Training gaps in digital skills for cancer healthcare workforce: insights from clinical,non-clinical professionals, and patients/caregivers

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Abstract

Background: The integration of digital technologies is becoming increasingly essential in cancer care. However, limited digital health literacy (DHL) among clinical and non-clinical cancer healthcare professionals poses significant challenges to effective implementation and sustainability over time. To address this, the European Union is prioritizing the development of targeted digital skills training programs for cancer care providers. A crucial initial step in this effort is conducting a comprehensive gap analysis to identify specific training needs.

Objective: The aim of this work is to identify training gaps and prioritize the digital skill development needs in the oncology healthcare workforce.

Methods: An Importance-Performance Analysis (IPA) was conducted. The survey assessed the performance and importance of seven digital skills: Information, Communication, Content Creation, Safety, e-Health Problem Solving, Ethics, and Patient Empowerment.

Results: A total of 67 participants from 11 European countries completed the study: 38 clinical professionals (CP), 16 non-clinical professionals (NCP), and 13 patients/caregivers (PC). CP acknowledged the need for a comprehensive training program, that includes all the seven digital skills. Digital Patient Empowerment and Safety skills emerge as the highest priorities for both CP and NCP. Conversely, NCP assigned lower priority to digital Content Creation skills and PC to digital Information and Ethical skills. The IPA also revealed discrepancies in digital Communication skills across groups ($H = 6.50$; $p<.05$).

Conclusions: The study showcased the pressing need for comprehensive digital skill training for cancer healthcare professionals across diverse backgrounds and healthcare systems in Europe. Based on the results the most urgent areas of digital skills training include digital Patient Empowerment and Safety skills. Incorporating patient and caregiver perspectives ensures a balanced approach to addressing these training gaps. These findings provide a valuable knowledge base for designing digital skills training programs, promoting a holistic approach that integrates the perspectives of the various stakeholders involved in digital cancer care.

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Original Manuscript

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Abstract

Background: The integration of digital technologies is becoming increasingly essential in cancer care. However, limited digital health literacy (DHL) among clinical and non-clinical cancer healthcare professionals poses significant challenges to effective implementation and sustainability over time. To address this, the European Union is prioritizing the development of targeted digital skills training programs for cancer care providers, TRANSiTION project among them. A crucial initial step in this effort is conducting a comprehensive gap analysis to identify specific training needs.

Objective: The aim of this work is to identify training gaps and prioritize the digital skill development needs in the oncology healthcare workforce.

Methods: An Importance-Performance Analysis (IPA) was conducted following a survey that assessed the performance and importance of seven digital skills: Information, Communication, Content Creation, Safety, e-Health Problem Solving, Ethics, and Patient Empowerment.

Results: A total of 67 participants from 11 European countries completed the study: 38 clinical professionals (CP), 16 non-clinical professionals (NCP), and 13 patients/caregivers (PC). CP acknowledged the need for a comprehensive training program that includes all the seven digital skills. Digital Patient Empowerment and Safety skills emerge as the highest priorities for both CP and NCP. Conversely, NCP assigned lower priority to digital Content Creation skills and PC to digital Information and Ethical skills. The IPA also revealed discrepancies in digital Communication skills across groups ($H = 6.50$; $p<.05$).

Conclusions: The study showcased the pressing need for comprehensive digital skill training for cancer healthcare professionals across diverse backgrounds and healthcare systems in Europe, tailored to their occupation and care setting. Incorporating patient and caregiver perspectives ensures a balanced approach to addressing these training gaps. These findings provide a valuable knowledge base for designing digital skills training programs, promoting a holistic approach that integrates the perspectives of the various stakeholders involved in digital cancer care.

Introduction

Cancer is the second leading cause of premature mortality and morbidity worldwide [1]. In the European Union (EU), nearly 4.7 million new cases of cancer and 2.1 million cancer-related deaths occur each year [2]. According to the European Commission (EC), the urgency to address cancer control and outcomes is a significant political challenge, as reflected in Europe's Beating Cancer Plan [3], with cancer being one of the five missions included in the Horizon Europe program.

Health literacy (HL), defined as the individual capacity to access, understand, evaluate, and apply health information to make informed health decisions [4], is widely recognized as a critical factor in effective cancer care [5,6]. With the increasing integration of digital technologies in oncology, such as symptom monitoring platforms, treatment adherence tools, telehealth, and mobile applications, HL has evolved to encompass the digital environment, giving rise to the concept of Digital Health Literacy (DHL) [7–11]. DHL has been defined in various ways, reflecting the evolving nature of health information environments. Broadly, DHL refers to the ability to seek, find, understand, and appraise health information from electronic sources, and to apply this knowledge to solve a health problem[12,13]. However, there is ongoing debate about its key attributes, particularly the relative weight of technical skills, critical thinking, health knowledge, and digital engagement, in shaping a comprehensive definition [14,15]. In response, recent studies have focused on four major areas: (a) conceptualizing and measuring DHL; (b) identifying and addressing the digital divide; (c) exploring the factors that influence DHL development; and (d) examining the health outcomes associated with DHL levels [16]. Regarding the latter, DHL enhances access to and quality of healthcare to the extent of being considered a "super determinant" of health, a factor with a profound impact across various health outcomes [17,18].

In cancer care, DHL is particularly relevant, enabling healthcare professionals and patients to benefit from digital innovations such as electronic health records, patient portals, symptom tracking tools, and remote care services [19]. Low levels of DHL have been associated with poorer clinical outcomes, including reduced overall survival among cancer patients [20–22]. Limited DHL not only hinders patients and caregivers but also poses challenges for healthcare professionals, potentially impeding the effective adoption of digital health solutions in clinical practice [23]. The project "Towards European Health Data Space (TEHDAS)" highlights significant disparities in the health system infrastructures across European countries, with not all of them being adequately equipped to ensure effective management of digital health [24]. Still, the main barriers to implementing digital health strategies in healthcare organizations are not technical issues (such as infrastructure or connectivity). Instead, they are rooted in gaps in digital skills among professionals and patients, concerns about data security and confidentiality in digital environments, and limited time availability [25–28].

