

Mapping and Assessing existing digital skills training programmes for healthcare professionals and health managers in Europe: An expert-based survey for investigating the landscape, accessibility, and effectiveness of training initiatives

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Abstract

Background: Digital skills training in health is crucial to ensure that the healthcare workforce is equipped to leverage the potential of digital technologies in delivering efficient and effective care. Identifying the existing training programs can be valuable to describe gaps and opportunities for acceleration in the digital age.

Objective: The mapping of the existing continuous education and professional development training options in digital skills in health and their assessment was the aim of this study.

Methods: As part of the EU funded project entitled “TRANSITION” - Digital TRANSition and dIgiTal resilience in Oncology, an expert-based approach was implemented for identifying training programmes in 14 European Countries. The data was collected via an online survey that was developed for the purpose of this study, and was consisted of twenty-three questions which were categorized in five domains (general information, reaction, learning, behaviour, and results). The analysis was performed by using Kirkpatrick’s four levels model and the Digital Competence Framework for Citizens.

Results: The analysis of the data showed that in a percentage of 39.6% there is no official training in digital skills for the healthcare workforce, even the fact in the 95.8% of the cases digital solutions were used in the daily practice. Countries scored lower than the mean in the overall performance status according to the Kirkpatrick’s model that reflects the gap in knowledge and skills of HCPs and health managers. The quality of the programmes was poor and the evaluation reflects the great need and the gaps in health workforce’s education in digital skills and health technologies application in practice.

Conclusions: There was variance in the availability and quality of digital skills training across Europe. The development of a comprehensive training programme targeted to improve HCPs and health managers knowledge and skills but also digital tools incorporation into practice is crucial.

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Original Manuscript

Mapping and Assessing existing digital skills training programmes for healthcare professionals and health managers in Europe: An expert-based survey for investigating the landscape, accessibility, and effectiveness of training initiatives

Background: Digital skills training in health is crucial to ensure that the healthcare workforce is equipped to leverage the potential of digital technologies in delivering efficient and effective care. Identifying the existing training programs can be valuable to describe gaps and opportunities for acceleration in the digital age. The mapping of the existing continuous education and professional development training options in digital skills in health and their assessment was the aim of this study.

Methods: As part of the EU funded project entitled "TRANSITION" - Digital TRANSition and digital resilience in Oncology, an expert-based approach was implemented for identifying training programmes in 14 European Countries. The data was collected via an online survey that was developed for the purpose of this study, and was consisted of twenty-three questions which were categorized in five domains (general information, reaction, learning, behaviour, and results). The analysis was performed by using Kirkpatrick's four levels model and the Digital Competence Framework for Citizens.

Findings: The analysis of the data showed that in a percentage of 39.6% there is no official training in digital skills for the healthcare workforce, even the fact in the 95.8% of the cases digital solutions were used in the daily practice. Digital skills were professional qualification in 31.3% of the countries, and 32 out of 57 programmes were provided by academic institutions. Half of the countries scored lower than the mean in the overall performance status according to the Kirkpatrick's model that reflects the gap in knowledge and skills of the workforce. Countries scored at the average or lower in all model's domains: reaction (92.9%), behavior (78.6%), learning (71.4%), and results (50%). The quality of the programmes was poor, as less than the half of competencies were met and the evaluation reflects the great need and the gaps in health workforce's education in digital skills and health technologies application in practice.

Conclusions: There was variance in the availability and quality of digital skills training across Europe. The development of a comprehensive training programme targeted to improve HCPs and health managers knowledge and skills but also digital tools incorporation into practice is crucial.

Introduction

Health care systems in Europe, as in other parts of the world, are being impacted and reshaped by digital transformation [1]. The implementation of digital innovations in health includes the utilisation of information and communication technologies (ICT) into health devices and services for

improved access to healthcare and quality of care, as well as health sector's efficiency increase [2]. Another emerging area where digital solutions have shown great promise, is that of reducing health inequalities [3]. However, at the same time, they risk exacerbating inequalities by disproportionately benefitting a subset of the population [4].

It is estimated that in the near future, more than nine out of ten professions in Europe will require digital skills, recognising them as one of the most in-demand skills [5]. However, there are significant differences between European Member States in peoples' knowledge and ability to use digital solutions, with up to 40% of Europeans lacking basic digital skills [6].

