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Improving physiotherapists' ability to recognise the presence of a serious pathology with a digital educational training: a mixed methods feasibility study

Jessie Janssen[1,2], Wolfgang Lackenbauer[1*], Simon Gasselich[1], Martina Edda Lickel[3], Lars Schabel[4], Reinhard Beikircher[5], Christian Keip[1], Manfred Wieser[3], Bruno Mazuquin[6] and Gillian Yeowell[6]

Abstract

Background Due to an aging population, the incidence of musculoskeletal disorders and serious pathologies like spinal fractures and cancer is rising. Physiotherapists are ideally positioned to screen for signs and symptoms of serious pathologies (red flags) early; however, training in recognizing these signs and symptoms is limited. Additionally, evidence on the effectiveness of digital educational tools for this purpose is sparse. This study aimed to assess the feasibility of a digital educational training designed to improve physiotherapists' ability to identify serious pathologies.

Methods A randomised mixed-methods feasibility study ran from March to May 2024, involving Austrian physiotherapists recruited via email. After providing informed consent and demographic data, participants completed a structured digital educational training. This training comprised three asynchronous chapters, with Chap. 2 featuring modules in orthopaedics, oncology, and internal medicine. Various digital formats (video podcast, presentations, animations) of different durations were included to gauge user preferences. Feedback was gathered using the Feasibility of Intervention Measure (FIM) and a mixed-methods survey. Quantitative data were analysed descriptively using SPSS, and qualitative data inductively using MAXQDA.

Results Thirty-nine physiotherapists registered, and 30 completed the digital educational training. The median FIM score was 5, indicating high feasibility. Participants favoured digital materials lasting 6 to 15 min. Qualitative feedback highlighted the need for platform improvements (e.g., flexible module access) and enhancements to the digital educational training (e.g., detailed background information, more complex vignettes, varied formats). Participants appreciated the asynchronous learning possibility, progression tracking, and varied short digital formats but noted the limitations of online learning compared to in-person interactions.

Conclusions Our findings suggest that a digital educational training aimed at improving physiotherapists' ability to detect serious pathologies is feasible. Participants emphasized the importance of adaptable platforms and a variation

*Correspondence:
Wolfgang Lackenbauer
wolfgang.lackenbauer@imc.ac.at
Full list of author information is available at the end of the article

in digital materials to enhance the training. Limitations included the need for additional complex vignettes and limited participation in face-to-face discussions. Future research should explore flexible learning options, complex scenarios, and direct feedback mechanisms.

Keywords Red flags, Physical therapy, Direct access, Training, Online, Asynchronous learning

Introduction

We live in an ageing society, where the proportion of people aged 65 and over is predicted to increase over the next five decades [1]. Older age is a risk factor for developing musculoskeletal complaints, and increases the likelihood of developing serious pathologies, such as spinal fractures or cancer [2]. Although early detection of serious pathologies is desirable, as it improves prognosis and treatment success, it can be difficult [3, 4]. As physiotherapists usually treat patients over longer periods of time, they are in an excellent position to identify signs and symptoms of serious pathologies that may develop over time and may not have been present at the time of a previous medical examination or initial assessment [5].

Regardless whether physiotherapists are working in a direct or non-direct access system, they can play a critical role in the early detection of serious pathologies affecting the musculoskeletal system [6–14]. However, published research using clinical vignettes suggests that physiotherapists and physiotherapy students lack in-depth training to accurately and autonomously identify the presence of serious pathologies [15–22]. Results of these quantitative studies are supported by qualitative data obtained from physiotherapy students [23] and qualified physiotherapists in Austria [24], qualified physiotherapists in Denmark [25] and new physiotherapy graduates in Australia [26] in which study participants highlight the need for more comprehensive education and training on the topic of screening for the presence of serious pathologies.

New guidelines have been published concerning the detection of serious pathologies [27, 28]. Finucane et al. [27] have proposed a traffic light system, which indicate the level of concern a physiotherapist should have regarding sending a patient for follow up. It progresses a patient from treatment as normal, through watchful waiting, to no treatment and (immediate) referral to a medical doctor. Even though it is still not always possible to clearly define the boundaries of the individual traffic light categories, this structure differs from the traditional keep, keep/refer and refer system introduced over 20 years ago [16] and could be ideal for educational purposes.

Since the COVID-19 pandemic, the world of learning and education has undergone a digital transformation and various digital learning resources and strategies have become an integral part of university and continuing professional development landscape [29]. The main advantages of digital learning are that it allows learning to be independent of time, allows students and learners to manage their own learning progress and to choose their preferred learning style. Another huge advantage is the low-grade accessibility of online lectures and materials. In the past, attending in-person courses that were located far away was often not feasible. With the expansion of digital learning, this is increasingly possible [29].