As a result of these challenges, experts in the field emphasise the need to develop flexible and easily accessible training programmes, such as online modules and hands-on learning approaches, supported by appropriate incentives to engage and retain the oncology workforce [29]. Nevertheless, the results of DigiCanTRain, a European-cofunded project under the EU4Health Programme (2021–2027) by approximately €1.98 million, highlight significant challenges in the implementation of digital skills training programs for cancer professionals across 25 EU countries. These challenges include a lack of coordination between national and international organizations in promoting training initiatives, as well as limited access to continuous accreditation mechanisms that ensure the quality and consistency of educational content [30]. In response to these gaps, DigiCanTRain aims to design, pilot, and evaluate a comprehensive digital-skills training curriculum for both clinical and non-clinical oncology professionals, with the goal of enhancing the adoption of eHealth technologies and fostering more person-centred, efficient, and resilient cancer care.

Despite these initiatives, international continuing education programs fail to identify the specific digital skills required by healthcare professionals [31]. Even if *DigComp 2.2: The Digital Competence Framework for Citizens* provides a reference framework for the global population on

existing digital competencies [32], it does not include specific ones oriented to healthcare professionals in cancer care, such as ethical or patient empowerment skills [33,34]. Moreover, there are no validated and widely used measurement tools available to assess eHealth competences [35,36]. Therefore, the review by Tinamz et al [37] highlights the need to create updated digital frameworks for different work settings, professional categories, and contexts. In the context of cancer care, the study of Leena et al [34] reveals that the digital skills of healthcare professionals are multifaceted. Consequently, they indicate that it is imperative that these skills be subjected to a process of assessment to facilitate the provision of training that is based on the actual learning needs of the professionals in question.

In view of this, the TRANSiTION project [38] was co-funded at 80% by the European Union with a total budget of €2,299,541.28. The project aims to design an advanced training programme for both clinical and non-clinical professionals involved in cancer care, equipping them with essential digital skills to enhance the efficiency and effectiveness of information exchange with patients and other healthcare providers. TRANSiTION brings together an interdisciplinary consortium of 24 partners from 14 Member States, all with extensive experience in the development, evaluation, and successful implementation of continuing professional development and training programmes in oncology.

Theoretical Framework

According to the EC, the development of a digital skills training programme should be preceded by a thorough analysis of training needs and existing gaps [39]. A needs analysis is a systematic process used to identify discrepancies between the current and ideal states of an organization or service [40].

One widely adopted and intuitive method for conducting such an analysis is the Importance-Performance Analysis (IPA). Originally developed by Martilla and James [41], IPA provides a visual and analytical framework to support strategic decision-making by comparing the importance of specific attributes to their perceived performance. It has been extensively applied across diverse sectors, including information technology (IT) services, marketing, banking, tourism, and sports [42]. More recently, IPA has been used in the assessment of training needs [43,44], process improvement [45] and the evaluation of healthcare services [46].

IPA is based on a two-dimensional grid that plots attributes according to their mean scores on two axes:

- Importance: the value or relevance assigned to the attribute by users.
- Performance: the perceived effectiveness or quality of that attribute.

The axes of the IPA grid are determined by the overall mean scores of importance and performance across all attributes assessed. The position of each attribute within the grid reflects its scores on these two dimensions. This allows for a relative comparison, enabling the identification of attributes that deviate from the general trend.

The resulting matrix is divided into four quadrants, each linked to distinct action strategies [47]:

- Quadrant I – Focus Here: High importance, low performance. These are critical areas in need of immediate improvement.
- Quadrant II – Keep up the Good Work: High importance, high performance. These are strengths to be preserved.
- Quadrant III – Low Priority: Low importance, low performance. These areas require minimal attention as they are not strategically significant.
- Quadrant IV – Possible Overkill: Low importance, high performance. These attributes may be receiving more resources than necessary.

To enhance the discriminative power of the analysis, this study will employ a modified version of the IPA proposed by Abalo et al [48]. This adaptation addresses the common issue of attribute saturation, whereby attributes tend to receive uniformly high ratings, limiting the ability to differentiate among them. The modified approach uses ordinal rankings instead of mean scores, improving the identification of priority areas, particularly relevant in healthcare settings [49] and in training needs assessments [50].

Based on this approach, an IPA chart will be generated using discrepancy scores from three key stakeholder groups: clinical professionals (CP), non-clinical professionals (NCP), and patients/caregivers (PC). CP will be defined as members of healthcare organizations providing direct cancer care (e.g., oncologists, radiotherapists, oncology nurses, family physicians, and community nurses). NCP will include individuals performing administrative or managerial tasks related to cancer care, regardless of professional category. Caregivers will be defined as those who provide physical, emotional, practical, and, in some cases, medical support to individuals diagnosed with cancer. These may be family members, close friends, or other persons designated by the patient, playing a critical role across all stages of treatment and recovery. A cancer patient will be defined as any individual at any stage of the disease, including those undergoing active treatment, in remission (with favorable progression and no ongoing treatment), considered cured but undergoing regular follow-up, cured without active medical surveillance, or experiencing a relapse.
The position of each attribute will be analyzed in relation to the diagonal and the corresponding quadrants of the IPA grid (see Figure 1).