Although, evidence supports that the application of digital technologies in health have great potential in improving the accessibility, quality, and flexibility of healthcare [1, 7] and can lead to more equitable and affordable systems by reducing disparities [7], healthcare workforce in Europe is lacking in digital skills which impact the adoption of technological solutions in daily practice [8]. The successful digitalisation in health encompasses the changes of the fundamental principles and approaches of healthcare professionals (HCPs) and non-clinical professionals (health managers) education [1] and requires incentives, organisational and academic support [9].

A variety of barriers to utilise digital interventions by health workforce have been identified and include infrastructure and technical issues, lack of educational resources, psychological barriers, and workload-related concerns [10]. On the other hand, the available evidence suggests that an effective change can be made by integrating digital skills learning into health science education curriculum and practice and considering the pedagogical design, the learning styles and HCPs expectations, and by including institutional elements like flexibility, access and costs for continuing education [10, 11].

It is getting clear that in the digital era, there is an urgent need in Europe to upskill and reskill the European health workforce [12] in modern practices to enable the acquisition of digital skills and competencies for current and future needs in prevention, diagnosis, treatment, monitoring and management of health-related issues and to monitor and manage lifestyle-habits that impact health. The first step for developing targeted strategies and interventions to enhance digital skills and ensure that the healthcare workforce is equipped to meet the demands of modern healthcare delivery requires the mapping of the current situation in training and education. While previous studies have typically focused on isolated or region-specific digital health training initiatives, often concentrating on select professional groups, the current research addresses a critical gap by systematically mapping and assessing a broad range of digital skills training programmes for both healthcare professionals and health managers across Europe, thereby offering a comprehensive and comparative perspective that informs policy development and best practices in digital healthcare. The aim of this study was to assess the availability and quality of digital skills training programmes and educational resources in fourteen European countries. It meant to provide a comprehensive overview of HCPs and health managers training in digital skills and helps identify gaps, opportunities, and areas for improvement.

Methods

An expert-based approach was implemented for identifying existing programmes for digital skills education and training for HCPs and health managers in 14 European Countries. The above strategy was used because information on the specific topic was not available in the literature and when some of the information was available this was fragmented and beyond the scope of this study. This method also provides nuanced, context-specific insights that broader survey or literature review methods might overlook, especially in a complex and evolving area like digital skills training. Experts can capture regional variability and emerging best practices, ensuring that the mapping and assessment reflect both the practical realities and the future directions of digital health education across Europe. The study was conducted as part of the European project “TRANSITION - Digital Transition and Digital Resilience in Oncology” (project reference: 101101261) co-funded under the EU4HEALTH programme [13]. While the focus of the TRANSITION project is on cancer workforce, the emphasis of the current study was broader on the available educational opportunities for HCPs and health managers.

Study Design and Data Collection

The data were collected through an online survey that was developed explicitly for the purpose of this study, and followed the CHERRIES recommendations for improving the quality of web surveys [14]. The survey consisted of twenty-three questions (Table 1) which were categorised in five domains: general information of the programme (6 items); reaction (2 items); learning (5 items); behaviour (4 items); and results (6 items). The survey was developed in three steps that included a scoping review of the literature to extract any relevant tools that were designed to elicit the desired information. As no questionnaire was retrieved, researchers reviewed the existing literature on how to map educational programmes and what the competences for digital skills in health include. A draft set of questions was created and a panel of experts identified from the project's consortium reflected on the proposed draft version. The last phase was to formulate the items according to the Kirkpatrick Model [15, 16]. The Kirkpatrick's four levels of training evaluation, is a globally recognised method of evaluating the results of training and learning programs. The items were rated on a Likert scale (0-1) for the general subscale, where 0 denotes No and 1 denotes Yes and on a likert scale (0-2) for the other subscales, where 0 denotes No; 1 denotes I am not sure / In some level; and 2 denotes Yes. The questions were then piloted with two experts in a parallel way and consensus was reached in an expert panel discussion. Their insights were instrumental in refining the survey items through multiple review rounds, ensuring that the language was clear, the content relevant, and the scales appropriately aligned with the study's objectives. This expert-driven validation process not only strengthened the questionnaire's content validity but also ensured that it accurately captures the diversity of digital skills training programmes across Europe.

