant 14, Male, 16)

The second series of interviews, with regard to the themes previously identified, are analysed below.

5.3.1 Risk of infectious disease

Some participants were concerned about the spread of infectious diseases, because they saw them as serious:

“Because they are life threatening” (Participant 7, male, 15)

Interestingly, one participant (participant 12, male, 16) explained that they took what they believed to be preventative measures in order to protect themselves from catching infectious diseases:

P12: Not [concerned about infectious diseases] on a day to day basis, but I mean. But yeah, the same kind of concern anyone would have. You know? I used to every morning I'd have vitamin tablets and stuff like that to try - whether it was good for me or not...

I: To protect yourself from infection?

P12: Yeah, to boost my immunity, but I mean, you know, reasonable concern but not being like paranoid about it.

5.3.2 Trust

As in previous interviews, participants saw doctors as trustworthy authorities on vaccination. For example:

"Doctors are trustworthy people and know a lot about this kind of thing"
(Participant 7, male, 15)

"Doctors' opinions may sway it [his opinion on vaccination] a lot because obviously the doctors have been to medical [training] and are incredibly well qualified and know exactly what they are doing" and that "probably an opinion from an incredibly well qualified individual or my parents [would influence me the most]" (Participant 8, Male, 16)

"Doctors are trained to be able to give medical advice." (Participant 10, male, 16)

It was apparent that participants believed doctors to be a good source of information, for this reason:

"A GP has had years of training and school nurse has to be qualified to I'd sort of know that the information I was getting was good." (Participant 12, male, 16)

This may be one possible reason why doctors are held in high regard compared with other sources of advice, such as family and friends:

“Because you know that they [doctors] are supposed to really know what they are talking about when it comes to that. And if there is anyone who you are supposedly going to trust, it would be probably be them. I’m not going to know everything about it, my friends aren’t, my family aren’t necessarily, so that’s the sort of view I’m going to need to take.” (Participant 12, male, 16)

Although family opinions were seen as influential on attitudes, because:

“I view them as a source of knowledge and a source of information”
(Participant 8, Male, 16)

As with previous interviews, participants said they would make their own decisions about vaccination:

“I’m sure it would ... if they were saying that I couldn’t because they wouldn’t be happy or whatever, I’d probably still try to argue that it was needed”
(Participant 12, male, 16)

This is reflected in comments from participants related to the concept of personal choice in vaccination decisions.

As with previous interviews, friends were seen as less influential on attitudes than family or doctors. For example:

“Probably slightly less influence I’d say, I’d imagine my family would be a bit more protective. But with friends, you know, I’m interested to hear views and things but it would still be my decision” (Participant 12, male, 16)

“If my family said something, if my friends said something, I’d be much more inclined to go with my family because they know more” (Participant 14, Male, 16)

These examples demonstrate that perceived level of knowledge is important. It is possible that this may explain why doctors are primarily trusted about vaccination, followed by family members, and then peers.

5.3.3 Safety of vaccination

As with previous interviews, most of the participants felt that vaccinations were safe, particularly because they were perceived to be well-tested by “professionals”:

I: How safe do you think vaccination is?

P7: Very safe

I: Why do you think that?

P7: Because everything that's done -it's all made sure that it's safe by professionals. (Participant 7, male, 15)

“They've all been tested so I'd say quite safe”

(Participant 11, Female, 16)

“I think they're safe. They're done many times a year by doctors.”

(Participant 13, Male, 16)

Despite this, when asked if he thought about risks of vaccination, one participant believed that skin infections after vaccination were a possible risk factor:

“Infection, into the arm” (P13, Male, 16)

Some participants were aware of ‘rumours’ about a lack of safety in vaccines, but still ‘trusted’ that vaccines were safe:

“I've heard a lot of rumours about vaccines - they say like mercury and stuff - but I tend to think they've been concocted and made by people who know exactly what they are doing and I trust them completely.” (Participant 8, Male, 16)

5.3.4 Effectiveness of vaccination

One participant was less confident in the effectiveness of newly developed vaccines, and stated that they would want to know it had been “proven to work”:

P12: “You know if it was quite- if it was a new one that no-one had really - if it's something that I know had been proven to work, maybe you'd have reassurance by family and friends, then that would help...You never really want to be the first one to test it, do you?”

I: So would you have more concern over that than a longer established vaccine?

P12: If it had been long established and it wasn't out of date and it had been proven that it was still working then I'd probably trust that."

5.3.5 Information needs

Participants described their experiences of vaccination, and highlighted a lack of information prior to being vaccinated. For example, when asked if anyone had discussed vaccination with them prior to vaccines being administered, participants said:

"No it was just sort of a 'go and get your jabs' thing."

(Participant 8, Male, 16)

"Not in terms of what it does, but they said "you better get it". But not so much"

(Participant 13, Male, 16)

Participants explained that while they were quite confident about vaccination, more information might make them feel even more confident:

"I'm already relatively confident about it, maybe if I could see exactly what was in the vaccination, all the vaccinations out there and maybe see accident risk and percentages about vaccines and statistics"

(Participant 8, Male, 16)

"People going through it with me so I know exactly what's in it, and what side effects it might have [would make me feel more confident about vaccination]."

(Participant 11, Female, 16)

"Maybe [I'd feel more confident about vaccination] if I was actually told what is in it and what I'm being vaccinated for". (Participant 12, Male, 16)

This comments are important, as they demonstrate a general feeling of not being provided with enough information, and that being provided with the facts about vaccination would make the participants feel more confident about vaccination.

5.3.6 Personal choice

As with previous participants, personal choice was also important to some later interviewees. One participant believed that vaccination decisions should be left entirely up to the child being vaccinated:

“It’s up to the child whether they want to be vaccinated or not because they won’t want to become ill” (Participant 11, Female, 16)

She later expanded on this by explaining that her family’s opinions on vaccination would not influence her attitude towards vaccination because:

“It’s my choice if I take it or not”. (Participant 11, Female, 16)

The idea that children who are old enough to ‘decide for themselves’ should be allowed to make their own decisions about vaccination was also highlighted by participants:

“When you are old enough to choose you should have the right to choose whether or not you should be vaccinated.” (Participant 13, Male, 16)

“I think if its someone my age, then I’d get to choose whether I’m getting vaccinated but when its parents who do have young children, then I’d say that they do have the right to choose but I think they should strongly be persuaded by the scientists or the people carrying out the experiments.”
(Participant 14, Male, 16)

5.4 Discussion

The interviews suggest that risk of infectious diseases, trust, and safety of vaccination, effectiveness of vaccination, information needs, and personal choice are important factors in teenagers' attitudes towards vaccination. Many of the themes extracted from the initial interviews are consistent with those observed by previous studies on adult attitudes towards vaccination (Gardner *et al.* 2010; Brown *et al.* 2012). However, an *additional* theme was found (which did not appear in adult studies): *personal choice*. Specifically, perceived *lack of choice* in vaccination decisions was an important factor for young people. This study shows the importance of developing methods for understanding the positions of young people on vaccination, and the specific factors that influence their attitudes and perception of vaccination.

The barriers to vaccination found in these interviews provide an insight into potential reasons for teenagers not to vaccinate, either themselves or any children they may have in the future. The barriers identified included ethical concerns about animals, fear of needles and group vaccination. These barriers could be addressed in attempts to increase vaccination coverage amongst teenagers, as these concerns are less prevalent in adults. A previous systematic review of barriers to childhood vaccinations (Mills *et al.* 2005) also found fear of needles to be a barrier to vaccination, but not animal welfare concerns or group vaccination - these are new findings.

Misconceptions about vaccination and misunderstandings about how vaccination works are important because of the implications for *informed consent*. Other work focusing on teenagers' knowledge and understanding of vaccination has shown that some young people have limited understanding of vaccination and the diseases vaccinated against in the United Kingdom (Hilton *et al.* 2013).

Vaccination is a sterile procedure in the UK, and so concerns about the sterility of vaccination shows that there may be miscommunication between healthcare professionals and teenagers about the sterility of vaccination.

All of the participants interviewed stated they would vaccinate any future children they might have. This is interesting, as some of the participants were not very confident about the safety of vaccinations or were unsure of the risk of vaccination.

This finding is consistent with the literature discussed in Chapter 2 – behavioural intent is not always a good indicator of future behaviour.

These findings suggest that clear information should be provided to teenagers prior to vaccination in order to ensure good understanding of vaccination. This relates to informed consent, as it raises the question: *if teenagers have limited knowledge and understanding of vaccination, how can they give informed consent?* This is also important in the context of future intent to vaccinate. How will information on vaccination be accessed between leaving school and having children? It appears that the internet is a common tool used to seek information on health issues such as vaccination, and this can have a direct impact on intent to vaccinate (Betsch *et al.* 2010). This suggests that it is important to encourage a good level of knowledge of vaccination in teenagers, so that they are able to discriminate between *good* and *bad* information.

There are limitations to this work. Many of the participants were non-religious and those that *were* religious believed that their religious views did not affect their views on vaccination. Many religious perspectives are not represented by the participants included in these interviews. In addition, the majority of participants that volunteered to be interviewed classed themselves as White British, and so other ethnicities are not represented in these interviews.

CHAPTER 6: THE INTERVENTION STUDY: IMPACT OF A DIGITAL EDUCATIONAL RESOURCE ON ATTITUDES OF YOUNG PEOPLE TOWARDS VACCINATION

This Chapter describes the results generated from a pilot trial and the main study trial conducted to assess the impact of the digital educational resource on attitudes of young people towards vaccination.

Attitudinal scores were generated for participants before and after exposure to the digital resource using an attitudinal survey. These attitudinal scores were compared with attitudinal scores of those receiving a presentation-based intervention and the scores of a control group.

A follow up session was conducted with the participants after six months. This was to investigate if any changes in attitude resulting from exposure to the resources were sustained after six months.

In addition to attitudinal scores, views on personal choice and information needs were also collected pre- and post-trial. Feedback was also collected from participants in both test groups to allow comparison of engagement levels depending on intervention format.

6.1 Introduction

Initial pilot trials (Section 6.4) were conducted with two schools in North West England (n=30; n=55). This allowed the interventions to be further refined before full trials conducted with GCSE Biology students (n=63) at a Secondary school in North West England (Section 6.5).

An eight question 5-point Likert scale attitudinal survey was used to collect participants' attitudes towards vaccination before and after exposure to either a digital resource or a PowerPoint presentation. Participants were given pre-trial and post-trial attitudinal scores.

Four attitudinal 'themes' were considered, which were derived from the scoping survey (risk of infectious disease; safety of vaccination; trust of healthcare professionals and government; effectiveness of vaccination). The survey contained two questions for each theme.

In addition (as described in Chapter 3), six (non-attitudinal) questions were used to collect additional data about participants' information needs and opinions on personal choice towards vaccination, which were analysed separately from the attitudinal survey. Finally, a short feedback form using a 5-point Likert scale was provided to each of the test groups, and participants were given the opportunity to provide written feedback on the session they had attended. Feedback comments were grouped into categories based on their common themes.

6.2 Methods

This Section describes the development of the trial materials. The digital educational resource described in Chapter 4 was tailored, based on the findings of the interviews discussed in Chapter 5, to create a suitable digital-based intervention. A presentation-based intervention was created alongside the digital-based intervention, against which the effects of the digital intervention could be compared. In addition, group discussion materials were developed to provide participants with a complete educational session about vaccination, and to ensure that all of the themes generated by the interviews were covered and discussed by both test groups. This ensured that any differences in participants' responses to the interventions were attributable to the format of intervention they received.

6.2.1 Development of a digital-based intervention

The digital software used in the intervention trial was based on the educational resource software described in Chapter 4. The intervention software included only the measles Section of the full software package.

As previously described, the interviews conducted with the target group (n=14) provided six themes that were important in teenagers' attitudes towards

vaccination. To meet the needs of the target group, each theme generated by the interviews (Effectiveness of vaccination, trust of doctors/healthcare professionals, safety of vaccination, risk of infectious disease, personal choice and information needs) were addressed in the trial activities. Table 20 briefly describes how each “theme” is addressed by a vaccination message within the overall intervention package and the intended outcome of each vaccination message.

Effectiveness of vaccination and risk of infectious disease were demonstrated through the use of the measles simulation, as it allows users to see the effects of raising and lowering vaccination coverage. At a low level of vaccination coverage, outbreaks occur and spread quickly through the population, and some agents in the simulation die, demonstrating the risk of infectious diseases to non-immunised people. When the vaccination coverage is set to a high value (above 95%), outbreaks are prevented, demonstrating to the user the effectiveness of vaccination at preventing the spread of infectious disease.

The information needs of the target group were addressed using a PowerPoint presentation about vaccination and the real-life risks of infectious diseases, using measles as an example. As interview participants expressed a desire to be provided with information about potential side effects of vaccination, this was also included. This also addressed the safety of vaccination theme. To address trust of doctors (and other healthcare professionals), the information and task for users was presented as a scenario in which the user needs to make a decision about whether or not to vaccinate their child. This also addressed the perception of personal choice in vaccination decisions.

TABLE 20 VACCINATION MESSAGES INCLUDED IN INTERVENTION

Theme	Vaccine message/Information provided	Where vaccine message can be found in the intervention	Potential outcome
Effectiveness of vaccination	High vaccination coverage (vaccination coverage of >95%) prevents outbreaks of infectious diseases such as measles.	Simulation activity	Increased awareness of the effectiveness of vaccination
Risk of infectious disease	Infectious diseases are a real life risk to people and populations, particularly to those with poor immune systems	Simulation activity	Increased awareness of the real life risk of infectious diseases
Safety of vaccination	Vaccines have been tested thoroughly for their safety, discussion of potential side effects of vaccination	Simulation activity & Group discussion activity	Increased belief in 'safety' of vaccination
Trust	Doctors can provide balanced information about vaccination	Group discussion activity	Increased trust of healthcare professionals
Information needs	Providing background information about vaccination and how it works	Simulation activity & Group discussion activity	Increase perceived level of knowledge of vaccination
Personal choice	Young people will go on to make their own decisions about vaccination	Group discussion activity	Increase perception of personal choice about vaccination decisions

6.2.2 Presentation-based intervention

A PowerPoint presentation was developed to deliver specific information related to vaccination. The information included in the PowerPoint was related to GCSE and A Level Biology specifications to ensure specific learning objectives and vaccination messages were included, and also to confirm its suitability for the target group. The messages included in the PowerPoint were:

- Background information about pathogens (Figure 17).
- What vaccination is and how immunity is induced by vaccination (Figure 18).
- Why vaccine boosters are needed (Figure 19).
- The importance of high vaccination coverage for herd immunity (Figure 19).

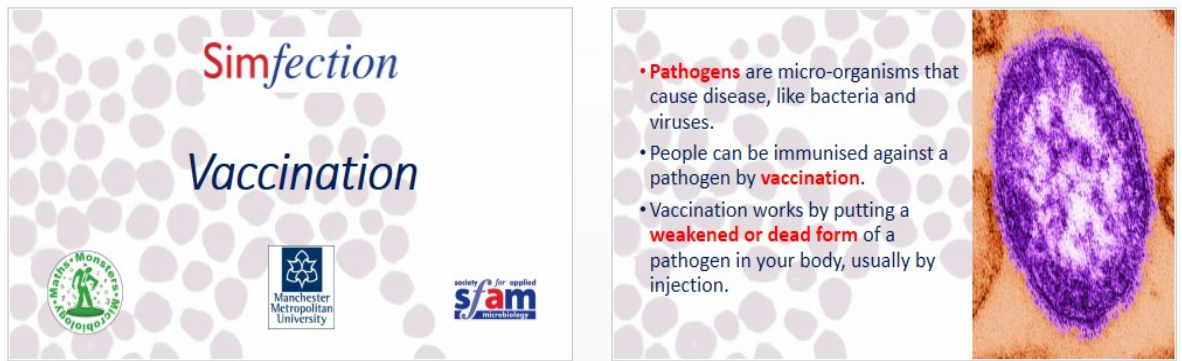


FIGURE 17 SLIDE 1 AND 2 OF THE PRESENTATION. SLIDE 2 DESCRIBES PATHOGENS AND VACCINATION

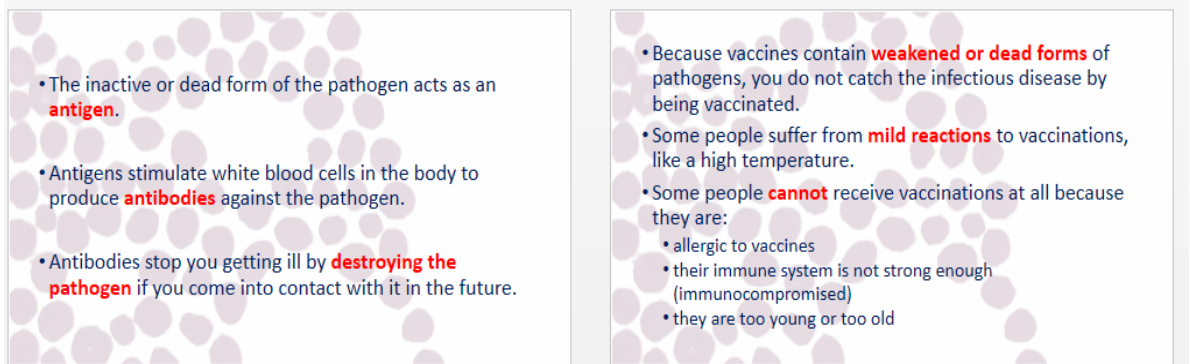


FIGURE 18 SLIDES 3 AND 4 OF THE PRESENTATION. SLIDE 3 DESCRIBES HOW IMMUNITY IS INDUCED BY VACCINATION. SLIDE 4 DESCRIBED WHY SOME PEOPLE CANNOT BE VACCINATED AND SIDE EFFECTS OF VACCINATION

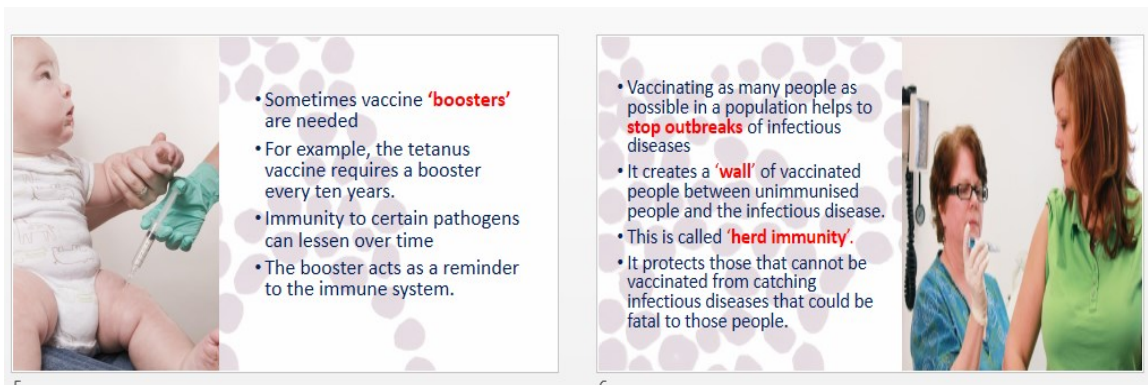


FIGURE 19 SLIDES 5 AND 6 OF THE PRESENTATION. SLIDE 5 DESCRIBES WHY VACCINE BOOSTERS ARE SOMETIMES NEEDED, AND SLIDE 6 EXPLAINS THE IMPORTANCE OF HIGH VACCINATION COVERAGE TO CREATE HERD IMMUNITY

6.2.3 Group discussion materials

A separate PowerPoint presentation was included to stimulate group discussion. The task incorporated 'role-play' and decision-making; participants were asked to

imagine that they needed to make a decision about whether or not to vaccinate their child against measles. They were provided with the pros and cons of vaccinating, using a 'doctor's' opinion and a 'friend's' opinion. Discussion questions were posed to both groups. These questions were developed to reflect the concepts of the Health Belief Model (Chapter 2):

1. Are there any advantages of vaccination? If so, what are they?
2. Are there any disadvantages of vaccination? If so, what are they?
3. Why do you think some people don't want to vaccinate?
4. How serious do you think infectious diseases like measles are?
5. How likely do you think it is that someone could catch measles?
6. Should people be encouraged to vaccinate by their doctors?
7. What would make you more likely to vaccinate?
8. Do you think that doctors or parents should have the most say about children's vaccinations?
9. Can you think of any other issues surrounding vaccination?

The intervention packages therefore addressed the major themes associated with teenagers' attitudes towards vaccination: Trust (primarily of doctors and scientists); Effectiveness of vaccination; Risk of infectious disease (being vaccinated against); Safety of vaccination; Perceptions of personal choice to vaccinate, and information needs. The information provided by the PowerPoint presentation is related to GCSE and A Level Biology specifications, in order to allow the intervention to also be assessed in terms of its educational value.

6.3 Data analysis

Based on their survey returns, participants were assigned pre-trial and post-trial attitudinal scores, each out of a possible total score of 40. Data were analysed using IBM SPSS 19. Mann-Whitney U-tests were used to analyse differences between the two groups included in the pilot trials (Section 6.4.3). Chi-squared analysis was used to compare any change in attitudinal scores across the two test groups and the control group in the main trial both after intervention and after six months (Section 6.6.1). An alpha value of 0.05 was used for all statistical tests (Papastergiou 2009; Dale *et al.* 2014; Mooney *et al.* 2006).

6.4 Pilot trials

Pilot trials were performed in order to ensure that the intervention materials were suitable for the range of demographics included in the target group, and to provide preliminary advisory data. This allowed any new issues with the intervention to be detected and resolved before the trials.

The total number of participants, distributed across two secondary schools, was 85. One school was represented by 30, with 55 students from the other.

Participants from each school were divided into two groups; one group received a lesson on vaccination using the digital-based intervention and one received a "standard" lesson using the presentation-based intervention.

6.4.1 School selection

In selecting schools for the trial, it was important to try to reach a range of demographics. The schools contacted included those in high and low income areas, from both inner city and suburban regions, and from both religious and non-religious administrations across the Greater Manchester region. A range of schools within the Greater Manchester area were approached through the University's department of Professional Development and Educational Innovation. An information sheet about the project was sent to approximately 30 schools, and two schools responded. To ensure a range of individuals were represented, demographic data were collected from participants.

It was considered that focusing on the local area of Greater Manchester was appropriate for this study, due to broad demographic similarity with the national average (Table 21; Table 22; Office of National Statistics, 2013).

In addition, focusing on the local area allows us to exploit good pre-existing links between the University and target schools, which helps to reduce the number of difficulties in securing schools for participation in trials. However, it should be noted that the aim of this study was not necessarily to produce generalizable findings that are generalizable to *all* young people in the United Kingdom.