Despite the need to for more training directed at physiotherapists and physiotherapy students on how to screen for serious pathologies [23, 24, 26, 30] and the growing field of online training, there is limited evidence in the current literature regarding the effectiveness of a digital learning tool for screening for serious pathologies [31]. In a previous study [32], we developed and validated a series of new clinical vignettes in the fields of oncology, internal medicine and orthopaedics, which were designed to reflect key scenarios relevant to physiotherapists working in a non-direct access setting. Building on that work, the current paper focuses on the integration of some of these vignettes into a digital educational intervention.

Before an intervention can be tested for effectiveness, feasibility and pilot studies are expected to be carried out [33]. This presents an opportunity to develop and evaluate a new educational approach to this topic. Hence, the aim was to test the feasibility of a digital educational training to improve physiotherapists' ability to detect the presence of serious pathologies.

Methods

Trial design

A mixed methods feasibility study was conducted between March and May 2024. A survey with quantitative (validated feasibility measure and closed questions) and qualitative (open ended questions and a discussion round) data was conducted at the end of the digital educational training. The CONSORT 2010 statement: extension for pilot and feasibility trials was used to report on the project [34], for the description of the intervention the TIDieR checklist was used [35].The project was examined by the Commission for Scientific Integrity and Ethics of the Karl Landsteiner Private University, and no medical ethical concerns about the conduct of the project were found (1076/2023).

Participants

Physiotherapists were eligible to participate in the study when they were registered as a physiotherapist in Austria, had treated patients within the last 12 months, willing to sign a confidentiality agreement on the presented content, and provided their consent to the study. No other in- or exclusion criteria were set.

The recruitment process took place between the 6th of February and the 10th of April 2024. Physiotherapists who had expressed interest in Red Flag screening during a previous national survey [36] were invited via email to participate. Alumni of IMC University of Applied Sciences Krems, Austria, and professional contacts of the researchers were also invited to take part. Additionally, a snowball recruitment strategy was used whereby participants were encouraged to share the invitation with their colleagues. The invitation email provided an explanation of the project, an overview of the feasibility study (including its objectives, timeline, and process), and a link to an online survey [37]. Following this, demographic data (age, gender, years of practice, clinical specialization, employment status), and personal data, email address and name, were collected. Participants were then asked to select a month (March, April, or May 2024) to complete the online education. Lastly, the participants provided written consent for the digital educational training and a confirmation email was sent.

Procedure

A reminder email was sent to the participants a few days before the course began. At the start of their chosen month, participants received an email which included a brief guide to using the online platform [38], a detailed user manual, and information about a voluntary discussion round held at the end of the month. An automated link for access to the online learning platform was sent on the same day. Participants had the rest of the month to individually complete the course. An email address was provided to answer additional questions regarding the access and content of the study.

Two weeks before the end of the course, participants were reminded about the course completion deadline and the upcoming discussion round. Upon completion of the digital educational training, participants received a certificate of attendance.

Intervention

The intervention was a digital educational training to improve physiotherapists' ability to detect the presence of serious pathologies. A first version of the digital educational training was sent to three physiotherapists as a pilot trial. Feedback was given on the general understanding of the course and on the perception of usability of the e-learning platform. The feedback from the pilot has been incorporated into the training.

We used the online learning platform 'Talent-LMS' to develop and run the training. The structure of the complete digital educational training can be found in the supplementary file 1. Content was separated into three chapters, all asynchronously available. Chapter 1 'introduction', Chap. 2 'clinical vignette modules', and Chap. 3 'feedback' were always listed in the same order. The training was designed in this way, so that participants could first get more theoretical knowledge about red flags in Chap. 1, before applying this knowledge in Chap. 2. Within Chap. 2, clinical vignette modules were presented for three different clinical specialisations: internal medicine (IM), oncology (ON), orthopaedics (OR). The content for the vignettes was taken from previous work by Lackenbauer et al. [32]. These vignettes were randomised in the six possible combinations using randomizer.org. At the end of Chap. 1 and each module of Chap. 2, a forum was available for discussion and asking questions to the researchers (PTs, MDs and a Health scientist) and fellow participants.

The introduction (Chap. 1) provided an overview of the course and participants were informed of the need to sign a confidentiality agreement, so that the information and videos in the training would not be copied. Following this, five 5-minute videos were presented, each covering key aspects of red flag screening through lecture-style presentations (recorded Powerpoint presentations).

Chapter 2 was divided into three subject-specific modules, each structured similarly to facilitate learning and application [39]. Every module included the following six parts: (A) document with background knowledge, (B) one clinical vignette (text or animation), (C) a quiz, (D) digital background material (written, video podcast or lecture-style presentation), (E) the solution to the quiz, and (F) a forum. Each module was structured in a different order to explore which order worked best. In addition, to explore preferences for different digital formats of the educational material, each module was designed with distinct presentation styles. For internal medicine background knowledge was provided through a video podcast featuring a specialized physiotherapist and a cardiologist, while the clinical vignette and its solution were presented as text. In the oncology module both the background information and solution were presented via a recorded lecture-style presentation, whereas the clinical vignette was presented as text. Finally in the orthopaedic module the clinical vignette was delivered as an animated video, with the background information and the solution provided as text.