The research team proofread and edited the survey based on the feedback that was undertaken.

The survey was distributed via email and hosted on Google Forms for a period of four weeks (June – July 2023). The email contained information about the aims of the study and consent to participate in the study was requested by the experts. The informed consent was obtained through an introductory section on the online survey where participants agree to terms and understand the purpose, confidentiality, and data security measures.

Additional to the survey, information about the training programmes on digital skills that were identified in the different countries (aim and the modules of the training) were provided in English by the experts, on a second period (November - December 2023).

Ethical Considerations

This study adhered to ethical principles for research involving humans [17]. Participants' confidentiality was secured by anonymising all data, and by using identification codes to ensure that participant identities cannot be linked to their responses. Participants were informed in advance that participation was voluntary, and they could withdraw at any time without consequence. Data was stored securely, and the results are presented in aggregate format to protect participants' privacy. Ethical approvals have been obtained accordingly from the Cyprus Bioethics Committee (EEBK ΕΠ 2023 01.184).

Data Analysis

Data collected from the survey was analysed using Kirkpatrick's four levels model that assesses both formal and informal training methods and rates them against four levels of criteria: Reaction, Learning, Behaviour, and Results [15, 16]. Descriptive statistics were used to summarise and describe the main features of the dataset, providing an overview of the data and helping identify patterns. The data related to programmes information was synthesised and analysed using the "Digital Competence Framework for Citizens (DigComp)" by the European Commission [18]. The DigComp provides a common understanding of what digital competence is, and was selected because an appropriate and widely accepted framework of digital competencies for professional in health was not identified. The framework recommends five categories (information and data literacy; communication and collaboration; digital content creation; safety; problem solving) that every person should be able to obtain and 21 competences that training programmes should take into consideration. The status of the countries in our sample was scored according to the training programmes evaluation by introducing a traffic light approach. More specifically, a category was marked as red (poor) when less than the half of a categories' competencies were met. Yellow was for those that at least the half of the competencies in a category were included in the training and green when more than the half or all of a categories' competencies were included in the modules.

Participants

The survey was conducted among a group of 18 European experts with extensive knowledge and experience of the topic. The experts were professionals working in the fields of digital health, health and cancer care, education, research or policy positions (Table 2.). Eligible participants were required to be recognised as national-level experts in digital health technology. This meant they had comprehensive knowledge and relevant experience in the digital health field within their own country. Additionally, they were involved in developing, implementing, or promoting digital health solutions and/or in shaping national policies and strategies aimed at integrating digital technologies into the healthcare system to enhance patient care, accessibility, and efficiency. At least one expert representing one of the 14 project's partners' countries was identified through project's research

network and/or was member of the consortium . Eighteen national experts on digital skills training from Belgium, Bulgaria, Croatia, Cyprus, France, Germany, Greece, Italy, Lithuania, Poland, Portugal, Romania, Spain, and Slovenia participated in the study.

Table 2. Experts' characteristics.

Country	Region	Gender	Expert's Background	Type of Organisation
Belgium	Flamish	M	Cancer Nurse, Researcher, Manager	Professional society, hospital
Bulgaria	National	F	Physician, Researcher, Academic	Professional and scientific society
Croatia	Osijek-Baranja County	F	Physician, Researcher, Academic	University
Cyprus		F	Researcher, Academic	University
France	Brittany	M	Physician	Universite
Germany		M	Researcher, Digital Solutions Expert	University
Germany		M	Physician, Researcher	University
Greece		M	Researcher, Cancer Nurse, Scientific & Policy Advisor	Ministry
Italy		M	Physician, Researcher in Cancer & Digital Health	Hospital
Lithuania		F	Digital Solutions Expert	Company
Poland	Central (Masovian District)	F	Researcher in Cancer & Digital Health	Hospital
Portugal	Porto	F	Medical Oncologist	Governmental oranisation
Romania		F	Physician, Researcher in Cancer & Digital Health	Hospital
Romania		F	Physician, Researcher in Cancer & Digital Health	University
Slovenia		F	Nurse, Academic, Researcher	University
Spain	Andalusia	F	Researcher in Cancer & Digital Health	University
Spain	Galicia	M	Researcher in Cancer & Digital Health	Governmental oranisation
Spain	Catalonia	M	Academic, Researcher in Cancer & Digital Health	University