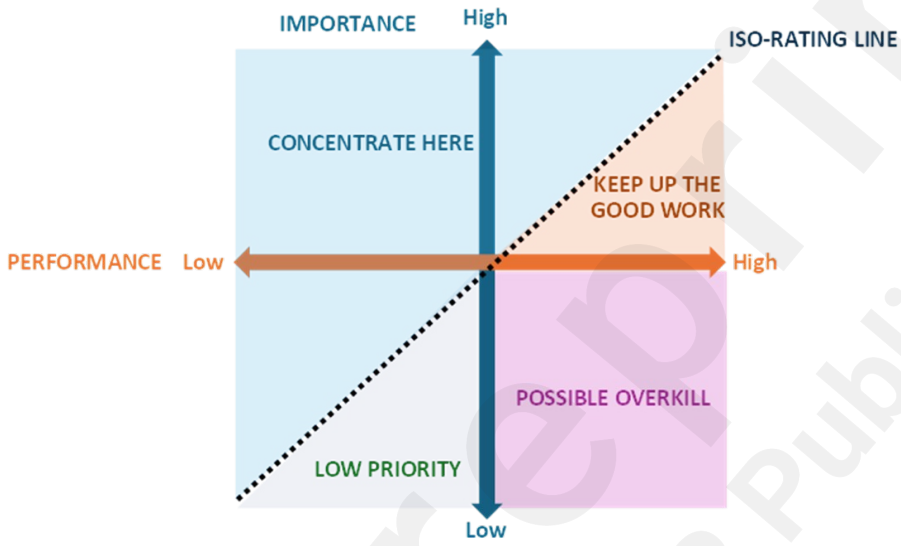

Figure 1.Representation of the alternative version of the IPA.

The current literature highlights a significant gap in digital skills among healthcare professionals [51]. Furthermore, while it is widely recognized that digital skills in healthcare are inherently multifaceted, a standardized framework to delineate and prioritize the most essential skills remains absent. Furthermore, not only training gaps are expected, but there will be differences between the health professionals included in the study.
Consequently, the aim of this study is to identify training gaps and prioritize the digital skill development needs in the oncology healthcare workforce through the application of Importance-Performance Analysis (IPA).

Method

Study Design

A selective methodology was used, which involved conducting an online survey among a group of experts selected within the consortium of the European project. Given the exploratory nature of the study and the specific expertise required from participants, a convenience sampling approach was employed to facilitate recruitment across diverse stakeholder groups and countries. This strategy was deemed appropriate due to the practical constraints of accessing individuals with relevant professional or lived experience in cancer care across several member states, all within a limited

timeframe.

The inclusion criteria required participants to be CP, NCP, or PC from member states of the TRANSiTION consortium, with the ability to comprehend and respond in English. Moreover, participants were required to have the capacity to provide informed consent. Recruitment was supported by consortium partners who identified and invited suitable individuals based on their direct involvement in cancer care or their experience as patients or caregivers. This pragmatic sampling approach enabled the collection of meaningful insights while ensuring feasibility in a multinational context.

Instrument

An ad hoc online questionnaire, available exclusively in English, was developed by the research team. While several validated instruments exist in the fields of DL and eHealth for the general population [12,15], they did not adequately address the specific objectives or context of our study. The TRANSiTION project aimed to design a training course tailored to professionals involved in cancer care. Therefore, beyond assessing general skills, it was crucial to identify the specific learning needs, expectations, and contextual factors affecting this particular group. Given these requirements, the development of a customized instrument was deemed necessary to ensure the relevance, specificity, and practical utility of the collected data for informing the design of the training intervention.

The structure and items of the questionnaire were based on *DigComp 2.2: The Digital Competence Framework for Citizens* [32] *and Measuring What Matters: The Patient-Reported Indicator Surveys* [52]. For the development of the items, the contents of the *Core Curriculum in eHealth* from the EU*US initiatives were reviewed [53], as well as the document *Mapping Health Data Management Systems through Country Visits: Development, Needs, and Expectations of the EHDS* by TEHDAS [24].

The final selection of questionnaire items was reached by consensus in an online focus group conducted in May 2023. During this session, it was decided to include two additional and independent sections (i.e., patient empowerment and ethics) informed by the prior work and practical experience of project partners who had previously identified core digital health skills as applied in professional practice [54].

The questionnaire was organized into three thematic sections. The first section included the information sheet and the consent form for participants. The second section addressed sociodemographic variables. The third section focused on assessing the need for training of seven key digital skills: Information, Communication, Content Creation, Safety, Problem Solving, Ethics, and Patient Empowerment. Moreover, seven-point Likert scale items were used to evaluate performance (with 1 representing *'Very bad*' and 7 '*Very good*') and Importance (with 1 representing *'Not important*' and 7 *'Highly important*'). The questionnaire items for CP and NCP were identical. Additionally, to make the results more representative, the third section asked about the performance of their colleagues within their organization from the respondent's perspective, aiming to shift the focus away from self-assessment of personal skills. Similarly, the items on the importance of digital skills referred to how crucial these skills are for cancer care. In contrast, patients were asked about their perception of the digital skills shown by the cancer professionals attending to them and about the importance of these skills for their cancer care—or, in the case of caregivers, for the care of the patient. The information letters and questionnaires can be found in Appendix I.

Procedure

The questionnaire was administered as a closed, invitation-only survey, accessible exclusively to individuals invited by TRANSiTION consortium partners. It was fully compatible with mobile phones, tablets, and computers, across all major operating systems. To prevent multiple entries from the same individual, participants were authenticated through their email address prior to receiving single-use access to the survey platform.

Recruitment was facilitated by the TRANSiTION consortium, which disseminated information about

the study to eligible participants. The consortium consisted of 24 European reference partners in the field of cancer care, including research institutes, universities, hospitals, oncology centres, and patient organisations [38].