The final chapter aimed to gather feedback on the digital educational training. Feedback was collected through the 'Feasibility of Intervention Measure' (FIM) [40], as well as a mixed methods survey and online discussion rounds (see below).

Outcomes

The FIM was used for the main outcome measure. It consisted of four different questions of feasibility and was rated through a 5-point Likert-Scale (1 = completely disagree to 5 = completely agree). The test retest reliability and validity of the FIM were acceptable, with a Cronbach alpha of 0.88 and 0.89, respectively [40].

Additionally, a survey with open- and closed-ended questions regarding the course content and format was completed (supplementary file 2). Closed-ended questions gathered information about the preferred order of the module parts, the preferred digital format of the educational material, and the preferred length of digital formats of the educational material. Each digital format was assigned points based on its rank (1st = 3 points, 2nd = 2 points, 3rd = 1 point), and a total score was calculated. These outcomes were collected immediately after participants finished the digital educational training.

The aim of the qualitative section (open-ended questions and discussion round) was to gather suggestions for enhancing the digital educational training. Therefore, in the online survey, specific questions were asked about barriers and facilitators of the course and ideas of their ideal learning tool. Additionally, within the last 10 days of the digital educational training a discussion round took place, allowing participants to have either completed or be near the end of their training. Completion of the training prior to the discussion round was not a requirement for participation. Each discussion round included four members of the research team, ensuring representation from different areas of the project (Talent LMS, Physiotherapy, Medical Doctor) to address any potential questions. A guided discussion encompassed the following topics: content, technical issues, possibilities to increase adherence, and implementation in practice.

Sample size

This study was deemed feasible if 80% of participants achieved a mean FIM score of 4 (agreement) or higher. The confidence interval (%) of feasibility was calculated using the following equation: 1.96 x √(p x (1-p)/n), where p was the percentage of feasibility and n was the intended sample size. With a sample size of 30 completed FIM questionnaires, we could therefore calculate a feasibility rate of 80% within a 95% confidence interval of +/- 14%- [41]. To allow a dropout rate of 20%, the total number of participants at the start of the training was calculated at 36.

Randomisation

The three modules in Chap. 2: Internal Medicine, Oncology, and Orthopaedics were offered in six different orders. Prior to the participant registration process, a block (6 × 6) randomisation sequence was generated by one researcher (JJ) using randomizer.org for a total of 36 spots. Participants were assigned to their respective order based on their registration number and were blinded to the intervention order. One researcher (SG) had access to the randomisation sequence and allocated the participants to the allocated group. The other researchers were blinded to the allocation during the study.

Statistical methods

All quantitative data was analysed using SPSS (V.29.0). Data extraction and descriptive analysis were done by two researchers (JJ, SG). A descriptive analysis was conducted for baseline demographics and quantitative data (median and range). Categorical variables were summarized using frequencies and percentages.

All qualitative data was gathered from open-ended questions and the discussion round. Two researchers (SG, MT) independently analysed the feedback inductively [42] using MAXQDA (V.24) and identified three categories. These categories were then discussed until consensus was reached.

Results

In total, 116 individuals began the registration process, however, 75 individuals (65%) dropped out after completing the first page (study details and confirmation), and 2 (2%) more withdrew while selecting a timeslot. Of the 39 remaining participants who successfully registered for the feasibility study, 30 (77%) completed the digital educational training (3 participants dropped out each month). Table 1 presents the demographic and characteristic description of the 30 participants (of which 21 (70%) identified as women) who completed the training. Thirteen participants started in March, 15 in April, and 11 in May (Fig. 1).

Feasibility

The overall median FIM score was 5 (completely agree) (Table 2). The domains of the FIM: 'seems implementable', 'seems possible' and 'seems doable' received a median rating of 5 (minimum 4, maximum 5). Only the domain 'seems easy to use' received a median rating of 4 (minimum 3, maximum 5).

Preferred order in the clinical vignette modules

Fourteen of the 30 participants (47%) preferred a similar sequence of the module parts: 'ADBCEF' ($n = 10$, 33%) and 'ABDCEF' ($n = 4$, 13%) (Table 3). These two options were quite similar, in that only the second and third module parts switched. First participants wanted to be able to download the background knowledge, then the clinical vignette or the digital background format was preferred. Afterwards a quiz was required and then the solution of the clinical vignette and a forum.

The other 16 participants (53%) all had different preferences, in such a way that all other sequences only occurred once or twice.

Table 1 Descriptive statistics of the participants

	N	%
Number of physiotherapists	30	100
Gender		
Woman	21	70.0
Man	9	30.0
Age (years)		
20–25	5	16.7
26–30	3	10.0
31–35	9	30.0
36–40	3	10.0
41–50	7	23.3
51–60	3	10.0
Clinical experience (years)		
1	1	3.3
2–3	10	33.3
4–5	2	6.7
6–10	3	10.0
11–15	3	10.0
16–20	3	10.0
> 20	8	26.7
Speciality		
Musculoskeletal	22	73.3
Neurology	2	6.7
Geriatrics	3	10.0
Cardiorespiratory	1	3.3
Gynaecology	1	3.3
Missing	1	3.3
Employment setting		
Self-employed	13	43.3
Employed	9	30.0
Employed and self-employed	8	26.7

Preferred digital format of the educational material

The educational material with the highest ranking was the video podcast, followed by animation and lecture-style presentation ranked next in second place (Fig. 2).