M: male , F: female

Results

From the analysis of the data, in the six out of 12 countries (50%) the data represents the situation to (a) specific region(s), whilst in the remaining 6 countries the information corresponds to the national level. Input on a regional level came from the following countries: Belgium (Flemish region); Croatia (Osijek-Baranja County); France (Brittany region); Poland (Central-Masovian

District); Portugal (Region of Porto); and Spain (Regions of Andalusia, Galicia and Catalonia).

Current Status and Challenges in Digital Health Utilisation and Optimisation

An official training programme was provided in 47.9% of the cases to HCPs and 29.2% to non-clinicians, while in a percentage of 39.6% there was no official training in digital skills for the healthcare workforce. Specific educational programmes in oncology were identified in only 4.2%. Experts from Bulgaria and Lithuania reported that in their countries a training programme in digital skills did not exist.

In the 64.6% of the training programmes, participants obtained a certificate after the successful completion, but only in 31.3% of the countries experts reported this was a mandatory qualification for the work or the career progression. The type of education was mostly (68.8%) in a formal way and provided by academic institutions (56.3%). The courses were either online asynchronous (52.1%) or with a physical presence (35.4%) demonstrating a preference towards self-directed training with flexible timelines.

The duration of the training programmes varied from 10 hours to 4 academic semesters, the frequency of their provision ranged from 9 times a month to once annually, and the number of the participants was reported to be between 15-50 persons. What was paradox from the analysis was that, even there was a relatively scarce provision of opportunities in digital skills' education, in the 95.8% of the cases, both HCPs and health managers were required to utilize digital skills in their daily practice.

Experts also reported that the targeted population (HCPs and health managers) had not the chance to participate in the content development or the methodology / tools for training of the programmes. Based on this fact, they believed that it explains the reason why the programs were not addressing the trainees' needs in a comprehensive or satisfactory way, or did not implement ways of learning appropriate for this population. Moreover, even the fact that an evaluation of the training was provided by the participants (i.e post training assessment), according to experts' views, this did not seem to be taken under consideration.

In addition, the lack of national strategy for education in digital technologies for HCPs and /or health managers, was one more reason that the training programs did not meet current needs in health and in oncology. Only in Greece, Cyprus, Slovenia and Poland the existence of a national strategy or legislation was reported to be in place. However, the level of execution of these strategies and legislations were highly diverse in these countries.

Kirkpatrick Model Analysis

The effectiveness and the utility of the trainings, and how people putting their learning into practice and how positively impacting their role and the wider organisation were addressed via Kirkpatrick's four-level training evaluation model.

The scores of the four domains of the Kirkpatrick's model, as well the overall score for the 14 countries are presented in the Table 3. Countries were ordered according to their overall performance. The colour spectrum visualises the performance status of the countries in the digital

skills according to the scores. Moving from red to green the colours represents the best rate. An overall view is also presented to the radar chart (Figure 1). Almost half of the countries scored lower than the mean in the overall performance status, which reflects the gap in knowledge and skills of HCPs and non-HCPs.

Table 3. Countries ranking on digital training programmes for healthcare workforce according to Kirkpatrick's model scores.

Country	Overall	Reaction	Learning	Behavior	Results
1. Italy	1.46	2.00	1.50	1.00	1.33
2. Greece	1.41	1.00	1.80	1.00	1.83
3. Slovenia	1.36	1.00	1.75	1.19	1.50
4. Croatia ¹	1.13	1.00	1.00	1.00	1.50
5. Poland ²	1.13	1.00	1.20	1.25	1.08
6. Spain ³	1.08	1.00	1.00	1.00	1.33
7. Portugal ⁴	1.00	1.00	1.00	1.00	1.00
8. Belgium ⁵	0.94	0.00	1.00	1.75	1.00
9. Cyprus	0.89	0.50	1.00	1.00	1.04
10. Romania	0.82	1.00	0.60	1.00	0.67
11. France ⁶	0.52	0.00	1.00	0.75	0.33
12. Germany	0.35	0.00*	0.26	0.37	0.77
13. Bulgaria	0.00	0.00	0.00	0.00	0.00
14. Lithuania	0.00	0.00	0.00	0.00	0.00