TABLE 21 ETHNICITIES OF GREATER MANCHESTER AND UNITED KINGDOM

Ethnicity	Greater Manchester		United Kingdom	
	Number	Percentage	Number	Percentage
White	2,248,123	83.8	55,073,552	87.17%
Mixed/multiple ethnic groups	60,710	2.3	1,250,229	1.98%
Asian/Asian British	272,173	10.1	4,373,339	6.92%
Black/African/Caribbean/Black British	74,097	2.8	1,904,684	3.01%
Other ethnic group	27,425	1	580,374	0.92%
Total	2,682,528	100	63,182,178	100.00%

TABLE 22 RELIGIOUS BACKGROUND OF PEOPLE IN GREATER MANCHESTER AND THE UNITED KINGDOM

Religion	Greater Manchester		United Kingdom	
	Number	Percentage	Number	Percentage
Christian	1657594	61.8	37,583,962	59.49%
Buddhist	9555	0.4	261,584	0.41%
Hindu	23478	0.9	835,394	1.32%
Jewish	25013	0.9	269,568	0.43%
Muslim	232787	8.7	2,786,635	4.41%
Sikh	5322	0.2	432,429	0.68%
Other religion	7429	0.3	262,774	0.42%
No religion	557129	20.8	16,221,509	25.67%
Religion not stated	164221	6.1	4,528,323	7.17%
Total	2,682,528	100	63,182,178	100.00%

The demographics of school included in the pilot trials are shown in Table 23.

TABLE 23 DEMOGRAPHIC INFORMATION OF PILOT TRIAL PARTICIPANTS

School 1			School 2		
	N=28	Percentage		N=55	Percentage
Gender			Gender		
Male	19	67.86	Male	50	90.91
Female	9	32.14	Female	0	0.00
			No answer	5	9.09
Age			Age		
13	19	67.86	15	34	61.82
14	9	32.14	16	15	27.27
Ethnicity			Ethnicity		
Asian/Asian British	16	57.14	Asian/Asian British	22	40.00
Mixed Ethnic Background	4	14.29	Black British/Black/African/Caribbean	5	9.09
White British	4	14.29	Mixed/Multiple Ethnic Background	6	10.91
Black British/Black/African/Caribbean	3	10.71	Other ethnic background	4	7.27
Other ethnic group	1	3.57	White British	1	1.82
Religion			Religion		
Christian	11	39.29	Muslim	39	70.91
Muslim	10	35.71	Prefer not to say	8	14.55
No Religion	3	10.71	No answer	5	9.09
Prefer not to say	2	7.14	No religion	3	0.05
Hindu	1	3.57			
Sikh	1	3.57			

6.4.2 Study procedure

An information sheet was sent to schools explaining the study. Schools were invited to select groups of students to participate in the study. Consent forms and

information sheets were sent to parents and guardians in order to obtain their permission for their child to take part in the study.

Participants were assigned a unique ID code in order to allow pre- and post-test attitudes and knowledge of vaccination to be measured and compared.

Participants were assigned (by class group, by their teachers) to a test group to receive either the digital resource or the PowerPoint based lesson. All participants were given a questionnaire covering attitudes towards vaccination, knowledge of vaccination, and additional questions about personal choice and information needs. While the digital intervention group (group A) were receiving the intervention, the traditional lesson group participants (group B) attended their usual scheduled lessons. Group A then went to their usual scheduled lessons and group B received the PowerPoint-based lesson. Groups were assessed before and after intervention using the same questionnaire. Data collection was conducted in December 2015 and January 2016.

Both test groups were motivated by the same learning objectives and received the same materials. The only difference between the two groups was that one group (A) received the digital resource, and the other (B) received a traditional PowerPoint lesson. This was to ensure that any significant differences in post-test scores could be attributed solely to the *type* of intervention. A lesson plan was prepared and used to control for any variables such as discussion and lesson time (Appendix 7). After pre-test assessment, both test groups received a brief introduction, followed by their group-specific intervention, followed by a group discussion led by the researcher on the advantages and disadvantages of vaccination. Both test groups received the same information and were asked the same questions (Appendix 1). Participants were then given a short worksheet to complete (Appendix 8). Finally, the post-test assessment (using the same questionnaire for both groups) was conducted at the end of the session.

Figure 20 shows how participants from each school were assigned to the intervention they received and the number of participants excluded from analysis due to non-completion of the survey. Data were collated so that all data from students receiving the digital intervention was compared with data from all students receiving the presentation intervention.

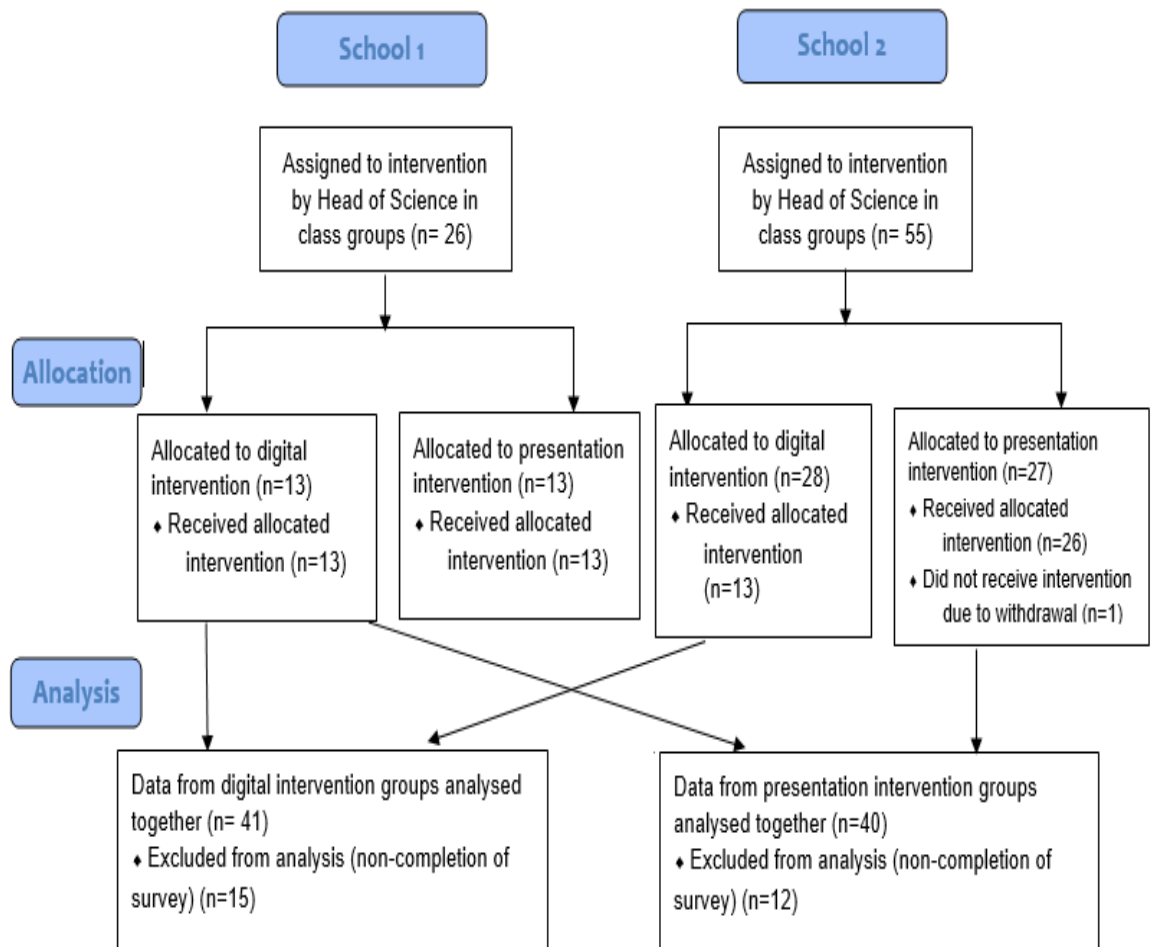


FIGURE 20 HOW PILOT TRIAL PARTICIPANTS WERE ASSIGNED TO INTERVENTION GROUPS

6.4.3 Outcomes of pilot trials

An overall attitudinal score was generated for each participant based on their responses to the eight attitudinal questions. Table 24 displays how the responses to each question were scored. Responses were scored between 1 and 5 and the sum of these scores provided the overall attitudinal score. Attitudinal scores were generated for each participant before and after intervention (Table 25). An “x” indicates that the participant did not complete that part of the survey.

TABLE 24 HOW THE ATTITUDINAL SURVEY WAS SCORED

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Vaccination can have serious side effects like causing disabilities in otherwise healthy people	5	4	3	2	1
The government would not let people get vaccinated if it was not safe	1	2	3	4	5
I would trust my doctor's advice on vaccination	1	2	3	4	5
Vaccines contain unsafe ingredients	5	4	3	2	1
Diseases like measles are dangerous	1	2	3	4	5
It is important to get vaccinated to prevent the spread of infectious diseases through my community	1	2	3	4	5
Someone who isn't vaccinated is likely to catch the infectious disease	1	2	3	4	5
People that don't vaccinate themselves or their children put others at risk	1	2	3	4	5

TABLE 25 ATTITUDINAL SCORES BEFORE AND AFTER INTERVENTION

Digital Groups		PowerPoint Groups	
Before	After	Before	After
24	30	33	34
33	34	35	37
34	20	30	x
37	35	28	29
36	37	32	25
30	29	35	37
30	30	29	28
29	32	29	31
31	30	28	21
33	30	23	22
28	35	33	x
36	33	24	31
26	27	27	37
29	28	23	28
34	x	31	29
x	30	31	X
33	38	30	X
37	28	30	X
29	30	26	31
x	x	28	27
33	x	X	33
33	x	29	25
35	21	35	X
x	27	34	35
29	24	32	31
24	x	16	33
24	x	29	X
33	33	X	X
x	27	28	27
30	27	33	X
29	32	33	33
26	x	29	39
x	30	31	29
32	37	29	28
31	31	39	28
32	30	35	33
x	36	32	33
x	29	34	32
24	19	X	33
24	30	X	33
30	x	27	22

Change in attitude was determined by calculating the difference in attitude from baseline to after intervention (Table 26)

TABLE 26 CHANGE IN ATTITUDINAL SCORES IN PARTICIPANTS RECEIVING THE DIGITAL OR PRESENTATION BASED INTERVENTION

Change in attitudinal score	
Digital	Presentation
6	1
1	2
-14	1
-2	-7
1	2
-1	-1
0	2
3	-7
-1	-1
-3	7
7	10
3	5
1	-2
-1	5
5	-1
-9	-4
1	1
-14	-1
-5	17
0	-1
-4	0
3	10
5	-2
0	-1
-2	-9
-5	-2
	1
	-2
	-5
	6

The Mann-Whitney test was used to compare change in attitudinal score from baseline between the digital and presentation groups. There was no statistically significant difference between the groups receiving the digital intervention (median= 0) and the participants receiving the presentation intervention (median=-0.5) (U=425.5, p=0.558).

Nineteen of the 83 participants did not complete all or some the attitudinal and knowledge survey. This was a significant proportion of the cohort, and suggested that there were issues with the data collection instrument.

A knowledge questionnaire (Figure 21) was given to participants and they were asked to complete the questions before and after receiving their allocated intervention. Their responses were marked according to a mark scheme developed in line with the National Curriculum (Section 3.3.2). Their total scores before and after intervention were compared before and after to give each participant a 'change in knowledge' score. The change in scores (Table 27) of the participants receiving the digital resource and those receiving the presentation were compared using Mann-Whitney U-test analysis. Whilst knowledge scored generally increased in both intervention groups, there was no statistically significant difference in knowledge after intervention between the digital intervention group and the presentation intervention group (U=927.0, p=0.9).

Some participants expressed verbal resistance to the knowledge section of the survey; several participants explained their lack of interest in completing the knowledge questionnaire, particularly in the post-trial survey.

For these reasons, and since the main focus of the project was the post-intervention *attitudes* of participants, the knowledge section of the survey was removed from subsequent trials.

- Can you describe what is injected into you when you are vaccinated?
- Can you explain why a person won't get ill if they have been vaccinated?
- What do you think is a benefit of vaccinating a large percentage of people?
- Can you think of any medical reasons a person would not be able to be vaccinated?
- Can you explain why 'booster' vaccinations are sometimes needed?
- Why can't a vaccine be made against some types of viruses like flu?
- Can you think of any potential risks of vaccination?

FIGURE 21 KNOWLEDGE OF VACCINATION QUESTIONNAIRE

TABLE 27 CHANGE IN KNOWLEDGE SCORES IN PILOT TRIAL PARTICIPANTS

Digital participants			Presentation participants		
Before	After	Change	Before	After	Change
0	5	5	3	5	2
2	5	3	1	3	2
0	2	2	1	0	-1
0	3	3	1	2	1
2	3	1	1	3	2
0	3	3	2	4	2
1	3	2	2	4	2
0	3	3	2	3	1
1	2	1	0	3	3
2	2	0	1	6	5
0	0	0	0	3	3
0	3	3	4	4	0
0	3	3	2	5	3
0	2	2	1	1	0
1	3	2	2	3	1
4	5	1	1	5	4
5	5	0	1	4	3
4	3	-1	0	5	5
2	6	4	3	6	3
1	4	3	5	6	1
1	2	1	5	4	-1
2	4	2	5	2	-3
5	9	4	2	4	2
5	7	2	2	2	0
4	7	3	2	3	1
3	6	3	1	5	4
4	6	2	1	6	5
3	4	1	3	6	3
4	6	2	5	6	1
4	0	-4	6	6	0
5	5	0	2	5	3
5	5	0	5	4	-1
4	7	3	4	4	0
1	7	6	5	2	-3
3	7	4	3	0	-3
4	7	3	0	1	1
4	6	2			
3	3	0			
2	5	3			
5	6	1			

6.5 Main trials

After the pilot trials were completed, and the protocols adjusted in the light of our findings, a main trial was conducted with GCSE Biology students (n=63) at a Secondary school in North West England. The results from this trial are discussed in Chapter 7. In this Section, the study protocol.

6.5.1 School recruitment and sample size

The University had pre-existing links with the trial school, so the Head of Science at the school was contacted with an invitation to participate, giving information on the project and contact details of the author. Information sheets, participant consent forms and parental consent forms were also provided to the school.

The demographics of the participants of the main trial are shown in Table 28. Most participants were white British (93.65%) and were either Christian (42.86%) or not religious (46.03%). The genders of the participants were close to even (46.03% female, 50.79% male), as were the ages of participants (46.03% age 14, 50.79% aged 15).

TABLE 28 DEMOGRAPHICS OF MAIN TRIAL PARTICIPANTS

	N=63	Percentage
Gender		
Male	34	50.79
Female	29	46.03
Age		
14	29	46.03
15	34	50.79
Ethnicity		
Asian/Asian British	3	5.45
Mixed Ethnic Background	1	1.59
White British	59	93.65
Religion		
Christian	27	42.86
No Religion	29	46.03
Other	1	1.59
Buddhist	1	1.59
Prefer not to say	5	7.94

6.5.1.1 Sample size

Power calculations were not carried out prior to conducting the study. The desired sample size was based on previous similar educational intervention studies; for example a study evaluating the effect of an educational intervention on human papillomavirus vaccine uptake in female students (n=58) (Gross et al. 2014) and a study evaluating the impact of an educational intervention on students attitudes towards mental health (n=54) (Dale et al. 2014). However, post-trial power calculations show that an n of 144 approximately would be needed to achieve statistical power at the recommended level of 0.80. This is discussed further in Section 7.2.

6.5.2 Study procedure

As with the pilot study, participants were assigned a unique ID code to allow pre- and post-test attitudes of vaccination to be measured and compared. Participants were assigned (by class group) to a test group: Digital-based intervention (Group A), Presentation-based intervention (Group C); or no-intervention (control, Group C).

All participants were given a questionnaire covering attitudes towards vaccination, and additional questions about personal choice and information needs. While the digital intervention group (Group A) were receiving the intervention, the traditional lesson group participants (group B) and control group (Group C) attended their usual lessons. Group A then went to their usual lessons and Group B received the traditional lesson.

Groups were assessed before and after either the intervention (for Groups A and B) or an appropriate delay (for Group C), using the same questionnaire after the same length of time (Group C completed the 'post-trial' survey after 45 minutes, to reflect the length of the intervention sessions received by the other groups). Data collection was conducted in January 2016 and six-month follow up assessments were conducted in July 2016.

Although the nature of the project did not allow for a longitudinal study over a period of years, the aim of the follow-up data collection was to explore if any changes in attitude brought about by the interventions were sustained over a shorter period of time. A period of six months was used for all trial participants, which is considered to be a suitable period of time based on previous intervention

studies (Hansen *et al.* 2012; Miller *et al.* 2003; Bull *et al.* 2012). Ideally, this would also reduce the number of “drop out” participants in the follow up session (due to the length of the school year).

As before, both test groups received the same learning objectives and materials, differing only in that one group (A) received the digital resource and the other the traditional PowerPoint lesson, as described in Section 5.3.3. In addition, each test group completed a short feedback form using a 5-point Likert scale and space for written comments (Appendix 8). The control group attended their usual lessons, completing only the attitudinal surveys.

Participants were assigned in class groups to one of the three groups by the Head of Science at the school. This was to minimise inconvenience to the school and teachers who had agreed to take part. Participants were all from the same educational level and were all ‘top set’ students. The same participants were used in all stages of the trials (Please see Figure 22 for more detail on number of participants at each stage).

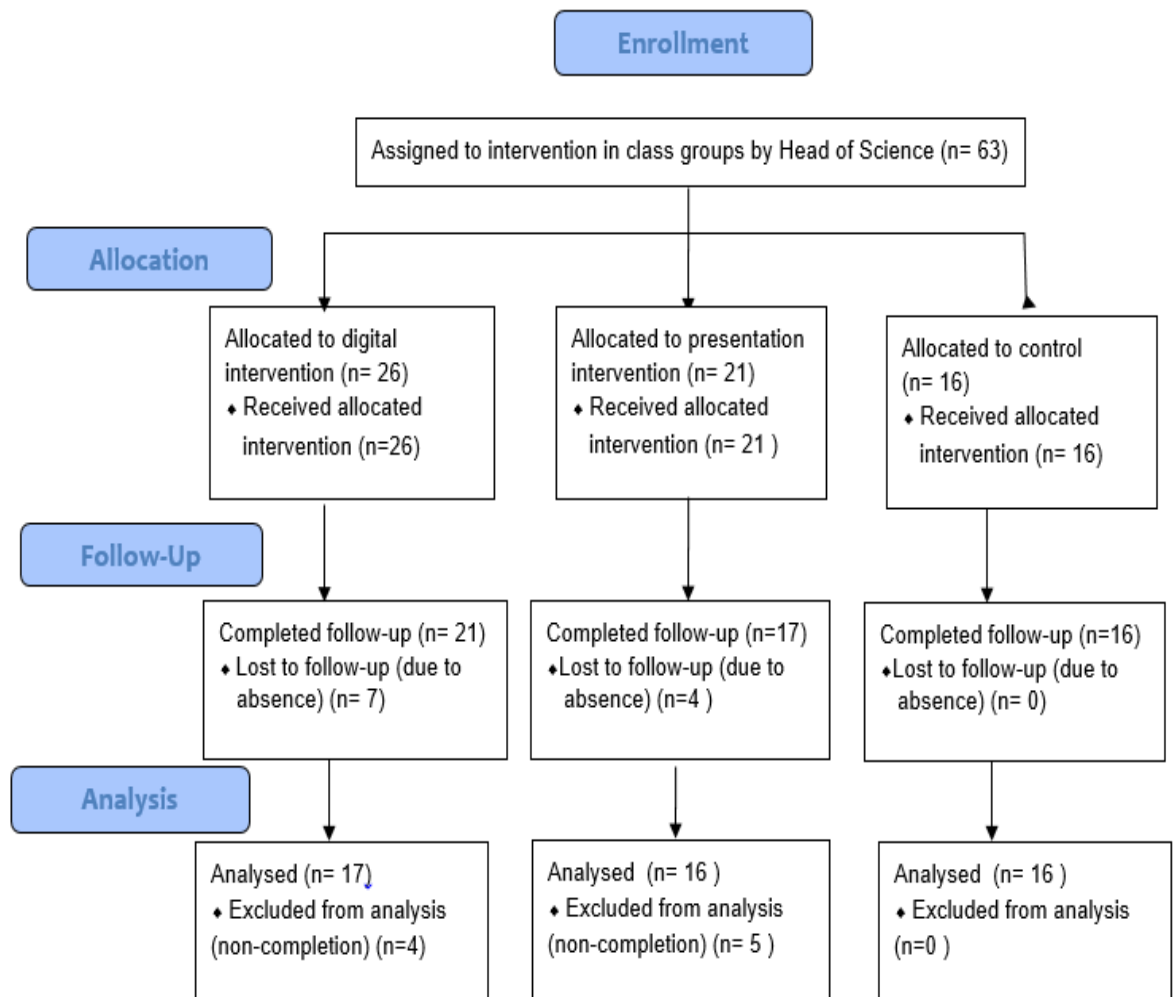


FIGURE 22 HOW PARTICIPANTS WERE ASSIGNED TO INTERVENTION GROUPS

6.6 Results

6.6.1 Attitudinal scores

An overall attitudinal score was generated for each participant based on their responses to the eight attitudinal questions. Table 29 displays how the responses to each question were scored. Responses were scored between 1 and 5 and the sum of these scores provided the overall attitudinal score. Attitudinal scores were generated for each participant before intervention (or control), after intervention (or control) and after six months. Change in attitude was determined by calculating the difference in attitude from baseline to after intervention, and then from after intervention to at six month follow up.

TABLE 29 HOW RESPONSES TO ATTITUDINAL SURVEY WERE SCORED

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Vaccination can have serious side effects like causing disabilities in otherwise healthy people	5	4	3	2	1
The government would not let people get vaccinated if it was not safe	1	2	3	4	5
I would trust my doctor's advice on vaccination	1	2	3	4	5
Vaccines contain unsafe ingredients	5	4	3	2	1
Diseases like measles are dangerous	1	2	3	4	5
It is important to get vaccinated to prevent the spread of infectious diseases through my community	1	2	3	4	5
Someone who isn't vaccinated is likely to catch the infectious disease	1	2	3	4	5
People that don't vaccinate themselves or their children put others at risk	1	2	3	4	5

Table 30 show the attitudinal scores of participants in each of the three trial groups, at each data collection point. Use of "X" indicates that the participant did not complete all or some of the survey and therefore their data was not included in analysis. The Shapiro-Wilk Test was used to test for normality. This showed that the data were not normal ($p = 0.043$, $df = 56$).