Preferred length of digital formats

The preferred length for digital formats ranged between 3 and 5 and 16–20 min. However, the majority of participants ($n = 16$, 53%) preferred a length of 6–10 min. With nine participants (30%) indicated that they preferred a length of 11–15 min.

Suggestions for enhancing the digital educational training (qualitative)

The main aim of the open-ended questions was to find suggestions for enhancing the digital educational training. Three categories were found: *1) valued aspects,* 2) *changes to the learning platform*, and 3) *changes to red flags training*.

In the first category, *valued aspects*, it became apparent that the participants were keen to keep certain aspects of the digital educational training. Participants liked it that in the *learning platform* they could "download background information" (PT35), and that there was a "progress indicator" (PT3). Additionally, it was seen as beneficial in the *red flags training* that "the videos were separated in short sequences" (PT7), so that they could "decide independently when to find time for it [the training]" (PT 8), and that the education used "clinical cases" (PT27) in "a mixture of formats" (PT7).

In the category *changes to the learning platform* the technical side of the learning platform was central. Two subcategories were found. The first subcategory referred to *the order of the educational parts*. Some participants preferred to have "first the background knowledge" (PT27) or requested "quizzes after each chapter" (PT35). In the second subcategory the participants asked to have *more flexibility on the learning platform*. For example, one participant asked to have "Access to retrieve individual modules again in the future and read/review them" PT26) another would have liked that "Elements (were) findable with search form" (PT3).

In the last category, *changes to the red flags training*, suggestions related to the category red flags were listed. Three subcategories were found: underpinning theory, application of theory, and bigger scope. In the *underpinning theory* subcategory changes to the background information were central. Participants shared that Finucane's traffic light system [27] in the explanation videos needed more information and depth: "differentiation of the traffic light system was too short, I needed more information" (PT24) or that they wanted "More background knowledge/more documents for reference would be helpful." (PT20). In the *application of theory* subcategory predominantly, the clinical vignette modules were in focus. Participants requested "more cases,….also more difficult (cases)" (PT20), and more "videos where a case is discussed"(PT32). Participants had different opinions on the use of animations. One participant said that "Animations for the case study would have helped me to better remember facts in the quiz "(PT29), whereas another participant mentioned that "I couldn't concentrate on the case study that was read out, so I had to listen to the video several times with my eyes closed." (PT31). In the *bigger scope* subcategory participants asked to have more "modules to other medical treatment areas" (PT51), and that "such a tool should soon be available for all physiotherapists" (PT14). One participant mentioned that they missed "Having patients in front of me, being able to talk and touch them and therefore getting a lot of information that I can't even put into words. Unfortunately, that's the disadvantage of online". (PT6).