¹ Osijek-Baranja County region ; ² Central (Masovian District) ; ³ Regions of Andalusia, Galicia and Catalonia ; ⁴ Region of Porto ; ⁵ Flemish region ; ⁶ Brittany region ; * N/A



red: poor when score is equal to zero; orange: poor when score is between zero and 0.6; yellow: from poor to average when score is between 0.61 and 0.99; green: adequate when score is equal to average (1) or higher

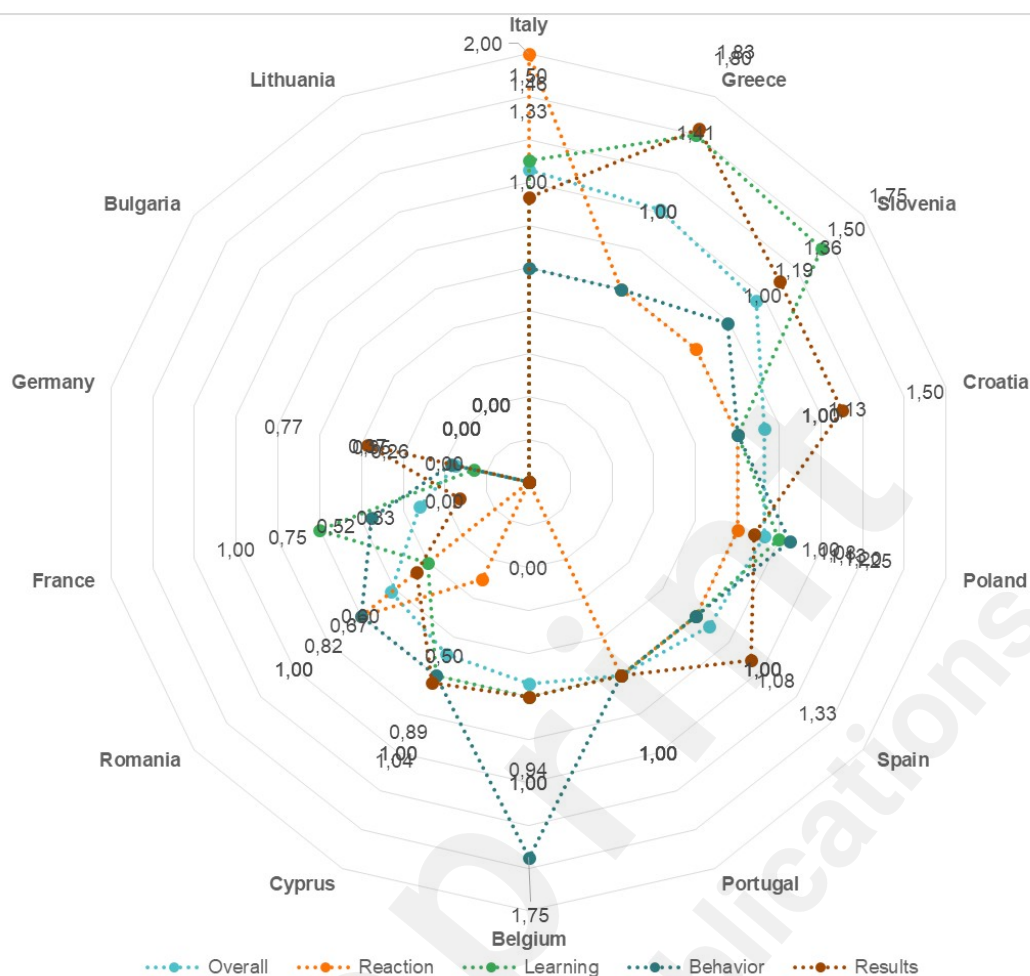


Figure 1. Radar chart of countries scoring on digital training programmes for healthcare workforce according to Kirkpatrick model. (Moving from the center which is equal to 0 to the last axis that equals 2, better performance is achieved)

Kirkpatrick model Subscale - Reaction

The satisfaction from the training programmes is described from the codes that emerged from the analysis (Table 4). Italy scored higher, countries that reached the average score were Greece, Slovenia, Croatia, Poland, Spain, Portugal and Romania, while Cyprus, Belgium, France, Germany, Bulgaria and Lithuania had the worst scores.