The survey was piloted by 8 members of the Spanish partners of the TRANSiTION consortium during June and July 2023. Based on the pilot, minor adjustments were made to improve the wording of certain items. On average, it was estimated that participants required approximately 15 minutes to complete the online questionnaire. Additionally, it was suggested to include the item: *"Have you received prior training in digital competencies/skills?"* with a dichotomous response option of "Yes" or "No".

Participants were recruited during July and August 2023. Before the survey, they were informed about the study's objectives, reminded of the voluntary nature of their participation, and asked to provide informed consent. Data was collected and stored using an online questionnaire implemented through eDelphi.org [55] in September 2023. This platform provides a confidential, single-use access system to the questionnaire for each participant, ensuring the confidentiality and anonymity of responses. To ensure procedural standardization, daily monitoring of the data collection process was conducted, allowing for the immediate resolution of any questions or technical issues that arose.

Data analysis

Data analysis included descriptive statistics, reported as means (M) and standard deviations (SD). Internal consistency of the items assessing digital skill domains was evaluated using Cronbach's alpha. Normality was assessed using the Shapiro-Wilk test. In cases where the assumption of normality was not met, non-parametric tests were applied. Specifically, group comparisons of importance and performance scores across clinical professionals (CP), non-clinical professionals (NCP), and patients/caregivers (PC) were conducted using one-way ANOVA or, when appropriate, the Kruskal-Wallis test. All analyses were performed using IBM SPSS Statistics (version 25.0).

Ethical Review

The study was reviewed and approved by the Pontevedra-Vigo-Ourense Research Ethics Committee (ref: 2023/309).

Results

Demographics

Initially, 152 participants expressed interest in taking part in the study. Of these, 33 were excluded for not meeting the inclusion criteria. Specifically, 24 participants who had registered as CP or NCP were in fact students without professional experience, and 9 PC were excluded due to insufficient English proficiency. Additionally, 28 participants (12 CP, 10 NCP, and 3 patients and 3 caregivers) accepted the informed consent but did not begin the questionnaire. A further 24 participants (8 CP, 10 NCP, 3 patients and 3 caregivers) declined to provide informed consent.

A total of 67 participants completed the study: 38 classified as CP, 16 as NCP, and 13 as PC. All participants who completed the survey responded to all questionnaire items. Of the total, 50 participants were females (75%), primarily aged between 31 and 45 years, and most resided in municipalities with populations over 100,000. Table 1 presents the main sociodemographic characteristics of the sample, stratified by group.

Table 1. Socio-demographic data of the participants.

Group	n	% female	Age (%)				Population of the resident municipality (%)		
			18-30	31-45	46-60	≥61	<50,000	50,000-100,000	>100,000
CP	38	76.3	26.3	36.9	28.9	7.9	18.4	15.8	65.8
NCP	16	75	31.3	43.7	18.7	6.3	12.5	6.3	81.2
PC	13	69.2	0	46.2	38.5	15.3	38.5	15.4	46.1

Note. CP: clinical professionals; NCP: non-clinical professionals; PC: patients/caregivers

The participants were from 11 European countries: Belgium (3 CP, 5 NCP and 2 PC), Bulgaria (10 CP and 2 NCP), Croatia (4 CP, 1 NCP and 3 PC), Cyprus (6 CP), Greece (1 CP, 1 NCP and 1 PC), Italy (1 CP, 1 NCP and 2 PC), Lithuania (1 CP and 1 NCP), Poland (1 PC), Portugal (3 CP, 1 NCP and 2 PC), Slovenia (1 CP, 1 NCP and 1 PC), and Spain (8 CP, 3 NCP and 1 PC).

The professions of the healthcare professionals were diverse. Among CP (n = 38), 16 were oncologists (42%), 12 were oncology nurses (32%), 6 were clinical researchers (16%), and 4 worked in other clinical professions related to cancer care (11%). Additionally, 19 worked in public organizations (50%), 12 in subsidized private organizations (32%), 4 in non-subsidized private organizations (11%), and 3 preferred not to specify (8%). Among NCP (n = 16), 5 were clinical data managers (31%), 4 were part of the administrative staff related to cancer care (25%), 3 worked in healthcare service management (19%), and 4 were employed in other non-clinical professions related to cancer care (25%). Furthermore, 8 worked in public organizations (50%), 7 in subsidized private organizations (44%), and 1 preferred not to specify (6%). All patients and caregivers (n = 13) were users of public healthcare services.

Internal consistency

As shown in Table 2, the internal consistency of the digital skills questionnaire was high across all domains (items B1 through B7 in Appendix 1) and participant groups. At the global level, Cronbach's alpha values ranged from 0.92 (Information) to 0.97 (Ethics), indicating excellent reliability. When analyzed by subgroup, clinical professionals (CP) and patients/caregivers (PC) consistently showed very high internal consistency, with alpha values above 0.85 in all domains. Non-clinical professionals (NCP) also showed acceptable to excellent consistency, though slightly lower in the domains of e-Health Problem Solving (α = .86) and Ethics (α = .90). These results support the internal reliability of the instrument across different respondent profiles.

Table 2. Internal consistency (Cronbach's α) of digital skill domains.

Digital skills	GLOBAL (α)	CP (α)	NCP (α)	PC (α)
Information	,92	,95	,91	,85
Communication	,93	,95	,89	,90
Content Creation	,95	,95	,92	,95
Safety	,96	,96	,95	,97
e-Health Problem Solving	,94	,97	,86	,92
Ethics	,97	,97	,90	,97
Patient Empowerment	,96	,96	,90	,98

Note. CP: clinical professionals; NCP: non-clinical professionals; PC: patients/caregivers

Performance and Importance Scores

This section presents the results from the third part of the questionnaire, which focused on seven core digital competencies relevant to cancer care professionals. Additional findings related to perceived training needs are available in Appendix 2. The seven competencies assessed were:

- Information, defined as the ability to search, evaluate, and manage digital health information effectively.
- Communication, referring to the capacity to interact, share, and collaborate using digital tools in healthcare contexts.
- Content Creation, understood as the skill to produce, edit, and adapt digital content appropriately for clinical use.
- Safety, which encompasses data protection, privacy, and cybersecurity practices.
- Problem Solving, the ability to identify and resolve technical or digital challenges in the care process.
- Ethics, related to the understanding and application of ethical principles such as confidentiality, consent, and digital equity.