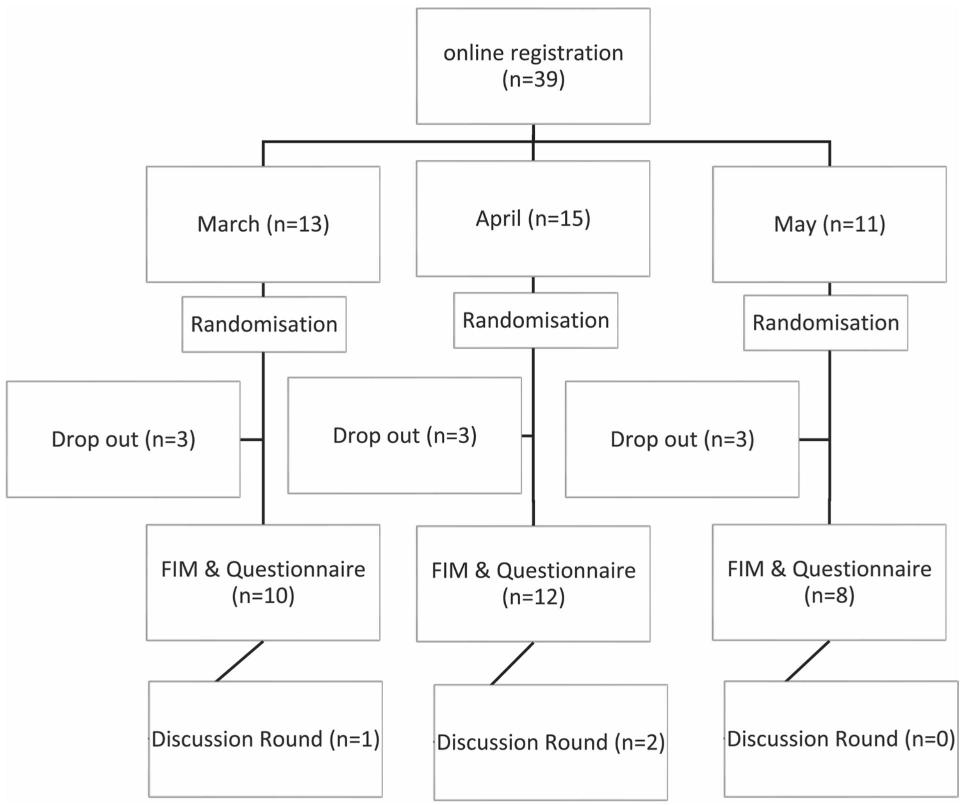

Fig. 1 Overview of the randomisation and data collection process

Table 2 FIM outcome

N=30	Seems Implementable	Seems Possible	Seems Doable	Seems Easy to use	Total
Median	5	5	5	4	5
Minimum	4	4	4	3	4
Maximum	5	5	5	5	5

Table 3 Preferred sequence of clinical vignette modules

1	A) Download document, background information	
2	B) Clinical vignette [32]	D) Digital background knowledge
3	D) Digital background knowledge	B) Clinical vignette [32]
4	C) Quiz	
5	E) Solution clinical vignette [32]	
6	F) Forum	

Discussion

This study tested the feasibility of a digital educational training to improve physiotherapists' ability to detect the presence of serious pathologies. Our findings suggest that an online training programme is feasible to use as an educational tool for physiotherapists. A recent study which developed a website focused on educating physiotherapists on serious pathologies in Denmark also found that the majority of their participants also indicated that the online education tool was feasible (unpublished data).

This study builds on our previous work in which we developed and validated a series of new clinical vignettes [32]. While that earlier paper detailed the development and validation process of the clinical vignettes, the current study examined the feasibility of a digital educational intervention that incorporates three of these newly designed vignettes, each presented in a distinct digital format. This feasibility study serves as a critical step toward evaluating the intervention's potential for broader implementation and informing the design of a future randomized controlled trial.

The chosen learning platform used in this study was a prefabricated online learning platform which meant that existing elements, such as videos, text or pictures, could be added in different orders. However, once the order was set by the researchers, it could not be changed by the participants. Therefore, a structure needed to be followed. At the beginning of this study, it was not clear how physiotherapy professionals wanted to learn in a digital educational training [39], therefore the three clinical vignette modules in Chap. 2 were constructed in different orders and preferences were asked. Even though half of

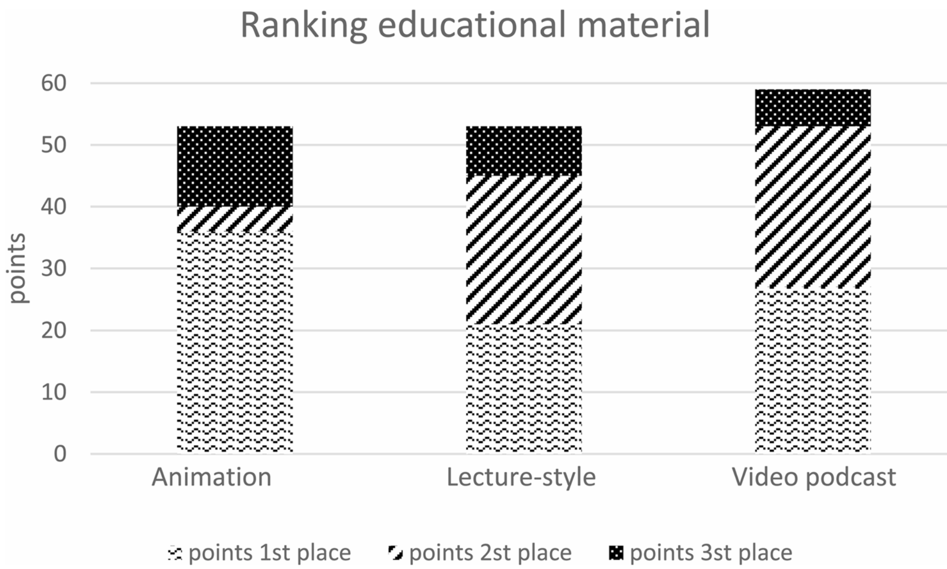

Fig. 2 Preferred educational material

the participants preferred a similar order, the other half listed varied learning preferences, indicating that there was no 'one-size fits all'. Also, the qualitative feedback emphasised that not everyone agreed with the structured approach (category: 'changes to the learning platform'). One possible solution is to build an interface where more flexible learning is possible [43].

The percentage of female physiotherapists who completed the digital educational training mirrors the Austrian physiotherapy population in 2021 and 2024 [44, 45]. The majority of the participants were working predominantly in musculoskeletal (73%) or geriatric (10%) physiotherapy, reflecting that the target population was reached. In addition, 43% of participants were self-employed, 30% were employed, and 27% were both employed and self-employed, providing a good mix over the employment status.