TABLE 30 ATTITUDINAL SCORES OF MAIN TRIAL PARTICIPANTS

Digital Group				PowerPoint Group				Control Group			
#	Baseline	After	Follow	#	Baseline	After	Follow	#	Baseline	After	Follow
			Up				Up				Up
1	35	33	33	1	32	34	37	1	36	34	34
2	35	35	X	2	35	33	31	2	33	29	38
3	33	33	32	3	28	32	31	3	30	30	33
4	30	31	29	4	29	33	34	4	32	36	32
5	31	31	33	5	30	32	33	5	30	34	35
6	30	29	31	6	35	36	36	6	27	35	32
7	36	31	28	7	36	35	36	7	31	26	33
8	31	36	33	8	33	35	34	8	27	30	35
9	x	30	X	9	29	30	36	9	36	30	38
10	x	31	34	10	39	38	38	10	28	27	31
11	32	35	34	11	35	37	x	11	29	30	33
12	30	31	31	12	35	36	32	12	34	32	38
13	30	32	32	13	30	33	32	13	32	33	33
14	31	x	31	14	x	29	35	14	34	32	33
15	31	32	29	15	30	35	35	15	34	33	32
16	34	34	X	16	30	33	x	16	30	26	33
17	32	37	30	17	33	35	36				
18	32	31	34	18	35	34	29				
19	28	36	35	19	32	32	x				
20	27	27	X	20	32	31	32				
21	29	30	36	21	x	32	x				
22	30	34	29								
23	35	38	X								
24	30	33	X								
25	30	34	32								
26	32	34	X								

6.6.1.1 Analysis

The data were assigned either + or – or 0 (an x denotes no answer provided) based on the change in attitudinal score from baseline, and from after intervention to follow up (Table 31). The frequency of positive, neutral and negative changes in attitude for each group was calculated (Table 32).

TABLE 31 CHANGE IN ATTITUDINAL SCORE OF MAIN TRIAL PARTICIPANTS

Digital Group				PowerPoint Group				Control Group			
#	Follow			#	Follow			#	Follow		
	Baseline	After	Up		Baseline	After	Up		Baseline	After	Up
1	35	-	0	1	32	+	+	1	36	-	0
2	x	x	X	2	35	-	-	2	33	-	+
3	33	0	-	3	28	+	-	3	30	0	+
4	30	+	-	4	29	+	+	4	32	+	-
5	31	0	+	5	30	+	+	5	30	+	+
6	30	-	+	6	35	+	0	6	27	+	-
7	36	-	-	7	36	-	+	7	31	-	+
8	31	+	-	8	33	+	-	8	27	+	+
9	x	x	X	9	29	+	+	9	36	-	+
10	x	x	x	10	39	-	0	10	28	-	+
11	32	+	-	11	x	x	x	11	29	+	+
12	30	+	0	12	35	+	-	12	34	-	+
13	30	+	0	13	30	+	-	13	32	+	0
14	x	x	x	14	x	x	x	14	34	-	+
15	31	+	-	15	30	+	0	15	34	-	-
16	34	0	X	16	x	x	x	16	30	-	+
17	32	+	-	17	33	+	+				
18	32	-	+	18	35	-	-				
19	28	+	-	19	x	x	x				
20	x	x	X	20	32	-	+				
21	29	+	+	21	x	x	x				
22	30	+	-								
23	x	x	X								
24	x	x	X								
25	30	+	-								
26	x	x	X								

TABLE 32 FREQUENCY OF POSITIVE, NEGATIVE AND NO CHANGE IN ATTITUDINAL SCORES IN PARTICIPANTS OF MAIN TRIALS

	Baseline to After			After to Follow Up		
	+	0	-	+	0	-
Digital	11	3	4	4	3	10
PowerPoint	11	0	5	7	3	6
Control	6	1	9	11	2	3

Differences between groups were analysed using Chi-squared analysis. There was no statistically significant difference between the three groups after intervention ($p=0.115$, $df=4$). In addition, there was no statistically significant difference between groups after the six month follow up ($p=0.116$, $df=4$).

6.6.2 Additional questions

Six additional questions about information needs and personal choice were asked using a five-point Likert scale survey. Responses were coded from 1-5 based on participants' agreement to each statement. Frequency of responses between groups at each data collection point were compared using Kruskal-Wallis analysis for each question. Post-hoc analysis where relevant.

6.6.2.1 Information needs

Frequency of responses to questions about information needs are shown in Table 33 and Table 34 below.

Question 1 – “More information about vaccinations should be given to me”

Using Kruskal-Wallis analysis, there was no statistically significant difference in responses across the trial groups to this statement ($p=0.862$, $df=8$) (Figure 23).

TABLE 33 “MORE INFORMATION ABOUT VACCINATIONS SHOULD BE GIVEN TO ME”

	Digital Group			Presentation group			Control group		
	Before	After	Six months	Before	After	Six months	Before	After	Six months
Strongly disagree	2	2	1	0	0	0	1	0	0
Disagree	3	4	3	1	1	2	0	1	1
Neither agree nor disagree	6	7	3	5	8	7	4	7	6
Agree	12	11	10	12	9	7	11	8	8
Strongly agree	4	2	2	2	3	1	0	0	1

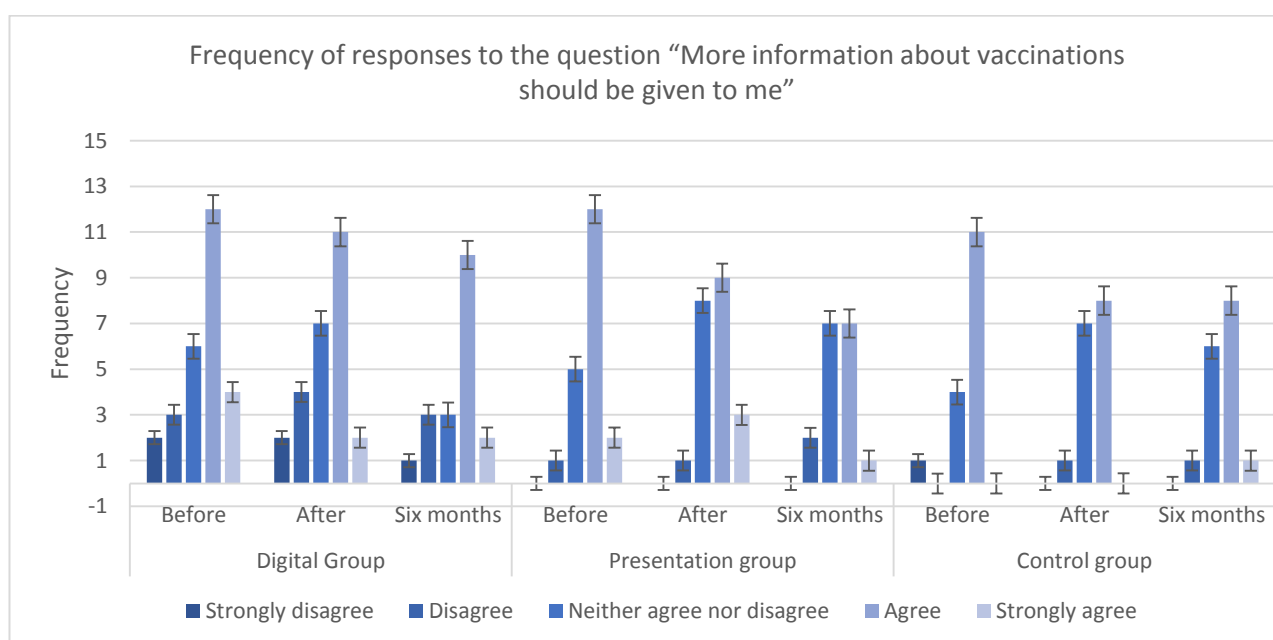


FIGURE 23 FREQUENCY OF RESPONSES TO THE QUESTION “MORE INFORMATION ABOUT VACCINATIONS SHOULD BE GIVEN TO ME”

Question 2 – “I know all I need to know about vaccination and how it works”

Kruskal-Wallis analysis showed a statistically significant difference between the three groups regarding the statement “I know all I need to know about vaccination and how it works” ($p=0.004$, $df=8$) (Figure 24). Post hoc analysis showed a significant difference between the digital intervention group and the control group after six months ($p=0.044$, $df=8$), with fewer participants in the digital group agreeing with the statement after six months.

TABLE 34 “I KNOW ALL I NEED TO KNOW ABOUT VACCINATION AND HOW IT WORKS”

	Digital Group			Presentation group			Control group		
	Before	After	Six months	Before	After	Six months	Before	After	Six months
Strongly disagree	1	0	1	2	0	0	0	0	0
Disagree	13	6	9	7	5	3	2	4	2
Neither agree nor disagree	6	6	4	7	5	7	2	2	5
Agree	5	11	4	4	10	7	7	7	5
Strongly agree	1	3	1	0	1	0	5	3	4

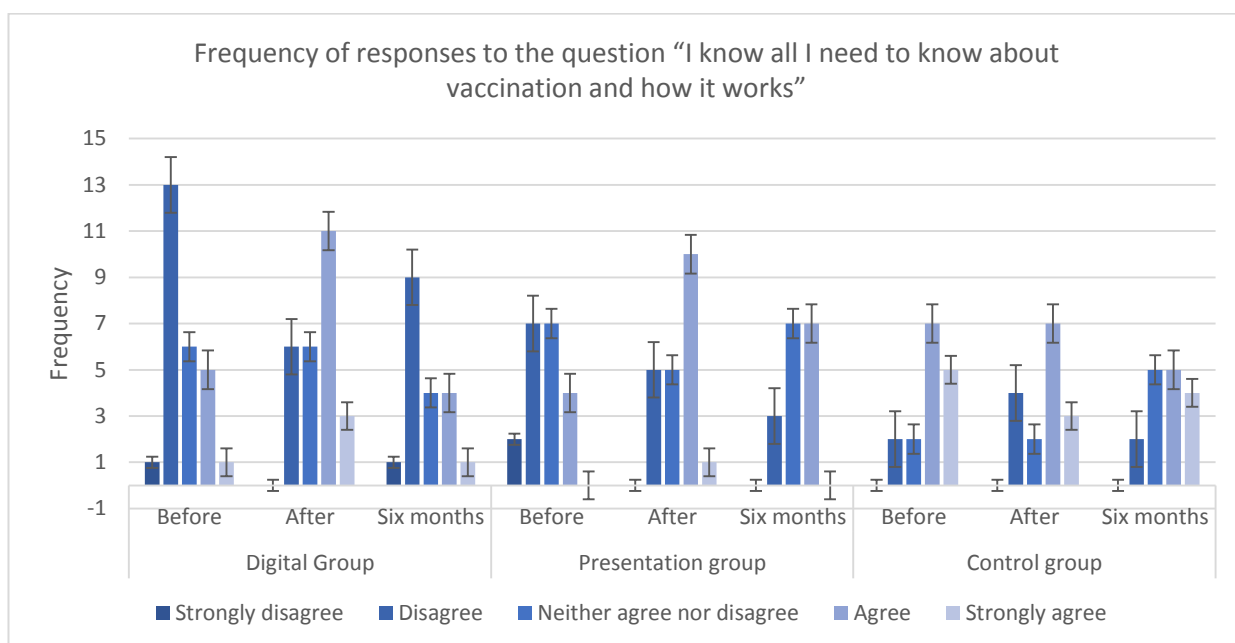


FIGURE 24 FREQUENCY OF RESPONSES TO THE QUESTION “I KNOW ALL I NEED TO KNOW ABOUT VACCINATION AND HOW IT WORKS”

6.6.2.2. Personal choice

Frequency of responses to questions about personal choice are shown in Tables 35, 36, 37 and 38 below.

Q3 “Children should have more say than their parents should when it comes to their own vaccinations”

Using Kruskal-Wallis analysis, no statistically significant difference in responses across the three groups to this statement ($p=0.255$, $df=8$) (Figure 25).

TABLE 35 “CHILDREN SHOULD HAVE MORE SAY THAN THEIR PARENTS SHOULD WHEN IT COMES TO THEIR OWN VACCINATIONS”

	Digital Group			Presentation group			Control group		
	Before	After	Six months	Before	After	Six months	Before	After	Six months
Strongly disagree	3	3	1	4	4	2	4	1	3
Disagree	6	10	7	5	6	4	8	9	8
Neither agree/disagree	6	4	6	7	5	8	1	3	4
Agree	8	8	3	2	2	2	0	3	1
Strongly agree	4	1	2	2	4	1	3	0	0

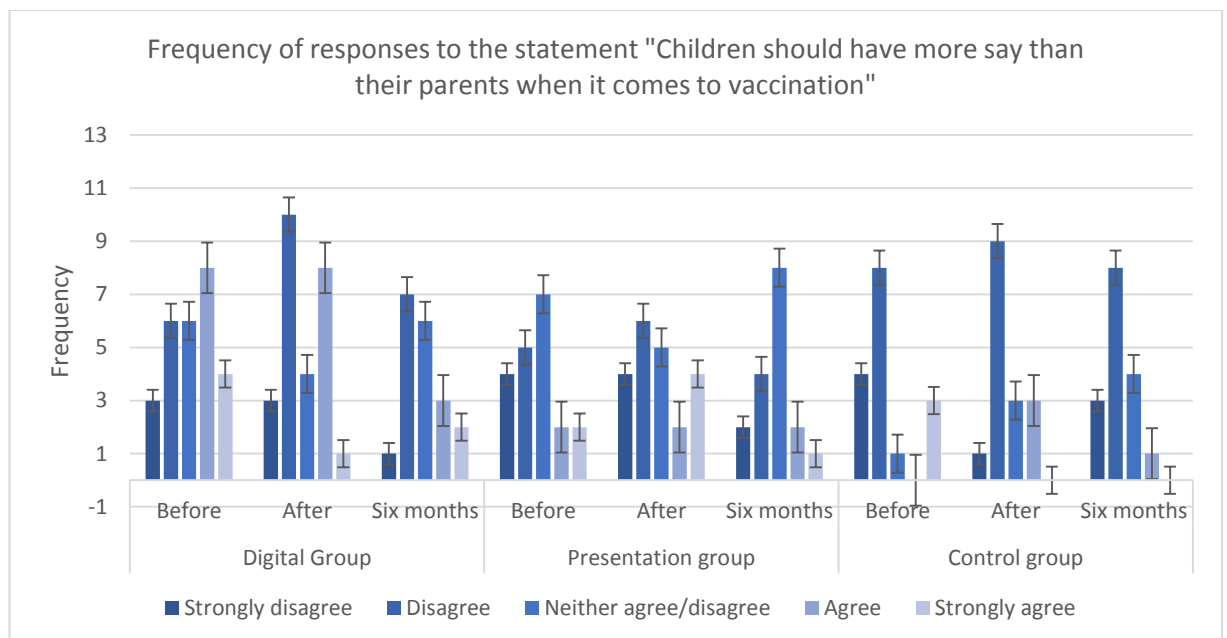


FIGURE 25 FREQUENCY OF RESPONSES TO THE STATEMENT "CHILDREN SHOULD HAVE MORE SAY THAN THEIR PARENTS WHEN IT COMES TO VACCINATION"

Q4 “Someone under 16 who is well informed should be able to choose to be (or not be) vaccinated without their parent’s consent”

Using Kruskal-Wallis analysis, there was no statistically significant difference in responses across the three groups to this statement ($p=0.82$, $df=8$) (Figure 26).

TABLE 36 “SOMEONE UNDER 16 WHO IS WELL INFORMED SHOULD BE ABLE TO CHOOSE TO BE (OR NOT BE) VACCINATED WITHOUT THEIR PARENT’S CONSENT”

	Digital Group			Presentation group			Control group		
	Before	After	Six months	Before	After	Six months	Before	After	Six months
Strongly disagree	3	1	0	0	1	1	3	2	1
Disagree	9	12	4	5	5	2	2	7	2
Neither agree/disagree	6	2	3	7	6	6	5	6	5
Agree	6	8	11	4	7	5	5	1	6
Strongly agree	3	3	1	4	2	3	1	0	2

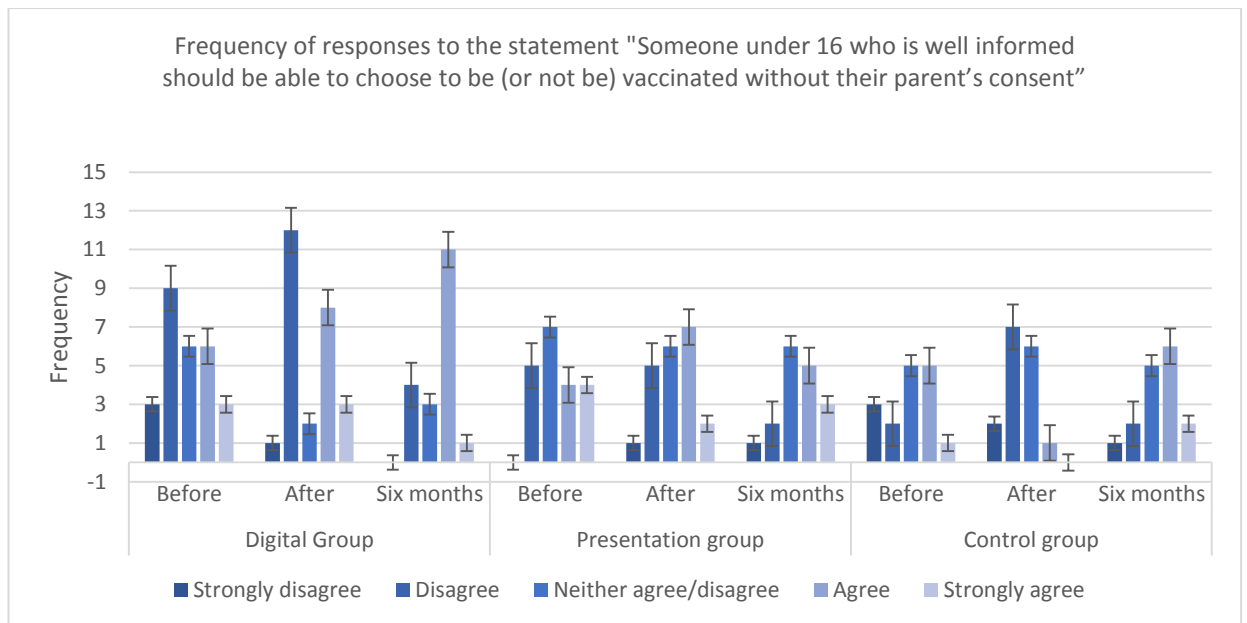


FIGURE 26 FREQUENCY OF RESPONSES TO THE STATEMENT “SOMEONE UNDER 16 WHO IS WELL INFORMED SHOULD BE ABLE TO CHOOSE TO BE (OR NOT TO BE) VACCINATED WITHOUT THEIR PARENTS’ CONSENT

Q5 “Doctors, not parents or their children, should have the final say about if a child is vaccinated”

Using Kruskal-Wallis analysis, there was no statistically significant difference in responses across the three groups to this statement ($p=0.85$, $df=8$) (Figure 27).

TABLE 37 “DOCTORS, NOT PARENTS OR THEIR CHILDREN, SHOULD HAVE THE FINAL SAY ABOUT IF A CHILD IS VACCINATED”

	Digital Group			Presentation group			Control group		
	Before	After	Six months	Before	After	Six months	Before	After	Six months
Strongly disagree	4	4	1	1	1	2	1	0	1
Disagree	8	12	7	7	2	3	7	11	7
Neither agree/disagree	11	4	4	6	6	6	5	3	1
Agree	3	4	4	5	8	3	2	1	7
Strongly agree	1	2	3	1	4	3	1	1	0

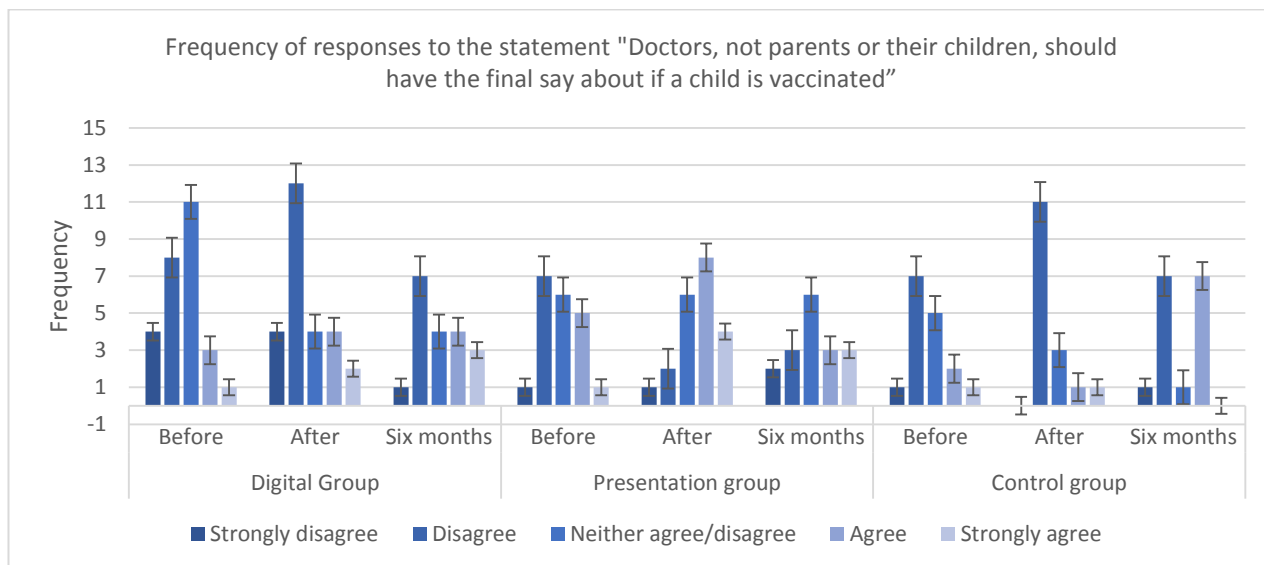


FIGURE 27 FREQUENCY OF RESPONSES TO THE STATEMENT “DOCTORS, NOT PARENTS OR THEIR CHILDREN, SHOULD HAVE THE FINAL SAY ABOUT IF A CHILD IS VACCINATED”

Q6 “It is nobody else’s business if I am vaccinated”

Using Kruskal-Wallis analysis, there was no statistically significant difference in responses across the three groups to this statement ($p=0.156$, $df=8$) (Figure 28).