- Patient Empowerment, defined as the ability to support patients in using digital tools to actively participate in their care.

Table 3 shows the importance and performance results for CP, NCP, and PC. As can be seen, all performance and importance scores reach notably high values, reflecting that oncology healthcare professionals perceive themselves as having strong digital skills, and, at the same time, that digital literacy is considered important in cancer care. Moreover, 22 out of 38 CP (58%) reported having received prior training in digital skills, a figure that rises to 11 out of 16 NCP (69%).

The digital skills that show the highest performance among CP are Information (M = 6.18) and Communication (M = 6.03). Similarly, these same digital skills, but in reverse order, are considered the most important for cancer care (M = 6.45 and M = 6.34, respectively). Additionally, Patient Empowerment digital skills achieve a similar level of importance (M = 6.32). In contrast, the digital skill with the lowest performance and importance scores is Content Creation (M = 5.37).

Digital Communication (M = 5.94) and Information (M = 5.88) skills exhibit the highest performance scores among NCP. In contrast, the skills considered most important for cancer care are those related to Patient Empowerment (M = 6). In comparison, the digital skills of Content Creation and e-Health Problem Solving demonstrate the lowest performance scores (both with M = 5.56), with the former also showing the lowest importance score (M = 5.44).

For PC, the digital skills in which oncology healthcare professionals perform best are Communication (M = 5.94) and Information (M = 5.88). The digital skills considered most important are Communication (M = 5.31) and Patient Empowerment (M = 5.23). In contrast, the lowest performance and importance scores are observed for the digital skills related to Content Creation (M =4.15).

Table 3. Importance and Performance for CP, NCP and PC.

Digital skills	Group	n	Performance M (SD)	Importance M (SD)
Information	CP	38	6.18 (0.98)	6.34 (1.34)
	NCP	16	5.88 (0.96)	5.94 (1.23)
	PC	13	5.85 (2.07)	5.23 (1.59)
Communication	CP	38	6.03 (0.97)	6.45 (1.29)
	NCP	16	5.94 (0.85)	5.69 (1.08)
	PC	13	5.23 (1.78)	5.31 (1.32)
Content Creation	CP	38	5.37 (1.58)	5.79 (1.36)
	NCP	16	5.56 (1.03)	5.44 (1.03)
	PC	13	4.15 (2.03)	4.15 (2.03)
Safety	CP	38	5.21 (1.49)	6.08 (1.56)
	NCP	16	5.25 (1.06)	5.81 (1.05)
	PC	13	4.69 (1.84)	4.62 (2.10)
e-Health Problem Solving	CP	38	5.53 (1.31)	6.18 (1.37)
	NCP	16	5.56 (1.09)	5.81 (1.17)
	PC	13	4.38 (1.80)	4.38 (1.55)
Ethics	CP	38	5.61 (1.28)	6.03 (1.50)
	NCP	16	5.50 (1.15)	5.75 (1.06)
	PC	13	4.92 (2.10)	4.38 (1.85)
Patient Empowerment	CP	38	5.50 (1.45)	6.32 (1.36)
	NCP	16	5.56 (1.09)	6 (1.15)
	PC	13	5.08 (2.11)	5.23 (1.36)
		MEAN	5.38 (1.47)	5.57 (1.40)

Note. CP: clinical professionals; NCP: non-clinical professionals; PC: patients/caregivers

Discrepancy Analysis

Table 4 presents the results of the discrepancy analysis, defined as the mean difference between performance and importance for each of the digital skills. As shown, for CP, Information digital skills exhibit the most positive discrepancy (M = 0.62). Conversely, Safety and Patient Empowerment

digital skills (both M = -0.87) show the most negative results. Regarding NCP, Communication digital skills display the most positive discrepancy (M = 0.25), while Safety digital skills have the most negative discrepancy (M = -0.56). For patients and caregivers, the highest positive discrepancy is observed in Information digital skills (M = 0.62), whereas the most negative discrepancy pertains to Patient Empowerment digital skills (M = -0.15).

Notably, despite the small sample size, statistically significant differences were identified in the discrepancies associated with Communication digital skills. Specifically, the discrepancy was positive for CP, negative for NCP, and nearly neutral for patients/caregivers (-0.42 vs. 0.25 vs. -0.08; $H = 6.50$, $p < .05$).

Table 4. Discrepancy for CP, NCP and PC.

Digital skills	Group	n	Discrepancy	*F*	*H*
	CP	38	-0.16		
Information	NCP	16	-0.06	1.13	3.58
	PC	13	0.62		
	CP	38	-0.42		
Communication	NCP	16	0.25	1.25	6.50*
	PC	13	-0.08		
	CP	38	-0.42		
Content Creation	NCP	16	0.12	0.65	1.26
	PC	13	0		
	CP	38	-0.87		
Safety	NCP	16	-0.56	1.10	2.89
	PC	13	0.07		
	CP	38	-0.65		
e-Health Problem Solving	NCP	16	-0.25	0.85	1.86
	PC	13	0		
	CP	38	-0.42		
Ethics	NCP	16	-0.25	1.24	2.19
	PC	13	0.54		
	CP	38	-0.82		
Patient Empowerment	NCP	16	-0.44	0.70	2.76
	PC	13	-0.15		

Note. CP: clinical professionals; NCP: non-clinical professionals; PC: patients/caregivers

IPA Chart and Key Findings

As a result of these discrepancies, the IPA chart was developed (Figure 1). The axes of the graph are formed by the mean scores of Performance (M = 5.38) and Importance (M = 5.57), previously collected in Table 2. Results are segmented for CP (in red), NCP (in green), and PC (in purple). This segmentation allows for the identification of high-priority training needs, as well as areas where training is of low priority or may even represent a misallocation of resources. Two key findings emerge from the overall analysis.