Table 4. Strengths and weaknesses of existing training programmes based to experts.

Strengths	Weaknesses
- Worthy - Successful - Appropriate style of delivery - Accommodates trainees' learning styles - Engaging - With health applicability	- Lack of experts - General content (no health applicability) - Expensive - Does not address trainees needs - Inappropriate style of delivery - Lack of interaction and guidance - Not offered frequent - Not updated content

According to the experts, the content of the programmes did not meet the needs of the participants who work in the field of cancer care, did not prepare the participants in current advancements in

health technology, which can impact their ability to effectively and efficiently uptake and accept (i.e. low acceptability) technological solutions in health.

Kirkpatrick model Subscale - Learning

In all of the items of the learning subscale (i.e. the acquisition of knowledge, skills, attitude, confidence and commitment by participants), the responses were scored more than 60% in the option "In some level", which demonstrates the inability of the trainings to develop participants skills, attitudes and knowledge, as well as their confidence and commitment to digital technologies. Countries that scored higher than the mean were Greece, Slovenia, Italy and Poland.

Kirkpatrick model Subscale - Behaviour

At the behaviour subscale scores were low, less than 10% (8.3%) in all items (i.e. participants' ability to teach / transfer knowledge, skills, and attitudes to other people and perform behaviour change). That means that training graduates were unable to apply and incorporate their training successfully into their practice. Countries with scores higher than the mean were only Belgium and Slovenia. The poor outcome reflects the gap between possessing digital skills and effectively imparting these skills to others due to lack paedagogical approach and programme design, and lack of teaching capacity for enhancing participants' confidence and role perception.

Kirkpatrick model Subscale - Results

The last level at the Kirkpatrick's model refers to the results of the training. As indicated by the participants' responses, the outcomes were negative or neutral, with scores ranging from 52.1 to 66.7% on the "in some level" and ranging from 10.4 to 35.4% on the "no" for the items of this level. This negative outcome supports that the existing programs were not addressing participants' needs in a comprehensive or satisfactory way, or do not implement ways of learning in an appropriate style for the health workforce. Items were namely: appropriate style of training; increasement of employees' retention, productivity, morale, satisfaction; and quality of care improvement. Countries that scored higher than the mean were Greece, Slovenia, Croatia, Italy and Spain.

Training Programmes Competencies Evaluation

The performance of the countries in our sample, by assessing the acquired digital competencies by the educational programmes, is presented in a visual snapshot (Table 5). No country had a sufficient training programme in digital skills for the healthcare workforce, according to the data, as no one of the five categories was marked as green in any countries. As training programmes in Bulgaria and Lithuania were not identified, the evaluation of those countries at this stage was left blank. Moreover, there were missing data from 4 out of 14 participating countries and more specifically from Belgium, Croatia, France and Italy (response rate 71.43%).

The evaluation of the training programmes competencies identified the weakest areas in digital skills education for HCPs and the health managers according to the DigComp. Most of the programmes lacked to provide adequate skills for digital content creation and for problem solving. The first category would allow participants to create and edit digital content, to improve and

integrate information into an existing body of knowledge, while understanding how copyright and licenses are to be applied, and the second to identify needs and problems, to resolve conceptual problems and situations in digital environments, and to keep up-to-date with the digital evolution. The following categories were in most cases on an average performance in most of the existing programmes: safety, communication and collaboration, and information and data solving.

Table 5. Digital training programmes for healthcare workforce evaluation per country.