TABLE 38 "IT IS NOBODY ELSE'S BUSINESS IF I AM VACCINATED"

	Digital Group			Presentation group			Control group		
	Before	After	Six months	Before	After	Six months	Before	After	Six months
Strongly disagree	2	2	0	1	3	4	1	2	1
Disagree	3	4	3	0	3	4	2	3	2
Neither agree/disagree	11	8	6	6	7	5	8	7	9
Agree	7	9	9	11	6	3	3	2	2
Strongly agree	4	3	1	2	2	1	2	2	2

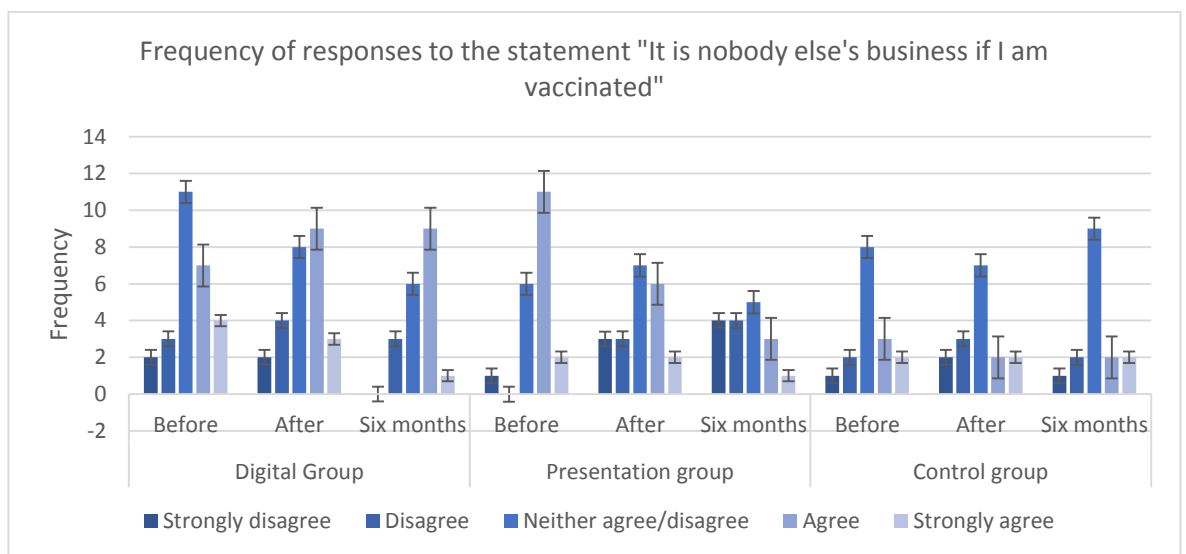


FIGURE 28 FREQUENCY OF RESPONSES TO THE STATEMENT "IT IS NOBODY ELSE'S BUSINESS IF I AM VACCINATED"

6.6.3 Engagement

Engagement was compared between the two intervention groups using a five-point Likert scale survey. Participants were asked to state their level of agreement with five statements about their thoughts on the session. The responses were given a code as shown in Table 39. The frequency of responses to each statement in each group were compared using Mann-Whitney U Test analysis.

TABLE 39 HOW THE ENGAGEMENT QUESTIONNAIRE WAS SCORED

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I found the session informative	1	2	3	4	5
The session was interesting	1	2	3	4	5
I thought that the session was fun	1	2	3	4	5
I learnt something new from this session	1	2	3	4	5
The session was a good way for me to learn about infectious diseases	1	2	3	4	5

The following data Tables (Table 40; Table 41; Table 42; Table 43) show the frequency of responses in both intervention groups. Both groups were generally positive about the intervention they had received, with the majority of participants in both intervention groups responding “agree” and “strongly agree” to each statement.

TABLE 40 Q1 “I FOUND THE SESSION INFORMATIVE”

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Digital Group (n=26)	0	0	0	24	2
Presentation Group (n=20)	0	3	0	10	7

TABLE 41 Q2 “THE SESSION WAS INTERESTING”

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Digital Group (n=26)	2	2	2	15	5
Presentation Group (n=20)	0	3	2	10	5

TABLE 42 Q3 “I THOUGHT THAT THE SESSION WAS FUN”

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Digital Group (n=26)	3	1	9	10	3
Presentation Group (n=20)	2	1	4	7	6

TABLE 43 Q4 “I LEARNT SOMETHING NEW FROM THIS SESSION”

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Digital Group (n=26)	0	2	1	20	3
Presentation Group (n=20)	1	1	0	12	6

TABLE 43 Q5 “THE SESSION WAS A GOOD WAY FOR ME TO LEARN ABOUT INFECTIOUS DISEASES”

	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
Digital Group (n=26)	1	0	3	19	3
Presentation Group (n=20)	0	3	1	10	6

Using Mann-Whitney analysis, there was no statistically significant difference in responses to questions about engagement between the digital group and the presentation group (Table 44), except for question 1 (I found the session informative), where more participants from the digital group agreed with the statement than the presentation group ($p=0.04$, $df=2$) (Figure 29).

TABLE 44 STATISTICAL ANALYSIS OF ENGAGEMENT FEEDBACK

Statement	Digital group median	Presentation group median	df	Significance
I found the session informative	4	4	2	0.04
The session was interesting	4	4	4	0.652
I thought that the session was fun	3.5	4	4	0.571
I learnt something new from this session	4	4	4	0.327
The session was a good way for me to learn about infectious diseases	4	4	4	0.86

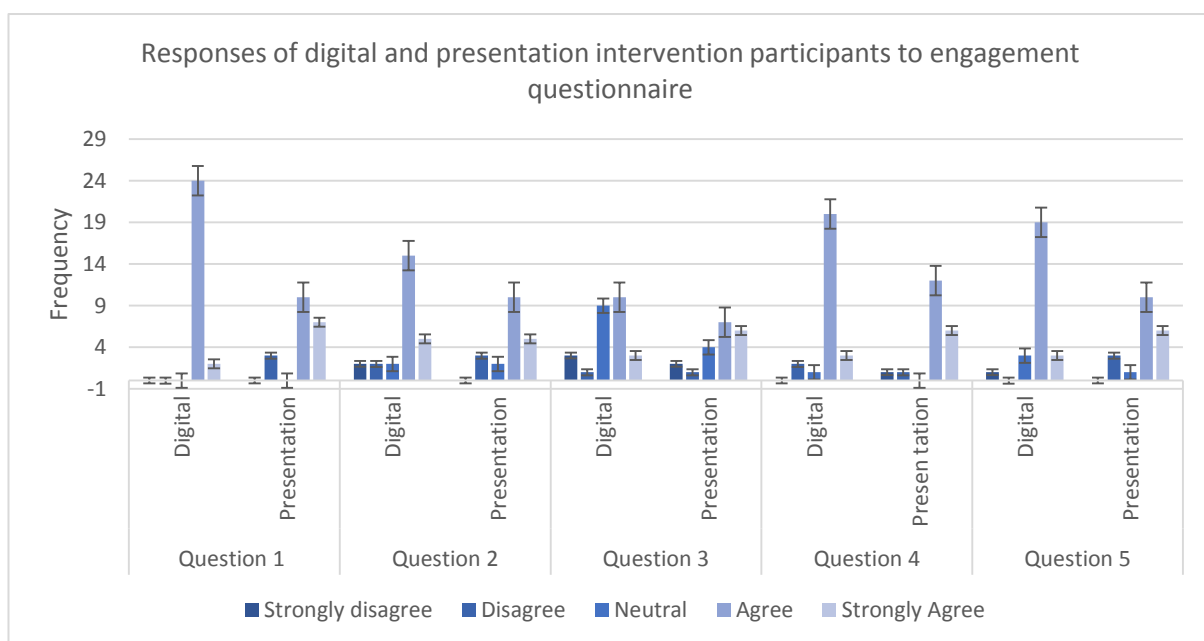


FIGURE 29 RESPONSES OF DIGITAL AND PRESENTATION INTERVENTION PARTICIPANTS TO ENGAGEMENT QUESTIONNAIRE

6.6.4 Written feedback

Participants were also encouraged to provide written feedback about what could be done to improve the resource they received, and to offer any other comments. The most common feedback theme from the digital resource group was a positive comment about the session (n=5), or interestingly, that the session could be more interactive or fun (n=5). The most common feedback item from the group receiving the PowerPoint presentation was that they would have liked more information to be provided to them (n=5), followed by a positive comment about the session (n=4).

6.7 Discussion

In this Section, the findings of the results presented in Section 6.6 are reviewed and evaluated, by reflecting in turn on each research question addressed by the trials.

6.7.1 Impact on attitudes of young people towards vaccination

There was no significant difference between the three groups immediately after intervention, or after six months. For this reason, the main conclusion of this research is that vaccination interventions *do not* have a significant effect on attitudes of young people towards vaccination. This conclusion is *entirely consistent* with the recent findings of Nyhan, *et al.*, which showed that vaccination interventions aimed at adults had limited effectiveness (Nyhan *et al.* 2014), and Dube, *et al.*, which showed that no available interventions could usefully address vaccine-hesitancy (Dube *et al.* 2015).

Pre-trial scores were generally positive (digital-based intervention group: 31.4; presentation-based intervention group: 32.5; Control group: 31.5), suggesting that this group was already well-disposed towards vaccination. This may account for the fact that there was no significant difference in attitudes after receiving the intervention. This is reflected in the findings from the interviews conducted early in this project, as discussed in Chapter 5. For example, one participant stated that they would want to get any vaccine available: “No, I would want to get them all [vaccines] to make sure I don’t catch the illnesses that are spreading” (Participant

3, female, 17). This implies an already generally positive attitude towards vaccination.

6.7.2 Impact on perceptions of information needs and personal choice

Participants were asked to answer how much they agreed or disagreed with two statements related to information needs (“I know all I need to know about vaccination and how it works” and “More information about vaccination should be given to me”), and with four statements related to personal choice (“Doctors, not parents or their children, should have the final say about if a child should be vaccinated”, “Children should have more say than their parents when it comes to vaccinations”, “Someone under 16 who is well informed should be able to choose to be (or not be) vaccinated without their parent’s consent” and “It is nobody’s business if I am vaccinated”). As described in Chapter 6, these questions were analysed separately from the attitudinal survey, in order to prevent introducing researcher bias (Hammersley & Gomm 1997).

6.7.2.1 Information needs

There was no significant difference between the three groups regarding the statement “More information about vaccinations should be given to me” initially after intervention, or after six months. This is consistent with the findings of the interviews conducted earlier in the research process. For example, one interviewee felt that they had not received enough information about vaccination, and that they would feel more confident about vaccination had they been provided with this information: *“Probably if there was more information surrounding it, like leading up the cervical cancer jabs that we had in year nine there wasn't much information, they basically just said 'You're getting injections so make sure to get in for it'”* (Participant 5, female, 19). This is also consistent with earlier studies, which suggest that teenagers would like access to more information about vaccination (Gowda *et al.* 2012).

There was a significant difference between the digital intervention group and the control group with regard to the statement “I know all I need to know about vaccination and how it works” after six months, with more participants from the digital intervention group disagreeing with the statement than participants from the control group. This suggests the level of confidence in knowledge of vaccination *decreased* after six months in participants receiving the digital resource, but this

was not the case in the presentation-based intervention group. It is important to consider why confidence in level of knowledge of vaccination was sustained in the presentation-based intervention group and not in the digital-based intervention group. It is possible that a greater level of confidence was instilled in presentation group participants by their being *given* information *directly* by the, as opposed to having to *obtain* information via independent learning (in the digital-based intervention group).

6.7.2.2 Personal choice

There was no statistically significant difference between the three groups initially after intervention or after six months with regard to the statements: “Children should have more say than their parents should when it comes to their own vaccinations”; “Someone under 16 who is well informed should be able to choose to be (or not be) vaccinated without their parent’s consent”; “Doctors, not parents or their children, should have the final say about if a child is vaccinated”; or “It is nobody else’s business if I am vaccinated”. This suggests that neither version of the intervention had an impact on participants’ views on personal choice in vaccination decisions.

6.7.3 Impact of digital resource on engagement levels

No statistically significant difference was observed between the digital resource group and the presentation-based intervention group in terms of engagement. This is an interesting finding, due to the ongoing debate on the value of digital resources in education, discussed in Chapter 2. Many researchers and practitioners argue that the use of digital resources leads to increased levels of engagement in students. For example, a study of students using a mathematics game to learn maths concepts found that participants found the game motivating and that the participants liked the game (Wijers *et al.* 2010), a study conducted in Scotland found that using games in the classroom increased learner motivation and engagement (Groff, 2010), and a study focusing on students’ subject interest found that it was enhanced by the use of computer simulation using worked examples (Yaman *et al.* 2008).

Therefore, it is significant that participants receiving the presentation-based intervention reported similar levels of engagement to those receiving the digital-based intervention. Both test groups were generally positive about the intervention

they received. It is possible that a greater difference in engagement might be found with different age groups. A study of first-year university students found that the students “conformed to fairly traditional pedagogies” and there was no evidence to support previous studies supporting a ‘radical change’ in educational approaches to support perceived changes in how students prefer to learn (Margaryan & Littlejohn 2008). However, the pilot trial participants were aged 13-14, and also showed little difference in engagement with the digital-based intervention compared with the presentation-based intervention participants. Therefore, it is possible that any differences in younger participants would not be observed.

The feedback received suggests that the *format* of the intervention was *not significant* to these participants. Written feedback was generally positive. Participants did not outwardly object to completing the questionnaires, and only three questions were unanswered out of all the questionnaires completed by the 63 participants. Participants seemed engaged and interested in the trial, the intervention and the overall project; several asked questions about the intervention topic as well as wider issues in healthcare and infectious disease epidemiology (for example, antibiotics and immunity).

Based on both the quantitative and qualitative feedback collected from participants from both the pilot trial and intervention trial, and personal reflections recorded during the trials, there is no difference in engagement attributable to the type of intervention received.

6.7.4 Personal reflections on trials

Overall, the trials (i.e. the methods used to test the research questions) were suitable. Most participants were engaged and interested in the project. Due to the modifications made in response to the pre-trials conducted, the full trials took the expected amount of time to complete, with sufficient time to address issues surrounding vaccination with the participants. In addition, there were minimal non-completions of the survey, suggesting that the data collection instrument was appropriate. The school involved with the trials was helpful and welcoming – the teachers involved were enthusiastic about the project and encouraged the students to be fully engaged in the process. This support allowed the trials to be conducted effectively.

CHAPTER 7: DISCUSSION, CONCLUSIONS, AND FUTURE WORK

In this final Chapter, the main findings of this research are discussed, by drawing on the findings discussed in the previous Chapters. The limitations of the work, its contributions to the research area, and recommendations for future work are also discussed.

7.1 Main findings

This research centres on the issue of suboptimal vaccination coverage in the United Kingdom. As discussed in Chapter 2, current vaccination coverage in the United Kingdom remains below the level recommended by the World Health Organisation (World Health Organisation 2012). In fact, in 2015, the uptake of the first dose of the Measles-Mumps-Rubella vaccine decreased for the first time in eight years (Health and Social Care Information Centre 2014). Historically, researchers have believed there to be a link between public perceptions of vaccines and vaccine uptake (BBC News 1998; McCartney 2013), and studies on adult perceptions of the MMR vaccine have shown that uncertainty of the safety of the vaccine was still prevalent ten years after the MMR vaccine was falsely linked to autism (Brown *et al.* 2012; Godlee Jane Marcovitch, Harvey 2011).

Several initiatives have attempted to improve public perceptions of vaccination. These have previously focused on adults (Cates *et al.* 2014; Shourie *et al.* 2013; Gowda *et al.* 2013; Porter-Jones *et al.* 2009), in particular, adults who will soon become parents or have recently become parents due to the timing of childhood vaccines - the majority of childhood vaccines are offered in the first year of a child's life (NHS 2014). These initiatives have included education about the benefits of vaccination, decision-aids and promotional items (Cates *et al.* 2014; Shourie *et al.* 2013; Gowda *et al.* 2013; Porter-Jones *et al.* 2009). However, a recent meta-analysis of previous vaccination interventions aimed at adults found limited success, and that they can, in some cases, actually *decrease* intent to

vaccinate (Nyhan *et al.* 2014). For this reason, and because of the gap in the literature covering young people, our project sought to assess the effectiveness of an educational vaccination intervention on attitudes in *teenagers* towards vaccination. This was deemed an appropriate age group to target, because it would reach a generally pre-parenthood group, members of whom have expressed interest in receiving more information about vaccination (Gowda *et al.* 2012).

When considering the format the intervention should take, the literature provided numerous examples of successful digital-based interventions for health (Arnab *et al.* 2013; Cheng *et al.* 2014; Cullen *et al.* 2005; Orji *et al.* 2013; Peng 2009; Shegog *et al.* 2007; Kato *et al.* 2008). "Games for Health" is a growing area of research (Baranowski *et al.* 2013). Notable examples include the 'Re-mission' game, a digital health intervention, which has been shown to improve adherence to medical treatments and knowledge and understanding of cancer in young adults and adolescents with cancer (Kato *et al.* 2008), and a game ("PR:EPARe") to be used in the classroom for Relationship and Sex Education (Arnab *et al.* 2013). For these reasons, a digital-based resource was developed (initially as an educational resource that could also be used in schools for education on vaccination as part of the GCSE and A Level Biology specifications) and tested for its effectiveness as an attitudinal intervention.

The initial phase of this research focused on gathering information about local teenagers' attitudes towards vaccination. There has been limited research in this area, as previous research on attitudes towards vaccination has focused on adults. Semi-structured interviews were conducted with fourteen teenagers from the local area. This provided a wealth of qualitative data that was analysed in-depth to provide general themes that were important in teenagers' attitudes towards vaccination. These themes were: effectiveness of vaccination, safety of vaccination, risk of infectious disease, trust of healthcare professionals, information needs and personal choice. The themes were used in the development of an attitudinal survey to assess participants' attitudes in trials. The interview participants were generally positive about vaccination, and the majority asserted that they would vaccinate any children they might have.

An attitudinal survey was used, as there was no suitable alternative available (surveys previously developed by other researchers focused on attitudes of adults/parents). Following the interviews, a series of statements were refined into an eight statement attitudinal survey. A focus group allowed the attitudinal survey to be tested for suitability for use with the target group.

Statements concerning future *intent* to vaccinate were not included. As discussed in Chapter 2, there is evidence to suggest that trying to predict behaviour using self-reported behavioural intent is unreliable, and follow-up after ten years to capture *actual* vaccination behaviour was beyond the scope of this project. For this reason, this research focused only on *current* attitudes towards vaccination, and the effect of the intervention on participants' attitudes.

The learning package described in Chapter 4, and the interventions described in Chapter 5, could be used as additional teaching tools for curricula covering the spread and control of certain infectious diseases. At each stage of the project, qualitative and quantitative data were collected, allowing refinement of the educational package. By the end of the development process, the feedback collected from teachers and students was generally positive, suggesting that the process was successful in developing an educational package that would be well accepted.

The major finding of this research is that the vaccination interventions tested did not have a significant effect on teenagers' attitudes towards vaccination. Trial participants generally had positive attitudes towards vaccination at the point of pre-trial data collection. When considered in the context of current research on vaccination interventions, this result is consistent with findings that vaccination interventions aimed at adults have limited effectiveness. It is possible then that similar findings might be found in other age groups.

However, despite this, it was found that the intervention improved self-perceived *level of knowledge* of vaccination. On reflection, despite striving to ensure that both groups received exactly the same information, it is possible that differences in responses between the two groups may be attributable to the differences in 'active' and 'passive' learning – the most 'active' phase of the trial for the presentation-based intervention group was the group discussion. This may have caused the presentation-based intervention group to be more focused on this

phase of the trial than the digital-based intervention group, and so this affected their responses.

In addition, the majority of the participants agreed with the statement “More information about vaccination should be given to me” both before and after exposure to the interventions. This reflects the findings of the interviews conducted earlier in the research process; several interviewees stated that they would like to receive more information on vaccination.

No statistically significant difference between the digital resource group and the presentation-based intervention group in terms of engagement was observed. This is important, as it may feed into the current debate about the value of digital resources in education. The feedback from both test groups suggested that the format of the intervention did not affect the level of engagement of these participants.

7.2: Limitations of the work

A limitation of this study was the sample size. The significance of the statistical analysis conducted may be limited by the small sample size used in the main trial (n=63), limiting statistical power. A post hoc power analysis, conducted using G-Power 3.1.9.2, showed that an n of 144 approximately would be needed to achieve statistical power at the recommended level of 0.80 (Cohen, 1988). For this reason, it is entirely possible that the study is underpowered and that a difference may have been observed between the trial groups had a larger sample size been used.

All of the participants included in the trial were GCSE Biology students from a school with a focus on science education, so this group might be better disposed towards vaccination than other less engaged groups, prior to intervention. This may also account for higher pre-trial attitudinal scores.

The pilot trial participants were from inner-city schools with a range of ethnic groups and religious backgrounds. Although full trials (including a control group) were not held with this group, the results from the pilot trials suggested that there was limited difference in post-trial scores between the two groups, reflecting the findings from the full trials. However, full trials conducted with a range of

demographics would provide a clearer picture of the impact of different demographics and less engaged groups.

Alternative data collection methods were considered (such as an online format of the intervention accompanied by an online version of the attitudinal survey) but were not included, due to the impossibility of controlling external factors that might compromise the validity of the data collected. In addition, while the ratio of male to female participants was well-balanced, several ethnic and religious groups were under-represented.

If possible, further trials could be conducted with a wider range of schools. This was difficult within the timeframe of the project, because although several other schools agreed to take part in the research, they withdrew nearer to the trial dates. The reasons given were varied; for example some were too busy with exam preparation to take part or had upcoming OFSTED visits. This was disappointing, but it highlights the difficulties that can occur when conducting trials in schools; due to the busy school year it can be difficult to successfully arrange dates for trials held within schools. However, due to the age of the target group including participants under the age of 18, obtaining participants through school 'gate-keepers' was the most suitable method of recruitment.

7.3 Contribution to research

This project contributes to the literature as follows: It provides an overview of local teenagers' attitudes towards vaccination. As previously stated, although previous research has focused on the attitudes of adults towards vaccination, there has been limited research on teenagers' attitudes towards vaccination. The interviews conducted provided an overview of themes important in participants' attitudes towards vaccination. They discussed issues that were important to them with regards to vaccination: some noted their potential barriers to vaccination (such as fear of needles and animal rights). The main themes generated from the interviews were (1) Risk of vaccination, (2) Trust of healthcare professionals, (3) Safety of vaccination, (4) Effectiveness of vaccination. Perceptions of personal choice in vaccination decisions and information needs were also important. These themes allowed the development of the survey used in trials to assess participants' attitudes towards vaccination and the development of the interventions.

This project also included the development and evaluation of an educational resource for the spread and control of infectious diseases. The educational resource developed was well accepted by the target group and trainee teachers, and using an iterative approach in its development allowed the educational resource to be closely aligned with the needs of the target group. It was important to develop a novel education resource, as previous research found that interventions currently available had limited effectiveness. There is potential for follow-up work to be done with the educational resource.

This research has demonstrated that the interventions tested had no significant effect on teenagers' attitudes towards vaccination. This reflects current research on the effect of vaccination interventions on adult attitudes towards vaccination (Nyhan *et al.* 2014). This finding feeds into to the wider area of research in 'Games for Health' and health interventions.