First, both CP and NCP perceive a greater need for training compared to the skills patients/caregiver's attribute to them. This is evident as most elements related to healthcare professionals are positioned above the diagonal, with some at a significant distance. In contrast, digital skills for patients/caregivers are located on or near the diagonal, with a few even below it.

Second, all digital skills for CP fall within the "Focus Here" quadrant, indicating that, while their prioritization may vary, all these skills require targeted training for this group. When evaluating each element individually, the IPA chart confirms that *Patient Empowerment* and, particularly, *Security* skills are the furthest from the diagonal and within the "Focus Here" quadrant for both clinical and NCP. Consequently, these represent the most critical digital skills requiring training.

For NCP, *Security* and *Patient Empowerment* skills are similarly the top training priorities. Notably, *Communication* skills meet the expected importance levels (located in the "Keep up the good work" quadrant), whereas *Content Creation* skills are deemed redundant (falling into the "Possible

Overkill" quadrant).

In the case of patients/caregivers, *Ethical* skills fall into the "Low Priority" quadrant, while *Information* skills are in the "Possible Overkill" quadrant. The remaining digital skills cluster near the diagonal, indicating a moderate level of alignment between their perceived importance and performance.

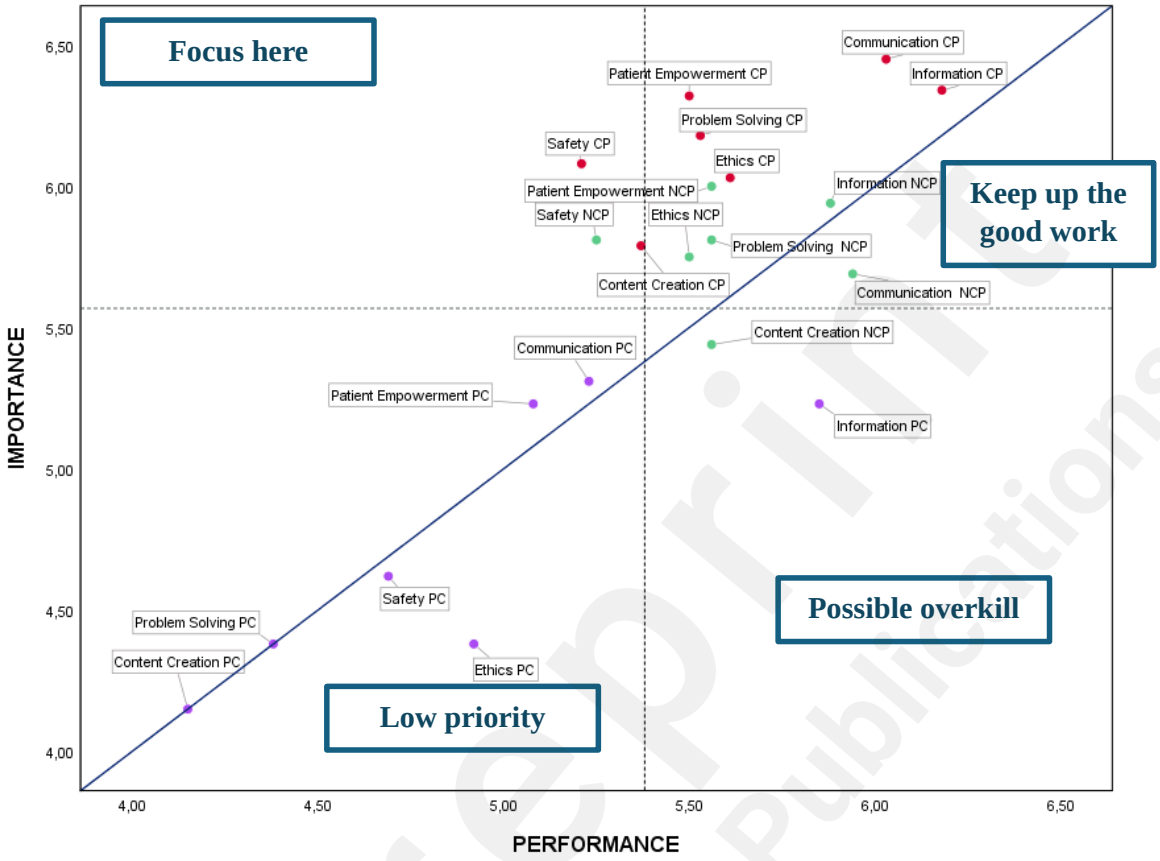

Figure 2. Comparative IPA graph CP vs. NCP vs. PC. Note. CP: clinical professionals; NCP: non-clinical professionals; PC: patients/caregivers

Discussion

Main results

This study identified key training gaps and digital skill development priorities within the oncology healthcare workforce by applying Importance-Performance Analysis (IPA) to a diverse panel of experts. The panel included three stakeholder profiles: clinical professionals (CPs), such as physicians and nurses; non-clinical professionals (NCPs), including managers, educators, and researchers; and patients and/or carers (PCs).

A major finding was the assessment of seven digital skills (*information*, *communication*, *content creation*, *safety*, *problem solving*, *ethical*, and *patient empowerment*) and the specific training needs associated with each stakeholder group.