Both quantitative and qualitative results showed that there was not one preferred format of the educational material. Despite the fact that the animation video reached the second place overall, it also received the most votes for first and last place in the quantitative data. The qualitative data confirmed this ambiguity. Additionally, participants indicated that a mix of several formats was seen as beneficial. This is in line with guidelines from Brame et al. [43] which also indicate that people benefit from having different formats to learn from.

A guideline for effective educational videos advises that, in order to reduce the cognitive load of students during learning, and to ensure the students are engaged, videos should be kept under 6 min [43]. However, the preferred length of videos in our study was between 6 and 15 min. An explanation to this difference could be in the fact that the participants in this study were already qualified physiotherapists and not students [46].

The recognition of serious pathologies, especially in the early disease stage, is a difficult task [3, 4]. Despite the fact that the traffic light system [27] was explained in the introduction of this digital educational training, participants indicated that they expected the traffic light system to have clearly defined cut off points. However, it should be kept in mind that even with experience and knowledge the categorisation of a case (for example normal treatment or watchful waiting) is not always straightforward. Future research or educational projects should therefore consider including an in-depth explanation on this uncertainty.

Limitations

Due to the recruitment strategy of this study, which involved snowballing, it was not possible to list the number of physiotherapists the invitation has reached. It is therefore not clear if all physiotherapists interested in this study received the opportunity to participate. In a previous survey study [36] however, we have asked Austrian musculoskeletal physiotherapists to indicate if they were interested in further studies on this topic, all ($n = 76$) interested physiotherapists were invited to this study.

For this digital educational training three clinical vignette modules have been prepared. Feedback from the participants indicated that more clinical vignettes and in different complexities would need to be developed in order to prepare for the clinical physiotherapy setting. Now that this study showed that such a training is feasible, the authors agree that the volume of the number of clinical vignettes and in-depth education should be expanded.

One of the data collection methods was the use of face-to-face discussion rounds. Even though participants have indicated that such rounds would be beneficial and despite two reminders in this study, the uptake of the discussion rounds was minimal. Future studies should further explore how a direct feedback round could be implemented into the online training.

Although participants who completed the study reported that the intervention was feasible, it is important to acknowledge the high dropout rate observed after registration. Specifically, 65% of prospective participants dropped out after completing the first page (study details and confirmation). This substantial early dropout rate suggests that the modules may be less feasible or engaging for a broader population than indicated by the responses of those who completed the whole digital educational training programme. Consequently, the findings relating to feasibility may reflect the experiences of a subset of participants who are more motivated or self-selecting. Future research should explore the reasons for this early dropout to better understand and address potential barriers to engagement for a wider audience.

Conclusions

This study showed that a digital educational training aimed to improve physiotherapists' ability to detect the sign and symptoms of serious pathologies is feasible. Based on the participants' feedback future studies should keep the asynchronous learning possibility, flexibility to learn when time is available, and the different learning formats. Additionally, more complex clinical examples, more detailed explanations of background information and consistently longer videos would help improve this education training programme.

Abbreviations

FIM Feasibility of Intervention Measure
PT participant

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

J.J., W.L., M.W., B.M, and G.Y. have made substantial contributions to the conception of the work, J.J., W.L., S.G, B.M, and G.Y. have made substantial contributions to the design of the work, J.J., W.L., S.G., M.L., L.S., R.B, C.K., and M.W. have made substantial contributions to the acquisition and analysis, J.J., W.L., S.G., M.L., R.B, B.M, and G.Y. have made substantial contributions to the interpretation of data, J.J., W.L., S.G. have drafted the work or substantively revised it. All authors have reviewed the manuscript and have approved the submitted version.

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Data availability

The dataset generated during the current study are available in anonymous form in the Github repository: https://github.com/JcadJanssen/redflag_feasibility.

Declarations

Ethics approval and consent to participate

The project and all experimental protocols were examined by the Commission for Scientific Integrity and Ethics of the Karl Landsteiner Private University. No medical or ethical concerns about the conduct of the project were found (1076/2023). All methods and experiments were performed in accordance with relevant guidelines and regulations.
Informed consent was obtained from all participants.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

[1]Institute of Therapeutic and Midwifery Sciences, Department of Health Sciences, IMC University of Applied Sciences Krems, Krems an der Donau, Austria
[2]Institute of Health Sciences, University of Applied Sciences St. Pölten, St. Pölten, Austria
[3]Human Medicine, Karl Landsteiner University of Health Sciences, Krems an der Donau, Austria
[4]Clinical Department of Orthopaedics and Traumatology, University Hospital Tulln, Tulln, Austria
[5]Department of Physiotherapy, FH Gesundheitsberufe OÖ, Wels, Austria
[6]Department of Health Professions, Faculty of Health and Education, Manchester Metropolitan University, Manchester, UK