7.4: Recommendations for future work

In the light of both the findings and limitations of this research, a number of recommendations for future work are offered. Some questions have arisen from the completion of this research:

1. Would vaccination interventions have a more significant effect on participants with more negative initial attitudes towards vaccination?
2. What, if any, effects do ethnicity and religious background have on the effectiveness of educational vaccination interventions?
3. If teenagers' attitudes towards vaccination *are* generally positive, but vaccination uptake is lower than the recommended level set by the World Health Organisation, what other factors are negatively influencing attitudes towards vaccination between adolescence and parenthood?

In terms of this specific project, collecting data from a wider range of schools would address the need for greater representation of certain ethnic and religious backgrounds. This would allow comparison of not only the pre-trial attitudes of different groups in the United Kingdom, but also the effects of the intervention on different groups. A wider range of schools would also allow the effect of vaccination interventions on participants with more negative views on vaccination to be assessed.

Since the intervention had limited effect on attitudes of the age group included in trials, and, as described in earlier, previous interventions have had limited success in adults, it would be interesting to compare these results with the effects of the intervention on a slighter older cohort of participants. This might allow researchers to find the 'optimal point of intervention' with regards to vaccination attitudes. The intervention could be trialled with University age students, or young adults recruited from local groups prior to parenthood.

In terms of the wider area of research, this project has demonstrated the difficulties in changing attitudes when using short-timescale interventions. This might suggest that more in-depth interventions are needed to change complex attitudes such as attitudes towards vaccination. In addition, this research has shown the difficulty of controlling external influences on attitude in longitudinal studies.

7.4.1 Mixed methods research

In this project, several different methods of collecting qualitative data were utilised, including interviews, focus groups, read-aloud evaluations and written feedback. This provided a wealth of data from which to draw conclusions about teenagers' attitudes towards vaccination. As described in Chapter 5, researchers who primarily use quantitative data might be less comfortable with collecting and analysing qualitative data (Robson 2011), and some quantitative researchers may consider the use of qualitative data less valid (Taquette 2015). Despite this, while the quantitative data was certainly useful for providing a way to analyse changes in attitude (by giving participants' attitudes a numerical value), incorporating qualitative data was an important aspect of this project when seeking to *understand* teenagers' views surrounding vaccination and in the development of the intervention. Therefore, the use of *qualitative data collection* is *strongly recommended* to other researchers seeking to develop and evaluate attitudinal interventions for complex health issues such as vaccination, or in the development of public engagement materials and educational resources.

7.4.2 Iterative approach

Some groups are harder to reach than the target group of this research. It can be difficult to utilise an iterative approach if there are small numbers of available participants (and so it might not be feasible to obtain separate testing groups to

ensure trial groups have not been used previously in pre-testing activities). However, where possible, an *iterative approach is recommended* to other researchers seeking to develop either public engagement materials, educational resources or health interventions. This approach allowed the intervention (and its associated materials) to be developed in collaboration with the target group, and the feedback collected was increasingly positive throughout the process.

7.4.3 Working with schools

An awareness of the busiest times of the school year (including school holidays and exam dates) can help in planning the best time to advertise trial involvement opportunities, contact teachers and suggest dates for trials. This research showed that, while many schools were interested in taking part in research projects relevant to the curriculum, it can be difficult to retain schools from initial contact to conducting trials for several reasons. Working with schools was, overall, a valuable and satisfying experience, and is a useful way to both reach groups under the age of 18 and to support links between universities and local schools.

7.5 Conclusion

The aim of this research was to determine the impact of a digital intervention on teenagers' attitudes towards vaccination. An educational digital-based resource for infectious disease epidemiology was developed and evaluated. The resource was well accepted by both students and teachers. For example, 92% of teachers said they would use the resource in their lessons and 90% of students said they learnt something new from SimFection. The resource is freely available online and there will be opportunities for further evaluation of the resource. This resource formed the basis of the attitudinal intervention.

A range of qualitative methods were used in the development of an attitudinal survey. In-depth interviews were used to establish the range of attitudes towards vaccination in local teenagers (n=14). These provided six themes important in teenagers' attitudes towards vaccination, which were used in the development of an attitudinal survey to assess participants' attitudes in trials.

The intervention was trialled with GCSE Biology students (n=63) by comparing the digital-based intervention with a presentation-based intervention and a control group.

There was no statistically significant difference in change in attitudinal score between the three groups after intervention or after the six month follow up, and no difference in *engagement* between the two intervention groups.

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APPENDIX 1: DATA COLLECTION INSTRUMENT

Vaccination Questionnaire

Background information

1. Age
2. Gender (Please tick one)
Male Female Other Prefer not to say
3. Ethnicity (Please tick one)
 - White*
 1. Welsh/English/Scottish/Northern Irish/British
 2. Irish
 3. Gypsy or Irish Traveller
 4. Any other White background, please describe
 - Mixed/Multiple ethnic groups*
 5. White and Black Caribbean
 6. White and Black African
 7. White and Asian
 8. Any other Mixed/Multiple ethnic background, please describe
 - Asian/Asian British*
 9. Indian
 10. Pakistani
 11. Bangladeshi
 12. Chinese
 13. Any other Asian background, please describe
 - Black/African/Caribbean/Black British*
 14. African
 15. Caribbean
 16. Any other Black/African/Caribbean background, please describe
 - Other ethnic group*
 17. Arab
 18. Any other ethnic group, please describe
4. Religious Background (Please tick one)
 - a. Christian (including Church of England, Catholic, Protestant and all other Christian denominations)
 - b. Buddhist
 - c. Hindu
 - d. Jewish
 - e. Muslim
 - f. Sikh
 - g. No religion
 - h. Prefer not to say

Knowledge of vaccination

Can you describe what is injected into you when you are vaccinated?
Can you explain why a person won't get ill if they have been vaccinated?
What do you think is a benefit of vaccinating a large percentage of people?
Can you think of any medical reasons a person would not be able to be vaccinated?
Can you explain why 'booster' vaccinations are sometimes needed?
Why can't a vaccine be made against some types of viruses like flu?
Can you think of any potential risks of vaccination?

Attitude towards vaccination

Please tick one response per row

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
Vaccination can have serious side effects like causing disabilities in otherwise healthy people					
The government would not let people get vaccinated if it was not safe					
I would trust my doctor's advice on vaccination					
Vaccines contain unsafe ingredients					
Diseases like measles are dangerous					
It is important to get vaccinated to prevent the spread of infectious diseases through my community					
Someone who isn't vaccinated is likely to catch the infectious disease					
People that don't vaccinate themselves or their children put others at risk					
More information about vaccinations should be given to me					
I know all I need to know about vaccination and how it works					
Children should have more say than their parents should when it comes to their own vaccinations					
Someone under 16 who is well informed should be able to choose to be (or not be) vaccinated without their parent's consent					
Doctors, not parents or their children, should have the final say about if a child is vaccinated					
It is nobody else's business if I am vaccinated					

APPENDIX 2:

MONSTERS, MICROBIOLOGY AND MATHEMATICS: THE EPIDEMIOLOGY OF A ZOMBIE APOCALYPSE

Verran, J., Crossley, M., Carolan, K., Jacobs, N. & Amos, M. (2013) Monsters, microbiology and mathematics: the epidemiology of a zombie apocalypse. *Journal of Biological Education* **48**:2, 98-104. doi: 10.1080/00219266.2013.849283

APPENDIX 3: FEEDBACK FORM FOR STUDENTS

Evaluation questionnaire

Thank you for attending the vaccination session. Please provide feedback using the form below by ticking 'strongly disagree', 'disagree', 'neither agree nor disagree', 'agree' or 'strongly agree' for how you found each aspect of the workshop.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I found the session informative					
The session was interesting					
I thought that the session was fun					
I learnt something new from this session					
The session was a good way for me to learn about infectious diseases					
I found the resource easy to use					
The resource is well designed					

How would you improve the session?

Additional comments:

APPENDIX 4: FEEDBACK FORM FOR TEACHERS

SimFection Learning Resource: Evaluation Questions

What is your teaching specialism? _____

Which disease are you looking at? _____

	Comments
Would you prefer the resources to be provided electronically or printed?	
How would you like it delivered? E.g. memory stick, web-key...?	
How appropriate is the language used?	
How user friendly do you find the software?	
How suitable is the content?	
What is your opinion on the way the software looks?	
Were the instructions for the SimFection software clear?	

What do you think about the design of the provided documents?	
Do you consider the quiz to be valuable or useful part of the resource?	
Would you rather receive a. the full teachers guide, lesson plans and PowerPoints and instruction booklet, or b. the information sheet and activity sheet only? Why?	
Does the whole resource appeal to you as a teacher? Are there any elements of the resource you would not use?	
What do you think the software should look like? E.g. colours, images.	
If you were going to use this resource, what would your lesson be about?	

Is there anything else you think could improve the resource?	
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APPENDIX 5: INTERVIEW SCHEDULE

Introduction

Hello, thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you would prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than half an hour and will be tape recorded with your permission.

Background questions

First I would like to start with some background questions about you.

1. How old are you?
2. How would you describe your ethnicity?
3. What is your religious background?
4. Are you a student?
If yes: What are you currently studying?
If no: Are you currently in employment?

Main body of interview

1. Do you know what vaccination is? (Immunisation; Jabs)
If yes: Please can you describe how vaccination works?
Where does your knowledge of vaccination come from? Did you learn about it in school?
If no: Define vaccination to interviewee (“is when a weakened virus or bacterium, a part of a virus or bacterium, or a weakened product of a bacterium is deliberately administered to you (normally by injection) so that your immune system can prepare to fight a future infection”)
2. Can I ask if you remember ever being vaccinated? Or know that you have been? (When you were a child or a teenager?)
If yes: How old were you?
What happened?
Do you remember anyone discussing vaccination with you? Who?
If no: Do you know why not?
3. Do you think vaccinations are safe? (Very safe? Not very safe?)
4. What do you think the risks of vaccination are?
Why do you think that?
5. Do you worry about the spread of infectious diseases? (Such as measles, mumps, and influenza?)
Why/Why not?

6. Why do you think some people are against vaccination? (Some people are worried about the risks of vaccination or think that vaccines are not necessary)
7. What are your opinions on the reasons that people have for not vaccinating?
8. Do you think parents should have the right to choose not to vaccinate their children?
9. If you needed to make a decision about whether to personally vaccinate or not, where would you look for information? (For example, family, friends, internet, and news reports?)
10. How would you know if an information source is reliable?
11. Do you ever discuss health issues such as vaccination?
Who with?
12. Would your family's opinions on vaccination influence your attitude towards vaccination?
(For example, if your parents were for or against vaccination would that make you more or less likely to vaccinate?)
Why/why not?
13. Would your friends' opinions on vaccination influence your attitude towards vaccination?
(For example, if your friends were for or against vaccination would that make you more or less likely to vaccinate?)
Why/why not?
14. Would your doctor's opinions on vaccination influence your attitude towards vaccination?
(For example, if your doctor was for or against vaccination would that make you more or less likely to vaccinate?)
Why/why not?
15. If religious, do your religious views influence your views on vaccination?
Why/why not?
16. What do you think influences your views on vaccination the most? (For example media reports)
17. Do you have any ethical concerns about vaccination? (For example testing on animals, adults making decisions on behalf of their children?)
Do these issues impact your views on vaccination?
18. Do you have any concerns about sterility or cleanliness of vaccination?
19. Is there anything else that worries you about vaccination? (For example pain? Fear of needles? Ingredients of the vaccine?)
20. Do you think there are any specific vaccines that you would not accept?
(For example polio? Tetanus? Measles?)
Why?
21. What do you think would make you feel more confident about vaccination?
(For example, more information about its safety?)
22. If you decide to have children in the future, do you think you will vaccinate them?
What factors would influence your decision?

APPENDIX 6: INTERVIEW TRANSCRIPTS

Interview 1 Transcript

Interviewer: Hello, thank you for agreeing to be interviewed. Today I would like to ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than half an hour and will be tape recorded with your permission. First I would like to start with some background questions about you. How old are you?

Participant: 14

Interviewer: How would you describe your ethnicity?

Participant: ...

Interviewer: Like White British?

Participant: Yeah, White British

Interviewer: What is your religious background?

Participant: Erm, I don't have one

Interviewer: That's fine. Are you a student?

Participant: Yes

Interviewer: If yes, what are you currently studying?

Participant: I am at [local college] and I want to do performing arts

Interviewer: Okay, have you not started your GCSEs yet?

Participant: Just chosen them

Interviewer: Yeah, so do you know what vaccination is?

Participant: I have got an idea of it.

Interviewer: Do you want to try to describe how you think it works?

Participant: I don't know how to explain it but, like, I sort of know how it in a content but, like, I don't really know what it means. (I: Yeah) But I could sort of understand it. Err, I don't really know. I actually don't know how to explain it.

Interviewer: Okay, well it is when a weakened virus or bacterium or part of a virus or bacterium or a weakened product of a bacterium or virus is deliberately administered to you normally by injection so that your immune system can prepare to fight a future infection.

Participant: Oh right okay

Interviewer: So they give you a tiny part of it and that produces an immune response. Then if you ever encounter it again, your body will be able to fight it off. So can I ask if you ever remember being vaccinated? Or know that you have been?

Participant: Yes I have, I had it quite a few weeks ago.

Interviewer: Oh right okay, what was that for?

Participant: Err... I think was for cancer? Or just for going on holiday or something.

Interviewer: So how old were you?

Participant: I was 13

Interviewer: 13. So what happened?

Participant: They gave me two injections. One in each arm and they made me sign a piece of paper making sure it was alright. And that was it really.

Interviewer: Do you remember anyone discussing vaccination with you?

Participant: Yeah, but that was like five years beforehand (Laughs)

Interviewer: And who was that?

Participant: It was with my form tutor

Interviewer: Oh right, okay, so it was in school?

Participant: Yeah

Interviewer: Ok, do you think that vaccinations are safe?

Participant: Yeah

Interviewer: Very safe, or?

Participant: 50/50

Interviewer: So what do you think the risks of vaccination are?

Participant: Either that the injection could go wrong, or your body could maybe make like, could get immune or resistant, like the bacteria or virus could overtake that.

Interviewer: Okay, so it wouldn't work?

Participant: Yeah, or they could do the wrong, like chemicals that they put inside you.

Interviewer: Oh right. Okay. Erm, so what makes you think - Where does that idea come from?

Participant: Err, because many people make little mistakes like that

Interviewer: So human error?

Participant: Basically.

Interviewer: Err, do you worry about the spread of infectious diseases? Like mumps, or measles, or influenza?

Participant: My mum kind of more (laughs) than I do, but she makes me cautious so it makes me watch out

Interviewer: Why do you not worry about it so much?

Participant: Because... I don't know...because like things happen for a reason. Because I don't think it's that visible, like diseases and viruses, I just feel like I shouldn't really be worried but I am always thinking about what I should do just in case.

Interviewer: Yeah, okay. So why do you think some people are against vaccination?

Participant: Just because either they are really scared of measles, or... I don't know. [Inaudible] I don't know for that question actually.

Interviewer: Do you think parents should have the right to choose not to vaccinate their own children?

Participant: No, I don't think they should have a choice really.

Interviewer: So do you think it should be up to the doctor?

Participant: Yeah or the child.

Interviewer: If you needed to make a decision about whether to personally vaccinate or not, where would you look for information?

Participant: Online really.

Interviewer: Online. Yeah, so how would you know if an information source was reliable?

Participant: ... If you read it, or somebody tells you about it.

Interviewer: Erm, do you ever discuss health issues such as vaccination?

Participant: With who? Just anybody (I nods) Yeah, sometimes. Like yeah, if something might have happened with [name], like if somebody is ill, then we would discuss, or my parents would discuss and I will just listen, but at school sometimes it's a part of the lesson or whatever. But yeah.

Interviewer: So with your family and sometimes at school. So would your family's opinions on vaccination influence your attitudes towards vaccination?

Participant: No, because I feel like, if I wanted it, I would get it because I feel like it's my life choice. Because when I'm older, I don't want that disease when I'm older.

Interviewer: Okay, so why do you think that they wouldn't?

Participant: Err, maybe because they are just worried about me or maybe because they just [inaudible]

Interviewer: Erm, so would your friends' opinions influence your attitude towards vaccination?

Participant: No, most of my friends are scared of needles (laughs) so no I wouldn't mind. It's my opinion so...

Interviewer: And would your doctor's opinion on vaccination influence your attitude towards vaccination?

Participant: Well, it depends on that because they are the experts so maybe but they could trick me not to because they use the big words.

Interviewer: So that would kind of put you off a bit?

Participant: yeah

Interviewer: So what do you think influences your views on vaccination the most?

Participant: Err, the amount of people that have viruses in them instantaneously nowadays and you have to ask like how or why and have you had vaccinations when you were a kid. Most of them say no because they just don't remember so like it makes me feel like I don't want to be like that.

Interviewer: So, people that you know influences you more than media, like newspapers and things like that?

Participant: Yeah (laughs) I think you can never really believe the media.

Interviewer: So you think you can never really believe the media?

Participant: Yeah

Interviewer: Do you have any ethical concerns about vaccination? For example, testing on animals, adults making decisions on behalf of their children or production of vaccines?

Participant: Err... sorry what was the question again?

Interviewer: Do you have any ethical concerns or worries about vaccination? Like testing on animals or...?

Participant: Err, yes and no, but yeah if something has to be done, it has to be done. If somebody or an animal is willing to do that and it sort of needs to be done. [Inaudible]

Interviewer: Okay so do you think that these kinds of issues impact your views on vaccination?

Participant: It makes me more, like, happy to do it because I know that somebody has like - it's been tested - so I know it's not bad or anything, so I feel more confident.

Interviewer: Do you have any concerns about sterility or cleanliness of vaccination?

Participant: Yeah because you don't know who else has been given the needle and you just want to make sure that whoever you are getting the vaccination off - you just want to make sure that they are professional and the right person to do it.

Interviewer: Yeah, is there anything else that worries you about vaccination?

Participant: Err....

Interviewer: Like pain or fear of needles or ingredients in the vaccine?

Participant: Oh, no, I just don't think about it, it's just a sharp pain and then it's gone then.

Interviewer: Yeah, great. Erm, is there anything that you think would make you feel more confident about vaccination?

Participant: Err, if - I feel like I'm quite confident enough to just get it anyway. I don't feel like I need anything else to make me confident because I'm confident enough to get it so I wouldn't be like scared or anything. So I don't know. It would make me more confident if the people - if I'd seen people that had had it - who've actually had the vaccination, not get that flu, but they could have had that chance but their body was immune to it.

Interviewer: Oh right okay. Erm, if you decide to have children in the future, do you think you would vaccinate them?

Participant: Yeah.

Interviewer: So what would influence your decision?

Participant: Because I know how I am feeling now, and my kids will feel the same, I hope - so I would get it for them because I wouldn't want to make my children ill. Like putting them in pain or ill.

Interviewer: Okay great, so that was the last question! Thank you for agreeing to be interviewed.

Interview 2 Transcript

Interviewer: Hello, thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than half an hour and will be tape recorded with your permission. First I would like to ask you some background questions about you. So how old are you?

Participant: 17.

Interviewer: How would you describe your ethnicity?

Participant: White English

Interviewer: What is your religious background?

Participant: Don't really believe in anything.

Interviewer: So Non-religious?

Participant: Yeah.

Interviewer: So are you a student?

Participant: Yeah, at sixth form

Interviewer: So what are you currently studying?

Participant: BTEC sport

Interviewer: Great, so do you know what vaccination is?

Participant: Erm, I think it's something to do with giving injections to help prevent diseases and stuff like that.

Interviewer: Yeah, so it is when a weakened virus or bacterium, a part of a virus or bacterium or a weakened product of a virus or bacterium is deliberately delivered to you, normally by injection, so that your immune system can prepare to fight a future infection.

Can I ask if you remember ever being vaccinated? Or know that you have been?

Participant: Yes. I think they did it in year 11.

Interviewer: In year 11.

Participant: They had the boosters.

Interviewer: The boosters for..?

Participant: For erm...what are they called now? I know they give you them when you are younger and then they give you the boosters so that you don't get them again.

Interviewer: Was it a MMR one?

Participant: Ahh, I can't remember what they were called, it was last year but every year 11 had to do it, and the girls had to do ones at different times.

Interviewer: Yeah, so how old were you?

Participant: Last year I was 16.

Interviewer: 16. So what happened?

Participant: We all got took out of the lesson and we had to go to the nurses and then basically just got all the injections in our arm.

Interviewer: Do you remember anyone discussing vaccination with you?

Participant: Erm, other than the science teacher, I don't. [Inaudible]

Interviewer: So was that for your GCSEs?

Participant: Yeah that's how I remember it because it was in the test.

Interviewer: Ok... so did nobody discuss with you that you were going to be vaccinated? Or what you were being vaccinated against?

Participant: Yeah maybe just the teachers but not much.

Interviewer: Do you think that vaccinations are safe?

Participant: Yeah

Interviewer: What do you think the risks of vaccination are?

Participant: erm, don't really think there is any because [inaudible] so I'm not too sure

Interviewer: So why do you think that?

Participant: Because they are there to like help so you don't get anything in the future, because you are already immune to it, so they are just trying to help you.

Interviewer: Do you worry about the spread of infectious diseases?

Participant: Yeah I do - sometimes I do, because it's always hard to prevent them yourself other than doing stuff like being clean and stuff like that. Other than that they are always going to be there so... I wouldn't risk getting them.

Interviewer: Okay, why do you think that some people are against vaccination?

Participant: Erm, maybe they don't like being injected? Other than that I'm not really sure.

Interviewer: Some people are worried about the risk of vaccination or think that vaccines are not necessary. What do you think about that?

Participant: I don't really understand what the risks are, but I don't really know that they aren't necessary because they are put there to prevent yourself from getting ill in the future.

Interviewer: Yeah, what are your opinions on the reasons that people have for not vaccinating?

Participant: I'm not too sure what you mean?

Interviewer: So like I said some people think they are not necessary.

Participant: What was the question again?

Interviewer: What are your opinions on these reasons?

Participant: I think they are not very good to be honest (laughs).

Interviewer: Do you think that parents should have the right to choose not to vaccinate their children?

Participant: Well... yeah because it's actually their children but at the end of the day I think that it should be a think that like everyone has to do. Like I said, it's just

there to try to prevent stuff for the future, I don't understand why you wouldn't want to do it.

Interviewer: If you needed to make a decision about if you would personally vaccinate or not, where would you look for information?

Participant: Do you mean about like what to do?

Interviewer: Yeah so, like with the ones in year 11, so would you ask your family, friends or look on the internet or at news reports?

Participant: Probably at like - we have a school nurse at school so I'd probably ask them.

Interviewer: Oh right

Participant: People that might want to [inaudible]

Interviewer: How do you know if an information source is reliable?

Participant: Erm, I remember doing this at sixth form. Do you mean on the internet and stuff like that?

Interviewer: Yeah

Participant: Like it's to do with how the website looks and what references are on there and who the people are that actually wrote it. Like what their background is, what university they are from and if they have PhDs.