Notably, the prioritization of these competences differed across groups. For CPs, the analysis revealed that all digital skills require further training, with *safety* and *patient empowerment* emerging as the highest priorities. NCPs showed a comparable pattern, although they assigned less importance to *content creation*. None of the competences was considered a low priority in this group.

In contrast, PCs viewed *information digital skills* with high performance but relatively low importance. The remaining competences were positioned in the low performance–low importance quadrant, though *communication* and *patient empowerment* were perceived as the most important among them.

These findings underscore the need for tailored digital training strategies that reflect the differing perceptions and priorities of each stakeholder group.

Comparison with other studies

Several previous studies have highlighted the widespread lack of digital literacy among healthcare professionals [56], which has led to the development of initiatives aimed at addressing this issue, particularly in the oncology field [38,57]. As Foadi & Varghese suggest [58] while CP demonstrate a high level of proficiency in using specialized software for their daily tasks, they do not receive sufficient training on the basic principles of digital systems, which are essential for thriving in an ever-evolving digital healthcare environment [59]. In fact, the article by Ramachandran et al [60] emphasizes that, while healthcare professionals should demonstrate a general orientation towards digital skills, opportunities are created for specialized digital skills, particularly for the safe and equitable use of new technologies. Regarding cancer care, the study by Barbosa et al [61] identifies digital safety skills as one of the six key domains for therapeutic radiographers/radiation therapists. Concerning patient empowerment, Navarro-Martínez et al [62] emphasize a worrisome trend: nurses, especially younger ones, exhibit limited or negligible use of technology to empower patients.

Incorporating the experience of healthcare service users is a central principle for the transition to digital healthcare with a patient-centered approach [63], making it essential to understand what patients and caregivers expect regarding the digital skills of their oncology professionals. eHealth policies should be designed to consider the diverse perspectives of health professionals, patients, and caregivers. Furthermore, it is essential to bridge the digital divide for cancer patients with low digital literacy, enabling them to effectively use digital platforms designed by professionals [64]. In this regard, it is noteworthy that the present study highlights that NCP perceive training in digital Content Creation skills as a potential misallocation of resources. Therefore, while these digital skills are important for enhancing cancer care, they should not be prioritized in training programs for this professional profile. The results suggest that enhancing digital information skills training within the oncology workforce may not be a pressing priority, as indicated by feedback from patients and caregivers. However, this does not imply that cancer patients are uninterested in receiving information on all aspects of the disease [65], nor that they are unwilling to embrace the potential of telecommunications to access relevant information [66]. In fact, the most necessary digital health function among cancer patients and caregivers is information and education on symptom management following cancer treatment [67] and the use of digital health technology can be experienced as a person guiding them during their cancer treatment [68]. However, as previous studies noted, the interest of patients with chronic diseases in receiving health information through digital modalities is often hindered by educational and age-related gaps. In many cases, this must be preceded by social and instrumental support from health promoters [69].

This study has also yielded a significant finding when comparing results across different groups: CP, NCP, and PC. Digital communication skills were rated as highly important by all three groups. This is consistent with the fact that social support through digital tools provides significant benefits for both patients and caregivers undergoing cancer treatment [70]. However, when analyzing discrepancies between CP, NCP, and PC, it was found that the discrepancies between performance and importance were statistically significant. The results indicate that digital communication skills training is a priority for CP, somewhat unnecessary for NCP, and almost neutral for patients/caregivers. First, NCP have limited direct interactions with patients, as their primary responsibilities center on the management and administration of services, which may account for the observed differences between CPs and NCPs. Accordingly, communication skills training for cancer care professionals who interact directly with patients has become a critical focus, employing structured checklists to systematically assess oncologists' behaviors during specialized doctor-patient consultations [71]. Second, Henry et al.'s review [72] emphasizes that digital communication skills are essential for CP to perform telehealth tasks, which may explain the priorities for training in this

group. Third, although cancer patients consider online platforms a preferred option for cancer follow-up consultations and delivering good news, they are not seen as suitable for initial visits or discussing bad news [73]. Therefore, patients and caregivers may demonstrate a less favourable stance toward digital communication skills compared to CP. For instance, when oncology nurses and surgeons do not mention Patient-Reported Outcome Measures (ePROMs), patients also refrain from discussing them [74].

Finally, it is worth mentioning that, in comparison, both CP and NCP are more critical of their digital skills training needs than patients and caregivers. Overall, healthcare professionals recognize that they are not achieving a level of performance that aligns with the importance of these skills for cancer care. This finding, in which service providers perceive a worse outcome than users, has been observed in other studies using IPA [47]. This apparent "halo effect", where patients and caregivers may rate professionals' digital skills more positively than professionals rate themselves, could reflect a high level of trust in healthcare providers. This is particularly relevant in the context of implementing new technologies and addressing the urgent need for digital skills training, as it suggests that end users may be more receptive to digital innovation than expected, potentially easing the path for adoption and integration of new tools in cancer care.

Strengths and Limitations

This study has several strengths. It utilized a sample of experts purposely selected by the TRANSiTION project consortium (European Cancer Organisation, 2024). The partners belong to fourteen countries from different geographic regions, with different types of organizations and occupational profiles. The partners have the personal email addresses of their members. Therefore, this ensured variability in the professional profiles of the participants, as well as different geogeographical backgrounds; additionally, patient involvement in the long-term improvement of HL is an essential requirement [25], making the inclusion of their perspective in this gap analysis a notable strength. Furthermore, while the use of the IPA method is well-documented in the literature, to the best of our knowledge, it has not been applied to evaluate training needs in digital skills for healthcare professionals, specifically in cancer care. Therefore, this study represents an innovative approach that could serve as a methodological foundation for future research. In addition, the survey probes aspects of cancer care that are not included in more general questionnaires. Moreover, the internal reliability of the instrument across different respondent profiles supports the incorporation of these skills in training design and/or scales development.