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References

1. European Commission. Ageing Report. Underlying Assumptions and Projection Methodologies. 2024. Available from: https://economy-finance.ec.europa.eu/publications/2024-ageing-report-underlying-assumptions-and-projection-methodologies_en. [cited 2025 Apr 29].
2. Coll PP, Korc-Grodzicki B, Ristau BT, Shahrokni A, Koshy A, Filippova OT, et al. Cancer Prevention and Screening for Older Adults: Part 2. Interventions to Prevent and Screen for Breast, Prostate, Cervical, Ovarian, and Endometrial Cancer. J Am Geriatr Soc. 20200903rd ed. 2020;68(11):2684–91.
3. Gould BE. Pathophysiology for the Health Professions. 3rd ed. Philadelphia : Saunders Elsevier; 2006.
4. Levack P, Graham J, Collie D, Grant R, Kidd J, Kunkler I, et al. Don't wait for a sensory level–listen to the symptoms: a prospective audit of the delays in diagnosis of malignant cord compression. Clin Oncol R Coll Radiol. 2002;14(6):472–80.
5. Cook CE, George SZ, Reiman MP. Red flag screening for low back pain: nothing to see here, move along: a narrative review. Br J Sports Med. 2018;52(8):493–6.
6. Boissonnault WG, Ross MD. Physical therapists referring patients to physicians: a review of case reports and series. J Orthop Sports Phys Ther. 2012;42(5):446–54.
7. Brindisino F, Passudetti V, Pennella D, Giovannico G, Heick JD. Recognition of pulmonary pathology in a patient presenting with shoulder pain. Physiother Theory Pr. 2022;38(4):597–607.