Interviewer: Erm. Do you ever discuss health issues such as vaccination?

P; Erm, honestly, I've not since last year. Personally, no.

Interviewer: Who did you discuss them with?

Participant: It would have been teachers and stuff like that.

Interviewer: Would your family's opinion on vaccinate influence your attitudes towards vaccination?

Participant: Erm... probably not, no because I can have my own opinion on stuff and I think that vaccination should be done and it's just going to help me in the future isn't it.

Interviewer: Would your friend's opinions on vaccination influence you?

Participant: (laughs) no. Probably not, either. I got my own mind so... I can make my own decisions.

Interviewer: Good, so would your doctor's opinion on vaccination influence your attitude?

Participant: Yeah, because they are a professional. I know that they know, I'm sure they'd try to influence me to get vaccinations properly.

Interviewer: What do you think influences your views on vaccination the most?

Participant: Erm... probably like seeing stuff on the TV and news about stuff abroad like people getting ill and getting told that if they'd had these vaccinations then it could have saved hundreds of lives.

Interviewer: Do you have any ethical concerns about vaccination?

Participant: Personally, no I don't.

Interviewer: So testing on animals and stuff like that?

Participant: How do you mean?

Interviewer: So when they are making vaccines they go through clinical trials

Participant: oh! And they trial them out on animals and stuff first?

Interviewer: yeah and then they do human trials and then they roll them out to the rest of the country. So would something like that impact your views on vaccination?

Participant: Yeah because obviously I don't want that stuff being done to animals but again, kind of okay because they've still got to test to make sure they are okay for humans. Do you know what I mean? So like I don't like the thought of it...

Interviewer: So you don't like the thought of it, but it wouldn't prevent you vaccinating?

Participant: Yeah

Interviewer: Do you have any concerns about the sterility or cleanliness of vaccination?

Participant: No, not really. I kind of think - I trust the people that are doing it, the nurses or doctors, I would hope - I trust that everything's clean.

Interviewer: That's great so, is there anything else that worries you about vaccination? For example, pain, fear of needles or ingredients in vaccines?

Participant: I was for my first one but after that I thought 'okay I can handle that' so not really no.

Interviewer: Do you think there are any specific vaccines you would not accept?

Participant: Err, can you give me an example?

Interviewer: Yeah, for example polio, tetanus, measles...?

Participant: That's the one I had last year! (Laughs) No, I don't think so. I think I'd just have anything if it had been recommended it by people that I know they know what they are talking about, I think that I'd definitely get it done. So yeah, personally yeah [inaudible]

Interviewer: What do you think would make you feel more confident about vaccination?

Participant: Erm... Maybe giving it like giving it you by yourself. I know when I did it, they had like 50 kids - students- in the hall [inaudible] that's the only thing that made me less confident about it. But other than that no, nothing really.

Interviewer: Okay, if you decide to have children in the future, do you think you will vaccinate them?

Participant: Yeah - definitely, yeah.

Interviewer: What factors influence that decision?

Participant: Just because it's a peace of mind that I can think 'oh well they aren't going to get this' so I know there's less chance of them getting something...?

Interviewer: No, that's great!

Interview 3

Interviewer: Hello, thank you for agreeing to be interviewed. Today I'll ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than half an hour and will be tape recorded with your permission. So first, I'd like to just start with some background questions about you. How old are you?

Participant: 17

Interviewer: How would you describe your ethnicity?

Participant: White British

Interviewer: What is your religious background?

Participant: I don't really have one.

Interviewer: Ok, are you a student?

Participant: Yes

Interviewer: So what are you currently studying?

Participant: I'm studying hairdressing

Interviewer: Do you know what vaccination is?

Participant: Like a needle or something?

Interviewer: It's when you have a weakened virus or bacteria, part of a virus or bacteria, or a weakened product which is deliberately administered to you by injection so that your immune system can produce an immune response to prepare to fight a future infection. So can I ask if you remember ever being vaccinated or know that you have been?

Participant: Can't remember, when I was a baby or something.

Interviewer: When you were a baby. Do you ever remember anyone discussing vaccination with you?

Participant: My doctor.

Interviewer: Do you think that vaccination is safe?

Participant: Erm, yeah, I don't really have a problem with it.

Interviewer: What do you think the risks of vaccination are?

Participant: Erm, I'm not sure, I don't really think there is risk

Interviewer: Okay, do you worry about the spread of infectious diseases? Like measles, mumps or flu?

Participant: Erm not all the time, but sometimes.

Interviewer: When would you be worried about it?

Participant: When I'm ill and I think it's going to carry on to get worse or something.

Interviewer: Why do you think some people are against vaccination?

Participant: Erm, I'm not sure, maybe because they don't believe it will help them get better.

Interviewer: so do you think they think it doesn't work or isn't necessary?

Participant: Or they just think it's there just to have it.

Interviewer: What are your opinions on these reasons?

Participant: I don't really have an opinion for it

Interviewer: Do you think parents should have the right to choose not to vaccinate their children?

Participant: No.

Interviewer: So do you think all children should be vaccinated?

Participant: Yeah. Because in case they get really ill and they've not had that injection to help them fight.

Interviewer: If you needed to make a decision about whether to personally vaccinate yourself, where would you look for information on vaccination?

Participant: I'd go to my local GP about it or information on the internet.

Interviewer: And how would you know if a source of information was reliable?

Participant: I'd probably go onto the NHS website to make sure it's definitely real.

Interviewer: That's great. Do you ever discuss health issues such as vaccination?

Participant: No, not really.

Interviewer: Would your family's views on vaccination influence your attitudes towards vaccination. So if your parents were for or against it, would that make you more or less likely to vaccinate?

Participant: No

Interviewer: No. Why not?

Participant: I don't know really (laughs)

Interviewer: What about your friends?

Participant: It's their choice if they want to get it done or not

Interviewer: So if they didn't want to vaccinate would that stop you from vaccinating? Or...?

Participant: No. If I wanted to do it, then I would do it.

Interviewer: What about your doctor's opinions on vaccination?

Participant: I don't know because they are like your doctor and they know what's best and not best for you so... I'd probably have to think about it. So is it really what I want to do, if I get it from my doctor.

Interviewer: What do you think influences your views on vaccination the most? So like media like newspapers or family?

Participant: Probably like newspapers.

Interviewer: Do you have any ethical concerns about vaccination? Like it being tested on animals?

Participant: Yeah, it's cruel I think, making them ill and they could die.

Interviewer: So would that impact on your views on vaccination?

Participant: No.

Interviewer: So you'd still get vaccinated? But it bothers you?

Participant: Yeah it bothers me that it's on animals that don't know what's going on.

Interviewer: Do you have any concerns about the sterility or cleanliness of vaccination?

Participant: Erm, no, not really.

Interviewer: Is there anything else that worries you about vaccination?

Participant: No.

Interviewer: Like pain or fear of needles? Or ingredients in vaccines?

Participant: Oh, well I have a fear of needles, but I know that if I need to get it done, then I will just get over my fear, or I'd ask them to freeze my arm or something (laughs)

Interviewer: Are there any specific vaccines you would not accept?

Participant: No, I would want to get them all to make sure I don't catch the illnesses that are spreading.

Interviewer: What do you think would make you feel more confident about vaccination?

Participant: I don't know really, I don't really have a problem with it.

Interviewer: And if you decide to have children in the future, do you think you will vaccinate them?

Participant: Yeah

Interviewer: What factors would influence your decision?

Participant: The fact that I know that once they've had it, they won't be able to get ill as easily and be able to fight it off with the vaccination.

Interviewer: That's great! Thanks very much.

Interview 4 Transcript

Interviewer: Hello, thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than half an hour and will be tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: 19

Interviewer: How would you describe your ethnicity?

Participant: White British

Interviewer: What is your religious background?

Participant: Roman Catholic

Interviewer: Are you a student?

Participant: Yes

Interviewer: What are you currently studying?

Participant: Psychology

Interviewer: Do you know what vaccination is?

Participant: Yes, it's like where they give you an injection of an illness to make you immune to it.

Interviewer: So where does your knowledge of vaccination come from?

Participant: School.

Interviewer: Can you remember which subjects you learnt about it in school?

Participant: Biology probably, yeah.

Interviewer: Can I ask if you remember ever being vaccinated or know that you have been?

Participant: No. I don't think I have ever been vaccinated. [Inaudible 0:01:04.4]

Interviewer: Do you know why you were not vaccinated?

Participant: No... I don't know why.

Interviewer: Do you think vaccinations are safe? P: I: How safe do you think vaccinations are?

Participant: I think they are safe for some people, but what if you were really weak and then you got vaccinated and it kills you?

Interviewer: What do you think the risks of vaccination are?

Participant: Your body not being able to fight it off, the vaccination, and becoming really ill.

Interviewer: Ok, so why do you think that?

Participant: Just common sense.

Interviewer: Do you worry about the spread of infectious diseases such as measles, mumps or influenza?

Participant: Not really, no.

Interviewer: Why not?

Participant: Just doesn't really affect me... in my everyday life. I don't see it as much of a risk.

Interviewer: Why do you think that some people are against vaccination?

Participant: Not sure. Maybe because...it's dangerous?

Interviewer: What are your opinions on the reasons that people have for not vaccinating?

Participant: I think that some people are scared of vaccination because they may think it may make them ill for a period of time and they might have time off work, they don't really want to be ill. They just think it's a threat that doesn't really affect me, just not going to get a vaccination because they are scared of the effects it will have.

Interviewer: Do you think that parents should have the right to choose to not vaccinate their children?

Participant: No I don't because I think that in the long run they could cost the healthcare system a lot more money if more children are getting ill. Although I do think "Who is anyone to inject anybody?"

Interviewer: If you needed to make a decision about whether to personally vaccinate or not, where would you look for information? For example family, friends, internet or news reports?

Participant: I think I'd probably look on the internet. I don't think there's much information provided to me about vaccinations.

Interviewer: Okay, how do you know if an information source was reliable?

Participant: Probably if it was on, like, the NHS website or something like that.

Interviewer: Do you ever discuss health issues such as vaccination?

Participant: No.

Interviewer: Would your family's opinions on vaccination influence your attitude towards vaccination? For example if your parents for or against vaccination would this make you more or less likely to vaccinate?

Participant: Erm, I think it depends on your relationship with your family and if you think that information is correct and if you value their opinion on stuff because if someone said they were against it, I would take that on-board but I would look at other resources to make an informed decision for myself.

Interviewer: So do you personally..?

Participant: I think it would make me question myself, but I definitely wouldn't take that as an all-end, like "I'm not going to do it" or "I will do it"

Interviewer: Would your friends' opinions on vaccination influence your attitude towards vaccination?

Participant: No, not really.

Interviewer: Why not?

Participant: Because I don't really value my friends' opinions that much. Especially about vaccinations.

Interviewer: Ok, would your doctor's opinions on vaccination influence your attitude towards vaccination?

Participant: Yeah, definitely.

Interviewer: Why?

Participant: Because they are healthcare professionals so I feel like their information's more reliable than one of my friends who doesn't really know much about vaccination.

Interviewer: Okay. Do your religious views influence your views on vaccination?

Participant: No.

Interviewer: Why not?

Participant: Because my religion doesn't say anything about vaccinations.

Interviewer: Ok. What do you think influences your views on vaccinations the most? For example media reports.

Participant: Yeah media reports to an extent but I do think there is a lot of media frenzy about stuff so I wouldn't take too much on board because a lot of the time the media just say something bad. Like, wasn't the one where with the children - they said something causes them Down's syndrome and nobody wanted to get it anymore? So I would probably look at something more informed.

Interviewer: Do you have any ethical concerns about vaccination? Such as testing on animals, adults making decisions on behalf of their children?

Participant: No, not really.

Interviewer: So these issues don't impact your views on vaccination?

Participant: Not really. Well - ok - I don't know. It depends. I don't know.

Interviewer: Do you have any concerns about sterility or cleanliness of vaccination?

Participant: Not really, no. Well I would like my needle - if someone injected me, I'd like it to be clean but, I'd assume it is.

Interviewer: Ok, is there anything else that worries you about vaccination? For example pain, fear of needles or ingredients in the vaccine?

Participant: Yeah. I genuinely think this is why I haven't been vaccinated. I think something bad is really going to happen to me because I never get needles for anything. I didn't even get the cervical cancer jab that everyone else got. I'm scared.

Interviewer: Are there any specific vaccines that you would not ever accept? For example polio, tetanus or measles?

Participant: I'd have to make an informed decision and research this further but right now I can't comment.

Interviewer: What do you think would make you feel more confident about vaccination? For example, more information.

Participant: I think that yeah, but I don't like needles so I still wouldn't do it but... yeah probably more information would make me more confident.

Interviewer: If you decide to have children in the future, do you think you will vaccinate them?

Participant: Yeah, I will but I don't think I will want to go with them because I don't like needles.

Interviewer: Ok, so what factors would influence your decision?

Participant: I don't know, I'd have to look into it and see what the doctor said to do.

Interviewer: Okay, thanks.

Interview 5 Transcript

Interviewer: Hello, Thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than half an hour and will be tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: 19

Interviewer: How would you describe your ethnicity?

Participant: White British

Interviewer: What is your religious background?

Participant: Don't have one.

Interviewer: Are you a student?

Participant: Yes

Interviewer: What are you currently studying?

Participant: Sociology and Criminology

Interviewer: Do you know what vaccination is?

Participant: Yes

Interviewer: Could you please describe how vaccination works?

Participant: They give you a bit of the disease to make you immune to it.

Interviewer: So where does your knowledge of vaccination come from?

Participant: School and family.

Interviewer: Can I ask if you ever remember being vaccinated?

Participant: Yes I do remember being vaccinated! {Laughs}

Interviewer: How old were you?

Participant: Erm...There was some when I was really young that I don't really remember, and then you get the cervical cancer jab at school and that was in year nine.

Interviewer: Yes, so what happened?

Participant: They injected me.

Interviewer: So did they pull you out of class...?

Participant: Yeah it was like an organised event, so instead of having an assembly, they made all the people in year nine go to the hall.

Interviewer: Do you remember anyone discussing vaccination with you?

Participant: Erm... Not like professionally - just like a family member.

Interviewer: Do you think - How safe do you think vaccinations are?

Participant: I think they are relatively safe. Erm, I mean I never really had a choice in whether I got vaccinated or not, my family just assumed that I would so.

Interviewer: What do you think the risks of vaccination are?

Participant: Erm, don't know, maybe.... I don't know.

Interviewer: Okay, do you worry about the spread of infectious diseases, like mumps, measles or influenza?

Participant: No.

Interviewer: Why not?

Participant: Because I've never met anybody that's had any of them.

Interviewer: What do - Why do you think some people are against vaccination?

Participant: Because they don't see the point injecting somebody if they don't have it. No point in preventing something that's not even happened or is unlikely to happen.

Interviewer: Yeah, what are your opinions on the reasons that people have for not vaccinating?

Participant: I think it's just personal opinion if people get it or they don't.

Interviewer: Do you think parents should have the right to choose to not vaccinate their children?

Participant: Yeah.

Interviewer: Ok, why do you think that?

Participant: Because... I wasn't particularly educated on vaccination so I feel like my parent's particularly know more about vaccinations than I do so if they suggested not to get it, for any reason. I probably wouldn't.

Interviewer: If you needed to personally make a decision about vaccination, where would you look for information? For example, family, friends, internet or news reports?

Participant: Probably a mixture, depending on what was going on.

Interviewer: How would you know if an information source was reliable?

Participant: I'd probably just look at multiple sources and compare and see if there were any consistent results.

Interviewer: Do you ever discuss health issues such as vaccination?

Participant: Yeah

Interviewer: Yeah, who with?

Participant: Just my family and some of my friends.

Interviewer: Great. Would your family's opinions on vaccination influence your attitude towards vaccination?

Participant: Erm, they might do a little bit, but I think ultimately the decision is mine.

Interviewer: Yeah. So why do you feel that way?

Participant: Erm, well I feel like it's personal opinion, like personally I would probably choose to get vaccinated but if they told me not to, I'd consider it but I'd probably do it anyway.

Interviewer: So you'd take it into consideration but you'd still make your own decision.

Participant: Yeah.

Interviewer: What about your friends? Would that influence your attitude towards vaccination?

Participant: Err. Not particularly.

Interviewer: Why not?

Participant: Because they are all idiots {laughs}

Interviewer: Okay, would your doctor's opinion on vaccination influence your attitude towards vaccination?

Participant: Erm... probably, yeah.

Interviewer: Why would it?

Participant: Because they are professional so I trust them.

Interviewer: Yeah. What do you think influences your views on vaccination the most?

Participant: Erm, probably like what my family think of it.

Interviewer: Do you have any ethical concerns about vaccination? For example, testing on animals or adults making decisions on behalf of their children?

Participant: Err, yeah, testing on animals does.

Interviewer: Do these issues impact your views on vaccination?

Participant: Yeah, because if was - well I'm assuming they are tested on animals - I mean, personally I don't agree with that but erm, I don't know. If it was something that was actively surrounding animal testing and if it was made a thing that 'this thing has been tested on animals' and it's harmed them then I'd probably be less likely to do it.

Interviewer: Yeah. Do you have any concerns about the sterility or cleanliness of vaccination?

Participant: Erm, no.

Interviewer: Is there anything else that worries you about vaccination? For example, pain, fear of needles, or ingredients in the vaccine?

Participant: Erm, no.

Interviewer: Are there any specific vaccines that you would not accept? For example, polio, tetanus or measles?

Participant: No. I'd just get all, yeah.

Interviewer: What do you think would make you feel more confident about vaccination?

Participant: Probably if there was more information surrounding it, like leading up to the cervical cancer jabs that we had in year nine there wasn't much - that - information, they basically just said 'you're getting injections so make sure get in for it'.

Interviewer: If you decide to have children in the future, do you think that you will vaccinate them?

Participant: Erm, probably yeah, especially the vaccinations that they get when they are really young and when they got older, I'd let them make their own decisions.

Interviewer: So what factors influence your decision?

Participant: Erm, more the fact that they would be my responsibility at the point when I could choose to get them vaccinated but once they are at an age where they can think for themselves, I don't see that my view should necessarily be theirs. I'd let them come to their own conclusions about it.

Interviewer: So what would it be that would influence it? Would it be because you don't want them to catch a disease or because.... is it safe? Is there anything like that that would concern you? Like the effectiveness of it?

Participant: I'd probably let them get the vaccinations when they are young to see how their reactions went and if that went okay I'd consider getting them more vaccinations in the future. But erm, nothing like major. It's more like morally and ethically if they didn't want to have it, then I don't feel like I should force them to have it.

Interviewer: Yeah, that's great. Okay, thank you.

Interview 6 Transcript

Interviewer: Hello, Thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer that is absolutely fine and you can withdraw from the

interview at any time. The interview should take less than half an hour and will be tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: 19

Interviewer: How would you describe your ethnicity?

Participant: White British

Interviewer: What is your religious background?

Participant: Jewish

Interviewer: Are you a student?

Participant: Yes

Interviewer: What are you currently studying?

Participant: Accounting and Finance

Interviewer: Do you know what vaccination is?

Participant: Yes

Interviewer: Please can you describe how it works?

Participant: It's when you are given part of an infection to build up your immune system

Interviewer: So where does your knowledge of vaccination come from?

Participant: School

Interviewer: Can I ask if you ever remember being vaccinated or know that you have been?

Participant: Erm, I definitely have been. I remember getting the cervical cancer jab.

Interviewer: Erm, so how old were you?

Participant: About 13, 14.

Interviewer: What happened?

Participant: they took us out of lesson and made us go down to the hall and we all had to have it done together.

Interviewer: Do you remember anyone discussing vaccination with you?

Participant: Yeah

Interviewer: Who?

Participant: Teachers. We had assemblies about them and stuff

Interviewer: How safe do you think vaccination is?

Participant: Very safe

Interviewer: What do you think the risks of vaccinations are?

Participant: I don't really know any of the risks

Interviewer: Ok, do you worry about the spread of infectious diseases such as measles, mumps or influenza?

Participant: Not really

Interviewer: Why not?

Participant: Because I've never really known anybody have diseases like that.

Interviewer: Yep. Why do you think that some people are against vaccination?

Participant: Because it's useless vaccinating against something you don't already - that you've not got.

Interviewer: Okay, what are your opinions on the reasons that people have for not vaccinating?

Participant: I think it's stupid to risk getting something by not being vaccinated.

Interviewer: Do you think parents should have the right to choose not to vaccinate their children?

Participant: Yes

Interviewer: Why do you think that?

Participant: Because it's their kid, it's their decision.

Interviewer: If you needed to make a decision about whether to personally vaccinate or not, where would you look for information? For example family, friends, internet or news reports?

Participant: I'd probably go on the internet and talk to my family.

Interviewer: How would you know if an information source was reliable?

Participant: I'd just do loads and loads of research on the internet on it.

Interviewer: Do you ever discuss health issues such as vaccination?

Participant: Yeah

Interviewer: Who with?

Participant: Family members

Interviewer: Would your family's opinions on vaccination influence your attitude towards vaccination?

Participant: Yeah

Interviewer: Why?

Participant: Because I trust their opinions on things.

Interviewer: What about your friends?

Participant: I probably wouldn't trust their opinion as much, because they are not as well informed.

Interviewer: Would your doctor's opinion on vaccination influence your attitude towards vaccination

Participant: Yeah

Interviewer: Why?

Participant: Because they know what they are talking about

Interviewer: Do your religious views influence your views on vaccination?

Participant: No

Interviewer: Why not?

Participant: Because I feel that your religion and health are completely different things.

Interviewer: What do you think influences your views on vaccination the most?

Participant: Family members probably.

Interviewer: Do you have any ethical concerns about vaccination? For example, testing on animals? Or adults making decisions on behalf of their children?

Participant: I don't agree with animal testing.

Interviewer: So would that impact your view on vaccination?

Participant: Yeah.

Interviewer: So would it make you less likely to vaccinate?

Participant: Yeah if I knew that it had come from testing on animals.

Interviewer: Do you have any concerns about sterility or cleanliness of vaccination?

Participant: No.

Interviewer: Is there anything else that worries you're about vaccination? For example pain, fear of needles or ingredients in vaccines?

Participant: Terrified of needles. And it scares me that I could be allergic to something in a vaccine, yeah.

Interviewer: Do you think there are any specific vaccines that you would not accept?

Participant: No, probably not.

Interviewer: Why?

Participant: I feel that it's all be tested quite a lot so they should be safe.

Interviewer: What do you think would make you more confident about vaccination?

Participant: A lot of information on what's in it and what the potential side effects could be.

Interviewer: If you decide to have children in the future, do you think that you will vaccinate them?

Participant: Yeah

Interviewer: What factors would influence that decision?

Participant: The risk of them getting an illness or - yeah just that probably.

Interviewer: That's great. Thank you!