Country	Information & Data Solving	Communication & Collaboration	Digital Content Creation	Safety	Problem Solving
Greece	average	average	average	average	average
Cyprus	average	average	average	average	average
Germany	average	average	poor	average	poor
Slovenia	average	average	poor	average	poor
Spain	average	average	poor	average	poor
Portugal	average	poor	poor	average	poor
Poland	average	poor	poor	poor	poor
Romania	poor	poor	poor	poor	poor
Bulgaria ¹	adequate	adequate	adequate	adequate	adequate
Lithuania ¹	adequate	adequate	adequate	adequate	adequate
Belgium ²	adequate	adequate	adequate	adequate	adequate
Croatia ²	adequate	adequate	adequate	adequate	adequate
France ²	adequate	adequate	adequate	adequate	adequate
Italy ²	adequate	adequate	adequate	adequate	adequate

■ adequate, ■ average, ■ poor

¹ no trainings identified, ² no data available

The findings of the evaluation reflect the great need and the gaps in health workforce's education in digital skills and health technologies application in their practice.

Discussion

The aim of this study was to identify and map the existing training programmes for HCPs and health managers in digital skills in Europe. The mapping of the programmes across 14 European countries (Belgium, Bulgaria, Croatia, Cyprus, France, Germany, Greece, Italy, Lithuania, Poland, Portugal, Romania, Spain, and Slovenia) highlighted certain patterns, practices and variations in training methods, strategy and quality of the programmes. The inequalities in access and provision of such educational opportunities, the low quality of the existing programmes, the lack of national strategies, and the inability of programmes to meet healthcare workforce's needs and current's practice requirements demonstrate the variation of digital skills training and complexity of digital skills development across Europe. Countries (Italy, Greece, Slovenia) with better performance in digital skills training had implemented more extensive strategies, which included specialised training (for medical oncologists, nurses, health managers), incentives for workforce development

(educational leave, career development), and mandatory continuing education (for career progression and job retention).

According to experts' responses in this study, digital health is increasingly seen as an integral part of health workforce's skill set and all roles have some kind of digital element nowadays. At the same time the gap in digital skills remains high across countries and professional disciplines. Another reason, according to the findings, is the fact that the existing training programmes were not addressing the needs of HCPs and the health managers, or they did not link theory, practice and the unique needs of healthcare. Therefore, the findings point to the need for the development and provision of comprehensive training in digital skills for professionals in healthcare setting, within and between countries. This training needs to focus on the quality, appropriate design and style and reflect HCPs and health managers' preferences and needs. Additionally, the accreditation of the programme will empower people and will enhance their professional inclusion and employability.

Digital health training programmes need to incorporate participants' aspects, consider their needs, and to be adapted to economic, social, cultural, and organisational factors [19 – 21]. The training programmes should address perspectives on various levels (decision-makers, digital health implementers, and users), the profile of trainees (including leadership skills), and highlight the urgent need for monitoring, assessment, and publishing the lessons learned of those experiences [22 – 25].

Training programmes in digital skills are representing an important component of future practice but limited academic and placement opportunities are currently being offered across Europe. Attention should be given to the use of apps in academic teaching and on placement, as well as in delivery of care [26, 27]. The lack of training in digital skills in Europe is a significant issue that has been acknowledged by the European Commission as a necessity for the digital transition [28, 29]. This acknowledgement has been reflected for an example as part of the communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions that is encapsulated in the report "2030 Digital Compass: the European way for the Digital Decade" [29]. In the same light, the EU Beating Cancer Plan supports maximising the potential of digitalization in healthcare as a means to address inequalities and the provision of patient-centered quality care across the disease Pathway [30]. Obstacles to developing successful trainings in digital area include, among others, the lack of guidelines and competence framework, and the low levels of expertise of the training programme staff [31 – 34].

The rapid technology advancements increases the importance of digital skills in the health setting. The digitisation of health and the increased reliance on ICT solutions, create the demand for professionals with digital skills for career progression and participation in in the digital care [35 – 37]. Inequalities in many European countries (i.e. both within and between countries) and the lack of the skills required could impact the economic growth and innovation. Thus, schools of health sciences need to incorporate digital skills training into their curricula to ensure that students are equipped with the necessary knowledge and abilities. At the same time, it is essential to provide opportunities for continuing education to those professionals already in the workforce to upskill or reskill in digital areas. For that reason, governments, health and educational institutions should

collaborate to provide equal opportunities. [38 – 40].