8. Crowell MS, Gill NW. Medical screening and evacuation: cauda equina syndrome in a combat zone. J Orthop Sports Phys Ther. 2009;39(7):541–9.
9. Lackenbauer W. Compression Fracture as a Cause of Persistent Complaints in the Thoracolumbar Spinal Region: Case Report. MSK – Muskuloskelettale Physiother. 2021;25(01):46–51.
10. Lackenbauer, W. Visceral Pathology as a Cause of Diffuse Pain in a Complex Pain Setting: Case Report. MSK-Muskuloskelettale Physiother. 2023;27(01):45–59.
11. Lopez G, Cataldi F, Bellin G, Dunning J, Fernández-de-Las-Peñas C, Galeno E, et al. Physiotherapy Screening for Referral of a Patient with Patent Foramen Ovale Presenting with Neck Pain as Primary Complaint: A Case Report. Healthc Basel. 202318;11(8). Available from: https://mdpi-res.com/d_attachment/healthcare/healthcare-11-01165/article_deploy/healthcare-11-01165-v2.pdf?version=1681890406.
12. Rodeghero JR, Denninger TR, Ross MD. Abdominal pain in physical therapy practice: 3 patient cases. J Orthop Sports Phys Ther. 2013;43(2):44–53.
13. Sforza C, Margelli M, Mourad F, Brindisino F, Heick JD, Maselli F. Spontaneous spleen rupture mimicking non-specific thoracic pain: A rare case in physiotherapy practice. Physiother Theory Pr. 2023;39(3):641–9.
14. Van Wyngaarden JJ, Ross MD, Hando BR. Abdominal aortic aneurysm in a patient with low back pain. J Orthop Sports Phys Ther. 2014;44(7):500–7.
15. Cross PS, Karges JR, Salsbery MA, Smith D, Stanley EJ. Management of acute sports injuries and medical conditions by physical therapists: assessment via case scenarios. Int J Sports Phys Ther. 2011;6(3):158–72.
16. Jette DU, Ardleigh K, Chandler K, McShea L. Decision-making ability of physical therapists: physical therapy intervention or medical referral. Phys Ther. 2006;86(12):1619–29.
17. Klein P, Rottler E, von Wietersheim J. Screening in Physiotherapy. physioscience. 20186;14(04):170–7.
18. Lackenbauer W, Janssen J, Roddam H, Selfe J. Keep/refer decision making abilities of European final year undergraduate physiotherapy students: a cross-sectional survey using clinical vignettes. Eur J Physiother. 2018;20(3):128–34.
19. Ladeira CE. Physical therapy clinical specialization and management of red and yellow flags in patients with low back pain in the United States. J Man Manip Ther. 2018;26(2):66–77.
20. Mount HE. Screening for medical Referral: Determining Variables that influence Accuracy. Vol. Doctor of Science. [Birmingham]: The University of Alabama; 2012.
21. Riddle DL, Hillner BE, Wells PS, Johnson RE, Hoffman HJ, Zuelzer WA. Diagnosis of lower-extremity deep vein thrombosis in outpatients with musculoskeletal disorders: a national survey study of physical therapists. Phys Ther. 2004;84(8):717–28.
22. Vaughn DW, Shoemaker MJ, Da Prato D, Murray KS, Van Huisen J. The Ability of Final-Year Doctor of Physical Therapy Students to Make Keep/Refer Decisions. J Phys Ther Educ. 2011;25:60–7.
23. Lackenbauer W, Janssen J, Roddam H, Selfe J. Evaluation of an educational intervention that aims to improve the keep/refer decision-making abilities of Austrian undergraduate physiotherapy students: a randomised pilot study. Int J Ther Rehabil. 2020;27(5):1–12.
24. Lackenbauer W, Gasselich S, Keip C, Lickel ME, Beikircher R, Wieser M, et al. An exploration of the ability of Austrian qualified physiotherapists to recognize serious pathology using clinical vignettes. In Basel, Switzerland; 2024.
25. Budtz CR, Rønn-Smidt H, Thomsen JNL, Hansen RP, Christiansen DH. Primary Care Physical Therapists' Experiences When Screening for Serious Pathologies Among Their Patients: A Qualitative Study. Phys Ther. 2022;102(5). Available from: https://www.ncbi.nlm.nih.gov/pubmed/35302642.
26. Phua R, Mandrusiak A, Singh L, Martin R, Forbes R. Identifying and navigating suspected serious pathologies: New-graduate physiotherapists' perspectives and developmental needs. Musculoskelet Sci Pract. 2024;71:102944.
27. Finucane LM, Downie A, Mercer C, Greenhalgh SM, Boissonnault WG, Pool-Goudzwaard AL, et al. International Framework for Red Flags for Potential Serious Spinal Pathologies. J Orthop Sports Phys Ther. 2020;50(7):350–72.
28. Rushton A, Carlesso LC, Flynn T, Hing WA, Rubinstein SM, Vogel S, et al. International Framework for Examination of the Cervical Region for Potential of Vascular Pathologies of the Neck Prior to Musculoskeletal Intervention: International IFOMPT Cervical Framework. J Orthop Sports Phys Ther. 2023;53(1):7–22.
29. Naseer S, Perveen HZ. Perspective Chapter: Advantages and Disadvantages of Online Learning Courses. In: Massive Open Online Courses - Current Practice and Future Trends. IntechOpen; 2023. Available from: https://www.intechopen.com/books/1002099. [cited 2025 Mar 11].
30. Budtz CR, Rønn-Smidt H, Thomsen JNL, Hansen RP, Christiansen DH. Primary care physiotherapists ability to make correct management decisions - is there room for improvement? A mixed method study. BMC Fam Pr. 2021;22(1):196.
31. Campbell M, Fitzpatrick R, Haines A, Kinmonth AL, Sandercock P, Spiegelhalter D, et al. Framework for design and evaluation of complex interventions to improve health. BMJ. 2000;321(7262):694–6.
32. Lackenbauer W, Gasselich S, Lickel ME, Schabel L, Beikircher R, Keip C, et al. Development and validation of clinical vignettes to inform an educational intervention for physiotherapists to detect serious pathologies: a mixed-methods study. BMJ Open. 2025;15(8):e097107.
33. Eldridge SM, Lancaster GA, Campbell MJ, Thabane L, Hopewell S, Coleman CL, et al. Defining Feasibility and Pilot Studies in Preparation for Randomised Controlled Trials: Development of a Conceptual Framework. Lazzeri C, editor. PLOS ONE. 2016;11(3):e0150205.
34. Eldridge SM, Campbell MJ, Bond CM, Hopewell S, Thabane L, Lancaster GA, et al. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. Pilot Feasibility Stud. 2016;2(1):64, s40814-016-0105–8.
35. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. BMJ. 2014;348(mar07 3):g1687–g1687.
36. Janssen J, Lackenbauer W, Gasselich S, Lickel ME, Schabel L, Beikircher R, et al. The ability of Austrian registered physiotherapists to recognize serious pathology. BMC Prim Care. 2024;25(1):387.
37. Unipark. Tivian XI GmbH; 2023. Available from: https://www.unipark.com/umfragesoftware/. [cited 2023 Jan 1].
38. Talent LMS. Epignosis; 2023. Available from: https://www.talentlms.com/.
39. Stander J, Grimmer K, Brink Y. Learning styles of physiotherapists: a systematic scoping review. BMC Med Educ. 2019;19(1):2.
40. Weiner BJ, Lewis CC, Stanick C, Powell BJ, Dorsey CN, Clary AS, et al. Psychometric assessment of three newly developed implementation outcome measures. Implement Sci. 2017;12(1):108.
41. National Institute of Health Research. Justifying sample size for a feasibility study. 2019.
42. Vears DF, Gillam L. Inductive content analysis: A guide for beginning qualitative researchers. Focus Health Prof Educ Multi-Prof J. 2022.
43. Brame CJ. Effective Educational Videos: Principles and Guidelines for Maximizing Student Learning from Video Content. Perez KE, editor. CBE—Life Sci Educ. 2016;15(4):es6.
44. World Physiotherapy. Annual Membership census. 2021. Available from: https://world.physio/sites/default/files/2021-12/AMC2021-Austria.pdf. [cited 2025 Mar 19].
45. World Physiotherapy. Austria: a profile of the profession in 2024. 2024. Available from: https://world.physio/membership/austria. [cited 2025 Mar 19].
46. Zimmerman WA. Long Video Lectures: Shifting to an Adult Learning Perspective. Adult Learn. 2019;30(1):38–40.

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