Interview 7 Transcript

Interviewer: Hello thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than fifteen minutes and will be tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: 15

Interviewer: How would you describe your ethnicity?

Participant: White British

Interviewer: What is your religious background?

Participant: None

Interviewer: Are you a student?

Participant: Yes

Interviewer: What are you currently studying?

Participant: GCSEs

Interviewer: Do you know what vaccination is?

Participant: Yes

Interviewer: Please could you describe how vaccination works?

Participant: Vaccination is when a - it's like a biology question! - Vaccination is when something is injected into the bloodstream to prevent diseases

Interviewer: That great! So where does your knowledge of vaccination come from?

Participant: School

Interviewer: Can I ask if you ever remember being vaccinated? Or know that you have been?

Participant: Yes

Interviewer: How old were you?

Participant: I would have been 14 when I was last vaccinated.

Interviewer: So what happened? Can you talk me through it?

Participant: Okay, it was in school, I was taken away to a different room and just injected.

Interviewer: Do you remember anyone discussing vaccination with you?

Participant: How do you mean?

Interviewer: Before you got vaccinated, did somebody talk to you about it?

Participant: Not really, no.

Interviewer: How safe do you think vaccination is?

Participant: Very safe

Interviewer: Why do you think that?

Participant: Because everything that's done -it's all made sure that it's safe by professionals.

Interviewer: What do you think the risks of vaccination are?

Participant: Sorry?

Interviewer: What do you think the risks of vaccination are?

Participant: I don't think there are any.

Interviewer: Do you worry about the spread of infectious diseases, such as measles, mumps and influenza?

Participant: Yeah, of course I do

Interviewer: Why?

Participant: Because they are life threatening

Interviewer: Why do you think some people are against vaccination?

Participant: Some people aren't properly educated about vaccination so get the wrong idea about it

Interviewer: That's great. What are your opinions on the reasons that people have for not vaccinating?

Participant: I think that it's wrong to not vaccinate and that everyone should be informed properly about it

Interviewer: Do you think parents should have the right to choose not to vaccinate their children?

Participant: No I don't

Interviewer: If you needed to make a decision about whether to personally vaccinate or not where would you look for information

Participant: I'd go onto trustworthy website like the NHS website for example

Interviewer: How would you know if an information source was reliable?

Participant: If it was proved [sic] by the government

Interviewer: That great. Do you ever discuss health issues such as vaccination?

Participant: Not often.

Interviewer: Would your family's opinion on vaccination influence your attitude towards vaccination

Participant: Yes.

Interviewer: Why?

Participant: Because I trust what my parents tell me

Interviewer: That's great, what about your friends' opinions?

Participant: Not really [laughs]

Interviewer: Why?

Participant: Because I find that I'm not influenced often by my friends' opinions

Interviewer: That's great, what about your doctor's opinions on vaccination

Participant: Oh definitely

Interviewer: whys that

Participant: because doctors are trustworthy people and know a lot about this kind of thing

Interviewer: what do you think influences your views on vaccination the most?

Participant: Probably what I'm taught in school

Interviewer: Do you have any ethical concerns about vaccination?

Participant: No

Interviewer: Do you have any concerns about sterility or cleanliness of vaccination?

Participant: Well yeah, if it's not properly carried out then that can be dangerous so they need to be carried out properly by professionals

Interviewer: Is there anything else that worries you about vaccination?

Participant: Not really.

Interviewer: So not like pain? Fear of needles?

Participant: Not really

Interviewer: Or ingredients?

Participant: No, definitely not

Interviewer: Are there any specific vaccines that you would not accept?

Participant: No, I don't think so

Interviewer: What do you think would make you feel more confident about vaccination?

Participant: I'm not sure, I don't know.

Interviewer: If you decide to have children in the future, do you think you will vaccinate them?

Participant: Definitely!

Interviewer: So what factors are the most important in that decision for you?

Participant: Just making sure that if I do have children that they are safe from everything I can protect them from.

Interviewer: Okay! Great! Thank you for being interviewed.

Interview 8 Transcript

Interview: Hello thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than fifteen minutes and will be tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: 16

Interview: How would you describe your ethnicity?

Participant: English...British.

Interview: So white British?

Participant: Yeah

Interview: What is your religious background?

Participant: Atheist

Interview: Atheist

Participant: Yes

Interview: Are you a student?

Participant: Yeah

Interview: What are you currently studying?

Participant: Sciences, Maths, English, IT, Business studies, Music, RE.

Interview: So GCSES?

Participant: Yeah

Interview: Do you know what vaccination is?

Participant: I could try to define it?

Interview: Yeah if you could try to describe how you think it works.

Participant: It's like when you inject somebody with sort of like dead diseased cells from things like polio and stuff and obviously the cells in the body will act like it's a threat, attack it and make cells to remember when to fight it if it ever strikes again

Interview: Can I ask if you ever remember being vaccinated? Or know that you have been?

Participant: Yes I was vaccinated last year.

Interview: Oh right, what was that against?

Participant: Measles, mumps and rubella

Interview: Ok, so how old were you?

Participant: I was 15

Interview: So kind of talk me through what happened?

Participant: Well you have like a time, every year group has to get vaccinated, it was done in the scout hut with medical supplies and stuff and if I remember correctly they just - we had two jabs and they placed two needles, one between each arm - one needle in each arm and then they just took it out and it was pretty much done, it left a bit of a sore but it was fine

Interview: That's great, so did anyone discuss vaccination with you before it was done?

Participant: No it was just sort of a 'go and get your jabs' thing.

Interview: How safe do you think vaccinations are?

Participant: well I mean nothing went wrong with our vaccination and I fully support vaccinations, I think they are really important to make sure that epidemics don't spread

Interview: So what do you think the risks of vaccination are?

Participant: I imagine risk, maybe if, the only thing I can think of is if a vaccination is done incorrectly maybe in the incorrect part of the body or done prematurely something like that, I don't think there are any risks

Interview: So why do you think that? Where does that knowledge come from?

Participant: Some of its general, maybe talking with parents once or twice and some of it's also - we study vaccination in science B1 and B2 so apart from that it's just general knowledge really

Interview: Do you worry about the spread of infectious diseases, such as measles, mumps and influenza?

Participant: Not often, no, it seems to be very contained isn't it? I've never really been... there's been stuff like swine flu but that just tends to be an overreaction in the mail so not really very worried

Interview: So why do you think some people are against vaccination?

Participant: Because there was a - I would say rumour, I'm not too sure - that it was causing autism which seems fairly fictional so I imagine some people would be against their child contracting autism from the vaccine

Interview: Yeah, what are your opinions on these reasons that people have for not vaccinating

Participant: I think that some people are very misinformed and don't fully know how vaccines work and how it can benefit people a lot

Interview: Do you think parents should have the right to choose to not vaccinate their children?

Participant: It may seem a little - I mean in my opinion everyone should be vaccine - vaccinated - just to prevent the spread of those diseases because if your child comes into school without vaccination and they contract say tetanus or measles mumps or rubella or rubella then it could be a potential risk to all the people around them

Interview: If you needed to make a decision about whether to personally vaccinate or not where would you look for information

Participant: Probably my local doctor or maybe the internet or somewhere like that

Interview: Yeah. So how would you know if an information source is reliable?

Participant: You can sort of look by the way it's written, the specialist language used or the general views of whoever's writing it because sometimes it's really hard to tell because it can be a really well formed argument

Interview: Do you ever discuss health issues such as vaccination?

Participant: Sometimes a lot of people talk about it online but I don't talk about it much with the people I know

Interview: Would your family's opinion on vaccination influence your attitude towards vaccination

Participant: It would probably.

Interview: Why?

Participant: Because they - most of the things my parents tend to influence me in, say my political views, because I view them as a source of knowledge and a source of information

Interview: What about your friends' opinions on vaccination

Participant: My friends' opinions might not mean as much because they just- they've been wrong about things before and I tend to be for vaccination

Interview: What about your doctor's opinion on vaccination

Participant: Doctor's opinion may sway it a lot because obviously the doctors have been to medical and are incredibly well qualified and know exactly what they are doing

Interview: So what do you think influences your views on vaccination the most?

Participant: Sorry?

Interview: What do you think influences your views on vaccination the most?

Participant: Probably an opinion from an incredibly well qualified individual or my parents

Interview: Do you have any ethical concerns about vaccination?

Participant: Not particularly, I mean yeah, no.

Interview: Do you have any concerns about sterility or cleanliness of vaccination?

Participant: Yes, sometime I do wonder maybe because obviously vaccination is a dead disease cell so I wonder if things have been sterilised properly and are the conditions fully clean to ensure a correct vaccination takes place other than I tend to just be all for them

Interview: Is there anything else that worries you about vaccination?

Participant: Not particularly, I think it's a good [inaudible]

Interview: What about pain? Or fear of needles

Participant: Yes! A few people I know, yeah they have extreme needle phobia, sort of fainting in front of needles

Interview: Oh right, okay!

Participant: Or in severe trauma, but I just tend to get on with it, it doesn't last very long and it's so you don't die

Interview: What about ingredients in vaccines?

Participant: I've heard a lot of rumours about vaccines - they say like mercury and stuff but I tend to think they've been concocted and made by people who know exactly what they are doing and I trust them completely.

Interview: That's great, what do you think would make you feel more confident about vaccination?

Participant: I'm already relatively confident about it, maybe if I could see exactly what was in the vaccination, all the vaccinations out there and maybe see accident risk and percentages about vaccines, statistics

Interview: That's great, if you decide to have children in the future, do you think you will vaccinate them?

Participant: I will most definitely vaccinate to make sure they are safe.

Interview: So what factors are the most important in that decision?

Participant: Erm, in getting my children vaccinated? Probably if they I do have a current health relationship with the doctor and I know they are well qualified. I trust that they will vaccinate my child mainly just the qualifications of the people that are taking out the procedure

Participant: That's great. So that's everything, thank you.

Interview 9 Transcript

Interviewer: Hello thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than fifteen minutes and will be tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: I'm 16

Interviewer: How would you describe your ethnicity?

Participant: White

Interviewer: British?

Participant: Yeah

Interviewer: What is your religious background?

Participant: Atheist and Christian

Interviewer: So were you brought up as a Christian and you are atheist or?

Participant: Brought up Christian and I'm an atheist

Interviewer: Are you a student?

Participant: Yes I am

Interviewer: What are you currently studying?

Participant: Geography, geology, art, biology, maths, normal [subjects]

Interviewer: GCSEs?

Participant: Yeah

Interviewer: Do you know what vaccination is?

Participant: Yes

Interviewer: Could you try to describe how vaccination works?

Participant: It's where a dead or weakened pathogen or version of the virus is injected into you to stimulate a reaction from your white blood cells so that they memorise it for when, when that actual virus comes and they need to get rid of it

Interviewer: Yeah. That great. Can I ask if you remember ever being vaccinated? Or know that you have been

Participant: I have yes

Interviewer: How old were you?

Participant: The first time I was very young and then I think 12 or 13

Interviewer: Do you remember what happened or?

Participant: Err, not especially

Interviewer: Do you remember anyone ever discussing vaccination with you?

Participant: Err, not really apart from my parents saying "it's fine, it doesn't hurt, it's fine" things like that

Interviewer: How safe do you think vaccination is?

Participant: Safe. Yeah safe.

Interviewer: What do you think the risks of vaccination are?

Participant: I'm guessing unsterilised things like that

Interviewer: So why do you think that? Where does that kind of idea come from?

Participant: I'm not sure I'm just thinking about what could get into your body that isn't meant to

Interviewer: So from your own mind? You've not seen that anywhere?

Participant: No

Interviewer: Do you worry about the spread of infectious disease? Like measles mumps or influenza

Participant: Not especially

Interviewer: Why not?

Participant: I just haven't put any thought to it

Interviewer: That's fine. Why do you think some people are against vaccination?

Participant: I'm not sure

Interviewer: Do you think parents should have the right to choose not to vaccinate their children?

Participant: I think they yes, I think they should be - but they should be sort of advised to

Interviewer: If you needed to make a decision about whether to personally vaccinate or not, where would you look for information

Participant: The NHS I guess. Perhaps my parents

Interviewer: So how would you know if an information source was reliable?

Participant: I wouldn't really. I'd just trust that if they are an official organisation then should provide the information.

Interviewer: Do you ever discuss health issues such as vaccination?

Participant: Not outside of school curriculum really, no

Interviewer: OK. Would your family's opinion on vaccination influence your attitude towards vaccination?

Participant: Yes

Interviewer: Why?

Participant: Because I think that if they are my family I'd take opinion into account and trust it.

Interviewer: What about your friends' opinions?

Participant: I would also but maybe less so

Interviewer: Than your family's?

Participant: Yes

Interviewer: What about your doctor's opinion on vaccination?

Participant: I'm not sure

Interviewer: What do you think influences your views on vaccination the most? In terms of like media -

Participant: I haven't really seen much about it in the media so I wouldn't know

Interviewer: Do you have any ethical concerns about vaccination?

Participant: Erm, not especially, not that I'd know of

Interviewer: Okay. Do you have any concerns about sterility or cleanliness of vaccination?

Participant: No

Interviewer: Is there anything else that worries you about vaccination?

Participant: No

Interviewer: Not like pain? Or fear of needles?

Participant: No

Interviewer: Or ingredients in the vaccines?

Participant: No

Interviewer: Is there any specific vaccine that you would not ever accept?

Participant: So long as I'm informed about it, no

Interviewer: What would you think would make you more confident about vaccination?

Participant: I don't know

Interviewer: If you decide to have children in the future do you think you will vaccinate them?

Participant: Yeah

Interviewer: So what factor is the most important for you?

Participant: I think safety and making sure they are safe and happy

Interviewer: That's great, thank you very much.

Interview 10 Transcript

Interviewer: Hello thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than fifteen minutes and will be tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: 16

Interviewer: How would you describe your ethnicity?

Participant: British born Chinese

Interviewer: What is your religious background?

Participant: Atheist

Interviewer: Are you a student?

Participant: yes

Interviewer: what are you currently studying?

Participant: GCSES

Interviewer: GCSES. Yeah. Do you know what vaccination is?

Participant: Yeah

Interviewer: Can you describe to me how vaccination works please

Participant: Well its - your injected with the necessary cells so your body knows how to fight against certain diseases

Interviewer: that's great. Can I ask if you ever remember being vaccinated? Or know that you have been?

Participant: yes I have been

Interviewer: So how old were you?

Participant: 15

Interviewer: can you talk me through what happened?

Participant: Well, I was with school so we were just vaccinated. I don't know how to explain that

Interviewer: did they take you out of class?

Participant: yeah

Interviewer: Was it the whole year?

Participant: yeah

Interviewer: Do you remember anyone discussing vaccination with you?

Participant: Yes

Interviewer: Who was that?

Participant: People at school

Interviewer: Like teachers?

Participant: Yeah

Interviewer: How safe do you think vaccinations are?

Participant: Very. I think

Interviewer: What do you think the risks of vaccination are?

Participant: I don't know

Interviewer: Do you worry about the spread of infectious disease?

Participant: Yes

Interviewer: Why?

Participant: Because they spread

Interviewer: Do you worry about the spread of measles, mumps or influenza?

Participant: Yeah.

Interviewer: Why do you think some people are against vaccination?

Participant: Because they think it will harm them.

Interviewer: What are your opinions on those reasons for not vaccinating?

Participant: Well, I'm not entirely sure. I just think that vaccinations don't really harm you but I've not looked into it that much that I would know.

Interviewer: Do you think that parents should have the right to choose not to vaccinate their children

Participant: Yes

Interviewer: So why do you think that?

Participant: Well, I mean, they should just be able to choose whether.

Interviewer: If you needed to make a decision about whether to personally vaccinate or not, where would you look for information?

Participant: Online

Interviewer: And how would you know if an information source was reliable?

Participant: Well, there are government sites I guess.

Interviewer: So you'd look for official sources of information?

Participant: Yeah

Interviewer: Do you ever discuss health issues such as vaccination?

Participant: Not regularly.

Interviewer: Would your family's opinion on vaccination influence your attitude towards vaccination?

Participant: Not really.

Interviewer: Why not?

Participant: They're not that educated in [inaudible] to do with vaccination

Interviewer: What about your friends' opinions on vaccination?

Participant: Erm I think it depends on how much they know, I guess

Interviewer: What about your doctor's opinion on vaccination?

Participant: Yeah

Interviewer: Why would that be?

Participant: Doctors are trained to be able to give medical advice.

Interviewer: What do you think influences your views on vaccination the most?

Participant: I guess what were taught in school.

Interviewer: That's great. Do you have ethical concerns about vaccination?

Participant: Not really.

Interviewer: Do you have any concerns about sterility or cleanliness of vaccination?

Participant: Not really.

Interviewer: Is there anything else that worries you about vaccination?

Participant: Not really.

Interviewer: Pain? Or fear of needles?

Participant: No.

Interviewer: Ingredients -

Participant: No.

Interviewer: Do you think there are any specific vaccines you would not accept?

Participant: Erm none that I know of.

Interviewer: What do you think would make you feel more confident about vaccination?

Participant: Being taught more about it, I guess.

Interviewer: If you decide to have children in the future, do you think you would vaccinate them?

Participant: Yes

Interviewer: So what factors would be important in that decision?

Participant: Well the effect of the diseases I guess

Interviewer: So how serious the disease you protect against is?

Participant: Yes.

Interviewer: That's great, that's all the questions, thank you very much.

Interview 11 Transcript

Interviewer: Hello thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than fifteen minutes and will be

tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: 16

Interviewer: how would you describe your ethnicity?

Participant: White British

Interviewer: What is your religious background?

Participant: Christian

Interviewer: Are you a student

Participant: Yeah

Interviewer: what are you currently studying?

Participant: GCSEs

Interviewer: Great. Do you know what vaccination is?

Yeah

Interviewer: Can you describe how vaccination works

Participant: It puts an inactive pathogen inside your body so that you can have a quick response against illness

Interviewer: So where does your knowledge of vaccination come from

Participant: School

Interviewer: Can I ask if you remember ever being vaccinated, or know that you have been

Participant: Yeah

Interviewer: So how old were you?

Participant: The last one was last year

Interviewer: So what was that for?

Participant: I can't remember

Interviewer: Was it HPV?

Participant: Yeah

Interviewer: So what happened? Can you talk me through the process? Did they take you out of class?

Participant: We were taken out of class and asked questions like if we were pregnant or if we're ill or anything so it was okay to take it

Interviewer: Yes, Do you remember anyone discussing vaccination with you?

Participant: No.

Interviewer: How safe do you think vaccinations are?

Participant: They've all been tested so I'd say quite safe

Interviewer: What do you think the risks of vaccination are?

Participant: I don't know

Interviewer: Do you think there are any risks of vaccination?

Participant: Probably because different people will react in different ways to them

Interviewer: Do you worry about the spread of infectious disease like measles mumps and influenza?

Participant: Yeah

Interviewer: Why do you worry about them?>

Participant: Because if I haven't been vaccinated, and even if I have been vaccinated, I could still get it.

Interviewer: Why do you think some people are against vaccination?

Participant: Because of things that it might contain or if it's against their religion.

Interviewer: What are your opinions on those reasons that people have for not vaccinating?

Participant: I think as long I know what's in it, I'll be happy to have it, and if it will have any side effects.

Interviewer: Do you think parents should have the right to choose not to vaccinate their children?

Participant: No

Interviewer: Why do you think that?

Participant: It's up to the child whether they want to be vaccinated or not because they won't want to become ill

Interviewer: If you needed to make a decision about whether to personally vaccinate or not, where would you look for information?

Participant: School nurse or doctor

Interviewer: So how would you know if an information source was reliable?

Participant: If more than one said the same thing, I'd check with different ones.

Interviewer: So for consistency?

Participant: Yeah

Interviewer: Do you ever discuss health issues such as vaccination?

Participant: Not really

Interviewer: Would your family's opinions on vaccination influence your attitude towards vaccination?

Participant: No

Interviewer: Why not?

Participant: I think it's up to - it's my choice if I take it or not.

Interviewer: What about your friends' opinions on vaccination?

Participant: No

Interviewer: Why not?

Participant: Same reason.

Interviewer: What about your doctor opinions?

Participant: Yeah because they know what they are talking about.

Interviewer: Do your religious views influence your views on vaccination at all?

Participant: No

Interviewer: Why is that?

Participant: I'd rather be safe and have a vaccination.

Interviewer: What do you think influences your views on vaccination the most?

Participant: Probably knowing about it. If I don't know about it I'm less likely to have it.

Interviewer: Do you have any ethical concerns about vaccination?

Participant: No

Interviewer: Do you have any concerns about the sterility or cleanliness of vaccination?

Participant: No

Interviewer: Is there anything else that worries you about vaccination?

Participant: No

Interviewer: What about pain? Fear of needles

Participant: No

Interviewer: Ingredients?

Participant: No

Interviewer: Are there any specific vaccines you would not accept?

Participant: If I know about them then I would accept them.

Interviewer: What do you think would make you feel more confident about vaccination?

Participant: People going through it with me so I know exactly what's in it, and what side effects it might have.

Interviewer: If you decide to have children in the future, do you think you will vaccinate them?

Participant: Yeah

Interviewer: So what factors would be the most important to you?

Participant: Whether it's going to make them more ill having it, or more ill them not having it.

Interviewer: Okay! Yeah that's great, thanks very much.

Interview Transcript 12

Interviewer: Hello thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question

you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than fifteen minutes and will be tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: 16

Interviewer: How would you describe your ethnicity?

Participant: White British

Interviewer: What is your religious background?

Participant: Christian

Interviewer: Are you a student?

Participant: Yes

Interviewer: What are you currently studying?

Participant: GCSEs

Interviewer: Do you know what vaccination is?

Participant: Yes

Interviewer: Can you describe how it works?

Participant: You are injected with a form of dead or inactive pathogen and your body - so it does no harm - but your body develops certain antibodies to fight it

Interviewer: That's great. Can I ask if you remember ever being vaccinated? Or know that you have been?

Participant: Yes, I remember being vaccinated last year

Interviewer: Oh right, so how old were you?

Participant: Fifteen.

Interviewer: So can you talk me through the process of what happened?

Participant: So I think they just...

Interviewer: Was it in school?

Participant: Yeah...

Interviewer: Did they take you out of class?

Participant: Yeah took us out of class and then I think what happened was - it wasn't particularly painful so they just put the needle in my shoulder or upper arm and then, that's it.

Interviewer: Do you remember anyone discussing vaccination with you?

Participant: As in..?

Interviewer: Before you went to go get vaccinated last year?

Participant: Yeah, I mean we'd learnt about it, but my sister had various ones that were a bit more painful when she was going to Africa and things like that, so yeah I'd had conversations with her about that

Interviewer: That's great, how safe do you think vaccination is?

Participant: I'd say it's safe, I think.

Interviewer: What do you think the risks of vaccination are?