Strengths

The findings of this study provide an overview of the current state of digital skills trainings for the health workforce in Europe, which helps to identify key areas for improvement and can serve as a benchmark for measuring progress over time. It also, highlights gaps in knowledge, skills, and resources that are crucial for developing targeted strategies and can inform policymakers, and other stakeholders, enabling them to make more informed decisions and allocate resources effectively. The findings could be used to raise awareness about digital skills training and serve as advocacy tools to promote change and improvement in the health digital transformation.

Limitations

Limitations include first of all the lack of depth. Mapping studies provide a broad overview of the existing phenomenon, and in particular this survey did not delve deeply into the content of training programmes. This is due to the fact that the main focus of the study was on identifying and categorising the available evidence, rather than critically appraising or synthesising it. Nevertheless, aspects of the quality of the training programmes were captured by the Kirkpatrick model. This has limited the likelihood impact on the reliability and validity of the findings and may not provide a complete picture of the available evidence. Moreover, in the half of the participating countries the data did not represent the situation on a national level. Lastly, a limitation identified in the study, is the retrieval of data from regional areas in specific countries rather than national data. Nevertheless, based on the experts' views, these regions reflect the national status in these countries and therefore are considered representative.

Implications for Future Research and Practice

Implications for future research and practice of these findings highlight the urgent need for a coordinated approach to enhance digital literacy among HCPs and health managers. The implementation of extensive training programmes that will cover specialised training, ensuring they are relevant to the clinical realities and up-to-date with technological advancements, and accessible to all is recognised as high priority, with policy support.

Digital competencies are increasingly essential for healthcare professionals and health managers in their daily practice, yet participation in digital training is not mandatory for most. This disconnect creates a significant gap between the skills required on the job and the training provided, ultimately contributing to the suboptimal adoption and integration of digital technologies in healthcare settings. By not ensuring consistent, required education in digital skills, organisations inadvertently perpetuate barriers to innovation, impeding improvements in patient care, efficiency, and overall service quality.

Moreover, research approaches to monitoring and evaluating the training initiatives, and implement innovative methods of learning could significantly improve the digital competencies and skills of the healthcare workforce, and ultimately enhancing patient care, and health systems' efficiency.

Conclusion

The mapping of current opportunities in digital skills education and training for the healthcare workforce reveals a significant variance in the availability, quality, and effectiveness of programmes across Europe. Key findings indicate that none of the surveyed countries demonstrated a robust digital training, and notable gaps were identified, particularly in specialised training and continuous professional development. Addressing the lack of digital skills training in health requires a multi-faceted approach, involving government policies, educational institutions, businesses, and individuals themselves. By addressing this issue, Europe can better equip its health workforce to thrive in the digital era and maintain its competitiveness on a global scale.

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Authorship contribution statement

The authors confirm contribution to the paper as follows: study conception and design: Andreas Charalambous; data collection: Dimitrios Protopiros; analysis and interpretation of results: Andreas Charalambous, Dimitrios Protopiros; Iolie Nicolaidou; Efthymou Kyriacou. Draft manuscript preparation: Dimitrios Protopiros. All authors reviewed the results and approved the final version of the manuscript.

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Data availability statement

The datasets generated or analysed during this study are available from the corresponding author on reasonable request.

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Table 1. Scales and items of the online questionnaire.

Scale	Items
Reaction	- What are the biggest strengths of the training? - What are the biggest weaknesses of the training?
Learning	- Do the participants acquire the knowledge that the training programme is focused on? - Do the participants acquire the skills that the training programme is focused on? - Do the participants acquire the attitude that the training programme is focused on? - Do the participants acquire the confidence that the training programme is focused on? - Do the participants acquire the commitment that the training programme is focused on?
Behavior	- Are the participants able to teach / transfer their knowledge to other people after the training? - Are the participants able to teach / transfer their skills to other people after the training? - Are the participants able to teach / transfer their attitudes to other people after the training? - Are the participants aware that they have changed behaviour after the training?
Results	- Is the training style appropriate? - Does the training increase employees' retention? - Does the training increase employees' production? - Do employees have higher morale after the training? - Does the training lead to an incensement in quality of care? - Are the participants satisfied from the training?
General Information	- Existence of official training. - Use of digital skills in practice. - Mandatory qualification. - Organisation that provides the training. - Duration of the training. - Type of education.

Supplementary Files

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