Participant: I mean, I suppose if anything a tiny bit of blood exposure but I don't - Yeah I'm not entirely sure to be honest.

Interviewer: Do you worry about the spread of infectious diseases like measles, mumps or influenza?

Participant: Not on a day to day basis, but I mean. But yeah, the same kind of concern anyone would have. You know? I used to every morning I'd have vitamin tablets and stuff like that to try and like - whether it was good for me or not -

Interviewer: To protect yourself from infection?

Participant: Yeah, to boost my immunity, but I mean, you know, reasonable concern but not being like paranoid about it.

Interviewer: Why do you think some people are against vaccination?

Participant: I suppose some people on a moral level I'm not entirely sure I mean the only reason that comes to my head is the actual process - it's painful or but I suppose maybe some people might think it's not quite natural or yeah they sort think were made how we are sort of thing but apart from that... yeah`

Interviewer: So what are your opinions on those reasons?

Participant: I think that with what we have and the ability we have within science that it makes for us to use that capability to help prevent the sort of spread of diseases and save lives at the end of it, so I think it makes sense.

Interviewer: If you needed to make a decision about whether to personally vaccinate or not, where would you look for information?

Participant: I'd say if it was just a slight curiosity I might ask my parents or friends or maybe look online. But it was a serious consideration I might ask my GP or the school nurse.

Interviewer: And how would you know if an information source was reliable?

Participant: That the same, if I was really seriously thinking about it, if it was from a professional or - a GP has had years of training and school nurse has to be qualified to I'd sort of know that the information I was getting was good.

Interviewer: Do you ever discuss health issues such as vaccination?

Participant: Not really [laughs]

Interviewer: Would your family's opinion on vaccination influence your attitude towards vaccination?

Participant: I'm sure it would, but I suppose if it was a bit, if they were saying that I couldn't because they wouldn't be happy or whatever, I'd probably still try to argue that it was needed but I'm not really at that point where they've had really strong views about it.

Interviewer: So you'd take it into consideration but you'd still make your own decision?

Participant: Yeah [inaudible 5.50].

Interviewer: So what about your friends' opinions on vaccination?

Participant: probably slightly less influence I'd say, I'd imagine my family would be a bit more protective. But with friends, you know I'm interested to hear views and things but it would still be my decision

Interviewer: What about your doctor's opinion on vaccination?

Participant: I'd probably take that quite seriously

Interviewer: Why is that?

Participant: Because you know that they are supposed to really know what they are talking about when it comes to that. And if there is anyone who you are supposedly going to trust, it would be probably be them. I'm not going to know everything about it, my friends aren't, my family aren't necessarily, so that's the sort of view I'm going to need to take.

Interviewer: That's great. So do your religious views influence your views on vaccination at all?

Participant: No. It's not something we ever talk about. I mean, I've grown up in a Christian family, but we've all had vaccination, we've never really talked about what we as a family should view towards it so no, it hasn't.

Interviewer: What do you think influences your views on vaccination the most?

Participant: I guess how it works, what the idea is and the intentions and how it's actually helped over the years. That kind of stuff and how you need it, I suppose.

Interviewer: Do you have any ethical concerns about vaccination?

Participant: I don't have any.

Interviewer: Do you have any concerns about sterility or cleanliness of vaccination?

Participant: I suppose there is that risk, but you'd have to be very certain of who was doing it I suppose and how clean the area was but when it's sort of an official, a school for example, like if it's something by someone you know you can trust or an area you can trust then that concerns a bit less but I think I'm not hugely concerned but it is a possibility.

Interviewer: Is there anything else that worries you about vaccination?

Participant: No

Interviewer: Pain? Fear of needles?

Participant: Yeah, if it's just a normal slight fear of needles but I think [inaudible]

Interviewer: What about ingredients in the vaccine?

Participant: Yeah, never really thought about it. Yeah I mean, it's that whole idea of trust really and the reliability of whatever you're using.

Interviewer: That's great. Do you think there are any specific vaccines you would not accept?

Participant: Pardon?

Interviewer: Are there any specific vaccines you would never get?

Participant: Erm, no, not that I know of now.

Interviewer: What do you think would make you feel more confident about vaccination?

Participant: In a situation whether my friends or family have had it, something like that, from one specific doctor or whatever, then I'd probably be more confident, you know if it was quite- if it was a new one that no-one had really - if it's something that I know had been proven to work, maybe you'd have reassurance by family and friends, then that would help.

Interviewer: So you just mentioned if it was a particularly new one, so how would that change what you thought about it?

Participant: You never really want to be the first one to test it do you. Yeah.

Interviewer: So would you have more concern over that than a longer established vaccine?

Participant: If it had been long established and it wasn't out of date and it had been proven that it was still working then I'd probably trust that.

Interviewer: If you decide to have children in the future, do you think you will vaccinate them

Participant: Yes

Interviewer: What factors are the most important to you?

Participant: Factors?

Interviewer: Yeah so -

Participant: Erm, so whatever has been proven to, I'm not going to - I wouldn't press certain religious or necessarily my own - I'd sort of highlight the importance of it - I'd sort of get them the vaccinations that would - that are quite common - the sort of MMR... but Erm yeah I think [inaudible] what I think the dangers are, what they really need, but [inaudible] unless there was - unless a serious ethical issue came up in the next few years I wouldn't risk that sort of [inaudible]

Interviewer: That's great, so thank you for agreeing to be interviewed.

Interview 13 Transcript

Interviewer: Hello thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than fifteen minutes and will be tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: 16

Interviewer: How would you describe your ethnicity?

Participant: White British

Interviewer: What is your religious background?

Participant: Christianity

Interviewer: Are you a student?

Participant: Yes

Interviewer: What are you currently studying?

Participant: GCSEs

Interviewer: Do you know what vaccination is?

Participant: Yes

Interviewer: Please could you describe how vaccination works?

Participant: A vaccination is basically where you have an inactive form of a disease injected into you and that tells your body to make the antibodies to fight the disease and when it actually comes into your body you know how to fight it.

Interviewer: So where does that knowledge of vaccination come from?

Participant: Biology lessons

Interviewer: Do you remember ever being vaccinated or know that you have been?

Participant: Yes, I had injections year ten and then I had injections again when I was four and when I was a baby

Interviewer: So you said you had some in year ten, so if you just talk me through the process of what happened?

Participant: we were went out in groups to the scout hut and we were [inaudible] to three different injections by properly trained people. They put it in our arm there [point] and that's it.

Interviewer: Yeah. Do you remember anyone discussing vaccination with you before you got vaccinated?

Participant: Erm, not in terms of what it does, but they said you better get it. But not so much

Interviewer: So who was it that discussed it with you?

Participant: My mum

Interviewer: How safe do you think vaccinations are?

Participant: I think they're safe. They're done many times a year by doctors.

Interviewer: What do you think the risks of vaccination are?

Participant: Infection, into the arm

Interviewer: So like a skin infection?

Participant: Yeah

Interviewer: Do you think there are any other risks with it?

Participant: I don't know really, on that.

Interviewer: Do you worry about the spread of infectious diseases?

Participant: I do. I'm generally quite hygienic but I trust the doctors to protect us.

Interviewer: So why do you think that some people are against vaccination?

Participant: {inaudible} it going wrong I suppose [inaudible] it may not work

Interviewer: What are your opinions on these reasons that people have for not vaccinating?

Participant: I think they are valid but they are not really - they are not - they are reasons which don't - they're not particularly, they are very unlikely to happen and shouldn't really be worried about them

Interviewer: Do you think parents should have the right to choose not to vaccinate their children?

Participant: Up to a certain yes, but when you are old enough to choose you should have the right to choose whether or not you should be vaccinated.

Interviewer: Okay, if you needed to make a decision about whether to personally vaccinate or not, where would you look for information?

Participant: The doctors, my parents.

Interviewer: And how would you know if an information source was reliable?

Participant: I wouldn't really. It would be my own judgment, if I thought that make sense I'd deem it reliable. If multiple sources said the same thing, I'd deem it reliable. I trust my mum and other people so I'd deem them reliable.

Interviewer: Great. And do you ever discuss health issues such as vaccination?

Participant: Not really

Interviewer: Would your family's opinions on vaccination influence your attitude towards vaccination?

Participant: Yes

Interviewer: So why is that?

Participant: Well they are my family. [Inaudible] they taught me what I know, they brought me up, and [inaudible] they will do in the future.

Interviewer: So you trust their judgment?

Participant: Yeah

Interviewer: What about your friends' opinions on vaccination?

Participant: Maybe to a certain extent. I can generally tell when they are joking and messing around but I know when they are serious so I'd listen.

Interviewer: Would your doctor's opinion on vaccination influence your attitude towards vaccination

Participant: Yes. They maybe are required but they do know what they are doing and they do know the risks of it and they try to minimize them so I trust them

Interviewer: You mean by like a [inaudible] so you think they would encourage you to vaccinate?

Participant: Yeah.

Interviewer: Do your religious views influence your views on vaccination at all?

Participant: Not really no.

Interviewer: Why not?

Participant: It's not a thing in our religion, it's not something that's talked about commonly.

Interviewer: That's great. And what do you think influences your views on vaccination the most?

Participant: Probably my parents and my school.

Interviewer: Do you have any ethical concerns about vaccination?

Participant: No

Interviewer: Do you have any concerns about sterility or cleanliness of vaccination?

Participant: There are concerns but I don't think there should be because they should be clean and they are clean.

Interviewer: Is there anything else that worries you about vaccination?

Participant: Not really..?

Interviewer: So like pain? Or fear of needles?

Participant: No

Interviewer: What about ingredients of the vaccine?

Participant: Erm, no I trust it that it's safe to be put into my body

Interviewer: Do you think there are any specific vaccines that you would never accept?

Participant: Not really. If I need a vaccine, if I'm getting it properly, I'll take it. I've had all the standard ones. So [inaudible] so there's no reason I wouldn't have [inaudible]

Interviewer: What do you think could make you feel more confident about vaccination?

Participant: Maybe if I was actually told what is in it and what I'm being vaccinated for? I know some people are a bit [inaudible] so at school there were padded things with us in there, but other than that not much.

Interviewer: If you decide to have children in the future, do you think you will vaccinate them?

Participant: Yeah

Interviewer: What factors would be the most important to you?

Participant: MMR. Oh, the ones I've had, can't name most of them but if the doctor said they need them then I'm sure they do and I'd give it them.

Interviewer: Great. Thank you very much.

Interview 14 Transcript

Interviewer: Hello, thank you for agreeing to be interviewed. Today I will ask you some questions about your views surrounding vaccination. If there is any question you'd prefer not to answer, that is absolutely fine and you can withdraw from the interview at any time. The interview should take less than fifteen minutes and will be tape recorded. First I would like to start with some background questions about you. How old are you?

Participant: 16

Interviewer: How would you describe your ethnicity?

Participant: White British

Interviewer: What is your religious background?

Participant: Atheist

Interviewer: Ok, Are you a student?

Participant: Yes

Interviewer: What are you currently studying?

Participant: A variety of subjects

Interviewer: GCSEs?

Participant: GCSES yeah

Interviewer: Do you know what vaccination is?

Participant: Yes

Interviewer: Please could you describe how vaccination works?

Participant: It's where you get given a part of a dead - an inactive - pathogen that you get put into your bloodstream and your antibodies fight it, and the memory cells will remember what antibodies were created so if you ever get that certain disease when its active the antibodies will be able be created quicker because the memory cells are remembering what combination of [inaudible] need to be created.

Interviewer: Yes, do you remember ever being vaccinated or know that you have been?

Participant: I've had injections sometime last year for some diseases but I don't remember.

Interviewer: So can you talk me through what happened?

Participant: Well it was all done to do with school. And my mum knew when I younger whether I had - what injections I had but it was - it seemed to be a thing that needed to be done at that age. so when you are fifteen, a lot of people in school, unless they already had it because they were going away, on holiday or something, they'd get an injection, for this- you know to stop you getting this disease. they just took you to a room and they sat you down and they talked to you while they were doing it, so they were very friendly and they just like I don't know like wiped the skin and put the needle in.

Interviewer: So did anyone discuss it with you before?

Participant: Yeah

Interviewer: Who was that?

Participant: We got told by our - I think it was our head of year. As a group, as a year group we got told about it, I'm pretty sure or maybe it was one of our teachers. But certainly when we went into the room that we were going to have our injection, because we went in, in sort of classes, in groups of thirty, they all gave us another

introduction into what would be happening and what would be going on and that it would all be under safe conditions.

Interviewer: So how safe do you think vaccination is?

Participant: Very.

Interviewer: What do you think the risks are?

Participant: Well I think a lot of people say that there's risks like some people do claim that vaccination in babies, that gives them, makes them prone to certain to type of illnesses something along those lines. But yeah I'd say they are safe.

Interviewer: Do you worry about the spread of infectious diseases?

Participant: No, because our day and age is advanced I'd say and there's a lot of different ways that we can fight certain diseases.

Interviewer: Why do you think some people are against vaccination?

Participant: Because they don't believe it will work or they are scared that it won't work and so like the case I was saying about the parents who don't want their children to be vaccinated - they are scared that, they may have read something somewhere that someone's made up or they've been sceptical about it and they've made up this article saying that you know, it will give X disease if you take this vaccination that's meant to save you from another disease and then people read it and go "ooh, quite sceptical about it" so they think it's a negative rather than a positive that it helps thousands of people.

Interviewer: What are your opinions on these reasons that people have for not vaccinating?

Participant: What I think of it?

Interviewer: Yeah personally, what you think about those reasons?

Participant: I think that obviously it's very easy criticise something or its very hard to go along with something that you're not experienced by but I think to not have your kids vaccinated against a certain disease because you think that they will be worse things happening. I think that's a poor reason and you should just believe the scientists or the people constructing this vaccination, when someone tells you that your kid needs a vaccination to help you fight against this disease you should agree with them and not take a risk that in the future that can become diseased because you chose to have your kid not vaccinated due to some article that you read that was structured by someone that was inexperienced.

Interviewer: Leading on from that, do you think that parent's should have the right to choose not to vaccinate their children?

Participant: Erm, yes, I'd say that it's their - I suppose it's their parents - the kids right but they are too young to choose, but I think if its someone my age, then I'd get

to choose whether I'm getting vaccinated but when its parents who do have young children, then I'd say that they do have the right to choose but I think they should strongly be persuaded by the scientists or the people carrying out the experiments.

Interviewer: That's great. So if you needed to make a decision about whether to personally vaccinate or not, where would you look for information?

Participant: My doctors because simply it's something medical and the doctors is the place that I think is medical so I'd go there and I'd try and ask and find out, or alternatively, look on the internet. But then you can find biased articles.

Interviewer: So how do you know if an information source is reliable?

Participant: Well, if I was speaking to someone in person then I'd feel more inclined that it would be reliable. I think that if it was online I'd look at multiple sources to see which is the correct one, almost like when you are doing some sort of homework assignment and they tell you to research something. If you don't know about it, you've got to look at multiple sources to see whether, what you are actually reading is correct first time.

Interviewer: Great, do you ever discuss health issues such as vaccination?

Participant: I discuss health issues, but vaccination not one that I've needed to discuss

Interviewer: that's great, would your family's opinions on vaccination influence your attitude towards vaccination

Participant: yes greatly because it's my environment that I am in so if someone in my family was against vaccination then I'd probably have more reasons in my mind going through why I would have a vaccination. That doesn't necessarily say that my own opinion would be to not have a vaccination, it just means that yes being in the influence of my family means I will be influenced by them

Interviewer: what about your friends' opinions?

Participant: less, less I wouldn't... if my family said something, if my friends said something, I'd be much more inclined to go with my family because they know more and at the end of the day who I am talking to is someone that has been influenced by their family so I'm not saying that their family got the wrong influence but.....

Interviewer: You'd be more wary?

Participant: yeah, if my family said you must have vaccination, and one of my friends said don't it will be bad, I'd be more inclined to say well my family says it's a good thing I should go with them, because they know more at the end of the day

Interviewer: okay that's great, so what about your doctor's opinion?

Participant: Oh absolutely, I'd agree with them all the way.

Interviewer: yeah so why is that?

Participant: trust - he's there for a reason, he's not there to make people's lives - he's not really there to be unhelpful. That's his job so he's going to try to do it best he can.

Interviewer: so what do you think influences your views on vaccination the most?

Participant: oh erm, what influences?

Interviewer: in terms of what you see or is it...?

Participant: Erm I think vaccination isn't a thing I tend to come across. I know a little bit about it, what I've been talking about because of what we studied for our Biology unit one at GCSE AQA because that mentions stuff about pathogen and how they fight them and [inaudible] but when it comes to actually thinking about vaccination, there's nothing I really think about, I'd say that I'd only be influenced by my family if it came up or you know, it's something that I don't really talk about and when it happened last year, it was just something, that just happened so go along with it, I didn't think that much of it to be honest.

Interviewer: Do you have any ethical concerns about vaccination?

Participant: No, it's nothing to do with religion or background or place of birth. Everyone's human, no one's going to have different reactions to a disease, you're always going to get ill from a disease so you must have [inaudible]

Interviewer: Do you have any concerns about sterility or cleanliness of vaccination?

Participant: What? Whether it's sterile?

Interviewer: Yeah, the actual needle

Participant: Oh well, I've never thought that. I just presumed it would be fine [laughs] I'd hope that they'd use I guess different needles or they'd certainly clean it in sort of chemicals before they put it in different things so

Interviewer: Is there anything else that worries you about vaccination?

Participant: No [laughs] but then everyone always goes 'oh it's going to hurt' so not really just try to make it as easy for the patient as you can which I think they do because it doesn't hurt that much, you know providing, it's the person as well, if they are very self-conscious and worried about it, you've got to ensure them it will be fine and if necessary sort of numb things if I can put it around the skin, in some little yeah.

Interviewer: What about ingredients in the vaccines?

Participant: No idea what chemicals! As the person whose getting it, I guess I should know because it's going into me but at the end of the day it's not something that I

think about I just think this is a cure for a disease that I may get so I must have it, I don't think about what chemicals go into it.

Interviewer: that great do you think there are any specific vaccines that would not accept

Participant: no. to be honest I've always thought why don't people get all vaccines because it would make sense. I don't understand how if someone was to get ill by a disease surely they would have had a vaccine, if you've got a vaccine for all possible diseases, obviously it would be a lot of material being put in [laughs] and your body wouldn't be able to cope with it, but the ones that are certainly very common, which I think they do. They vaccinate all the common ones, yeah there's no reason why I wouldn't want to have that.

Interviewer: yep, what do you think would make you feel more confident about vaccination?

Participant: I guess more reassurance but then it's already pretty reassuring anyway. When you get told about it, you feel confident, or certainly I feel confident but then I'm more of a confident person than other people with respect to whether it would hurt or yeah

Interviewer: and if you decide to have children in the future, do you think you would vaccinate them

Participant: yes

Interviewer: so what factors would be the most important for you?

Participant: Which ones or...?

Interviewer: So would it be because... what would you take into consideration?

Participant: The fact that if I've had it, and it's been fine, then they should have it and they'll be fine, if doctors are telling me that they need it, then it has to be done. You don't want to get twenty years down the line and they've got a life threatening disease, you know? You're a bit stupid to go "ah, actually I'm not going to". It's all about hindsight thinking. You've just got to do it, it's one of those things. There's no reason why you should be choosing against it, not that I can think of, but then I'm fine with it so I can't think of a negative reason.

Interviewer: Okay, thank you for agreeing to be interviewed.

APPENDIX 7: LESSON PLAN

Learning outcomes Students should: <ul style="list-style-type: none"> • Know what a pathogen is • Understand the process of vaccination and how it leads to immunity • Know what herd immunity is and how it is beneficial to a population • Background information about measles and how it can be prevented by vaccination 		Specification links: Infectious diseases; Vaccination
Procedure	Activity	Duration
Pre-test assessment	Participants will be asked to complete a short questionnaire to allow pre-test scores to be calculated on attitude and knowledge towards vaccination	15 minutes 5 minutes
Introduction	Brief introduction to the session. Researcher to introduce self and that the session is about vaccination and its importance.	20 minutes
Intervention	(Intervention groups will receive interventions separately – please see Section 4.1 for Gantt chart) Group A – Participants will use the digital resource to explore vaccination and measles by following the onscreen task. Participants will be given a short worksheet to complete.	
Conclusion	Group B – Participants will receive a PowerPoint presentation about vaccination and measles. Participants will be given a short worksheet to complete.	5 minutes
Post-test assessment	Group discussion – Class discussion led by the researcher on the advantages and disadvantages of vaccination. The same discussion questions will be asked to both groups. Participants will be asked to complete the same short questionnaire to allow post-test scores to be calculated on attitude and knowledge towards vaccination	15 minutes

APPENDIX 8: WORKSHEET

Vaccination worksheet

1. What is vaccination?

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2. What is the benefit of vaccinating?

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3. Why can't some people be vaccinated?

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4. What is it called when vaccination coverage is high enough to prevent outbreaks?

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5. What percentage of vaccination coverage do we need to prevent outbreaks of measles?

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6. What happens if vaccination coverage is low?

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APPENDIX 9: TRIAL FEEDBACK FORM

Evaluation questionnaire

Thank you for attending the vaccination session. Please provide feedback using the form below by ticking 'strongly disagree', 'disagree', 'neither agree nor disagree', 'agree' or 'strongly agree' for how you found each aspect of the workshop.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I found the session informative					
The session was interesting					
I thought that the session was fun					
I learnt something new from this session					
The session was a good way for me to learn about infectious diseases					
I found the resource easy to use					
The resource is well designed					

How would you improve the session?

Additional comments:

APPENDIX 10: ETHICAL APPROVAL MEMO

FACULTY OF SCIENCE AND ENGINEERING



Manchester
Metropolitan
University

MEMORANDUM

TO Kate Carolan
FROM Megan Schofield
DATE 18th March 2015
SUBJECT Application for Ethical Approval (SE141521)

On the 18th March 2015 the Head of Ethics for Science & Engineering considered your application for Ethical Approval (SE141521) entitled "Assessment of the impact of a digital intervention on public attitudes to vaccination". The application has been granted Favourable Opinion and you may now commence the project.

MMU requires that you report any Adverse Event during this study immediately to the Head of Ethics (Prof Bill Gilmore) and the Administrator (Megan Schofield). Adverse Events are adverse reactions to any modality, drug or dietary supplement administered to subjects or any trauma resulting from procedures in the protocol of a study.

An Adverse Event may also be accidental loss of data or loss of sample, particularly human tissue. Loss of human tissue or cells must also be reported to the designated individual for the Human Tissue Authority licence (currently Prof Bill Gilmore).

If you make any changes to the approved protocol these must be approved by the Faculty Head of Ethics. If amendments are required you should complete the MMU Request for Amendment form (found on the Graduate School website) and submit it to the Administrator.

Regards

Megan Schofield
Research Degrees Group Officer
All Saints North