This study also has several limitations. First, the questionnaire did not rely on previously validated scales to assess digital skills. However, there is currently no gold standard for measuring digital skills among healthcare professionals, and the instrument was developed based on established digital competence frameworks to ensure alignment with the study's specific objectives. Moreover, the aim of the project was not to validate a scale, but to collect meaningful data to inform the design of a Massive Open Online Course (MOOC) [38]. Although participants from several EU countries were included, the use of a non-probabilistic, purposive sampling strategy through consortium partners limits the representativeness of the sample and the generalizability of the findings beyond the context of the TRANSiTION network. Additionally, as the survey was available only in English, nine potential participants were excluded due to insufficient language proficiency, which may have introduced selection bias. The administration of the survey during the summer months also contributed to a relatively low response rate within a limited population. Moreover, the use of self-reported data introduces the possibility of response biases; although prior research supports the validity of self-report measures [75], the results should be interpreted with appropriate caution. Finally, although IPA is a widely used tool to guide priority setting in training and service improvement [43,44,46,76], it has certain methodological limitations [77]. The technique relies heavily on mean values to allocate items to quadrants, which may not fully capture the distributional characteristics of the data. In addition, the cut-off points, typically overall means, are somewhat arbitrary, which can affect the robustness and interpretability of the results. This study did not

include a sensitivity analysis to explore the impact of alternative quadrant definitions, which could have helped mitigate this limitation. This decision was primarily influenced by the exploratory nature of the research and the limited sample size. Future research should address these aspects to improve the reliability of IPA-based prioritization.

Impact in organizations and health

There is a growing body of literature that demonstrates the pivotal role of health literacy for achieving better health outcomes and higher quality of care [78]. Crucially, health literacy is modifiable and improving health literacy is increasingly recognised as a way of improving outcomes, including in Europe's Beating Cancer Plan. Therefore, the concept has rapidly gained an emerging strategic role in several governing bodies and cancer organizations, more comprehensive implementation of interventions and strategies is still needed.

The information that cancer patients need to know for their diagnosis and treatment is indeed complicated. It includes a new language of health terminology, understanding consents for complex treatments and procedures, attending appointments at the right time and place, and seeking help appropriately and in a timely manner. Equally, citizens should have the necessary skills to interpret information and make appropriate decisions for cancer screening (e.g. high-risk group of citizens) and prevention (e.g. lifestyle behaviour). Competencies in health literacy and communication can significantly contribute to reducing barriers related to health literacy and to improving the quality of healthcare and health outcomes for patients [78]. However, studies have shown that health professionals tend to overestimate the health literacy of patients and citizens and lack adequate competence to compensate for it. Therefore, preparing staff to respond to patients' health literacy is seen as a responsibility of healthcare organisations, which should be incorporated into their training programmes.

Cancer care systems need to adapt to technological advancements by providing online health materials that are evidence-based, quality-controlled, reliable, and both culturally and linguistically appropriate. Therefore, the incorporation and management of digital technologies that facilitate interactions between healthcare professionals and patients seem essential in current and future training programs. It should be noted that the digital skills of CP involved in cancer care are multifaceted, and all of them are essential for providing high-quality cancer care [34]. Therefore, the findings of this study support the need to implement comprehensive training programs for CP that address the main digital skills cited in the literature [79].

It is worth mentioning that, although patient empowerment is a vague concept, it has been increasingly applied in cancer care over the past decade [33]. The accumulated evidence suggests that shared decision-making and the use of interactive digital tools leads to positive outcomes for cancer patients [80,81].

In addition, the future European Health Data Space (EHDS), which aims to provide a coherent, reliable, and efficient system for the exchange and reuse of health data in research, innovation, policy-making, and regulation, will require a greater mastery of digital security skills for both clinical and non-clinical healthcare professionals[82].

The importance given by the EU to digital skills training has already been outlined. Based on expert input, our consortium believes it is essential that countries incorporate digital health literacy training at the earliest stages of education for health professionals and health managers and develop programmes focusing on digital skills in oncology [29]. Not only in the university setting, but also in continuing education, including hands-on training through internships, clinical rotations, and simulation exercises and to promote interdisciplinary collaboration.

The extension and adaptation of competences to the health environment is an example to follow. The involvement so far of 60 countries all over the World, and 1300 participants will facilitate this impact, supported by multiple meetings with European stakeholders (https://www.europeancancer.org/eu-projects/resource/transition) and diffusion through scientific societies and partners' Universities and/or National Health Services.

Finally, it points to research gaps for new scientific projects in the fields of social sciences and citizen science.

Conclusions

This study conducts a gap analysis using the IPA to assess the digital skills of healthcare professionals in oncology and identifies areas where further training is needed. The results highlight the necessity of developing comprehensive training programs for CP. Additionally, it underscores the critical importance of digital Safety and Patient Empowerment skills for both PC and NCP. The study incorporates the perspectives of patients and caregivers, who prioritize different training needs for healthcare professionals, placing comparatively less emphasis on digital information and ethical skills. These findings provide a knowledge base for designing training programs and eHealth policies, promoting a holistic approach that integrates the perspectives of the various stakeholders involved in digital cancer care.

Policy Summary

Healthcare professionals acknowledge that their digital skills require enhancement across all areas. Specifically, doctors and nurses need additional training in digital problem-solving, communication, and-above all-, skills linked to patient safety and empowerment. These priorities align with the perspectives of patients and carers, who emphasize the critical need for healthcare providers to strengthen their digital communication and patient empowerment capabilities.

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“During the preparation of this work the authors used DeepL Write in order to improve readability and language. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.”

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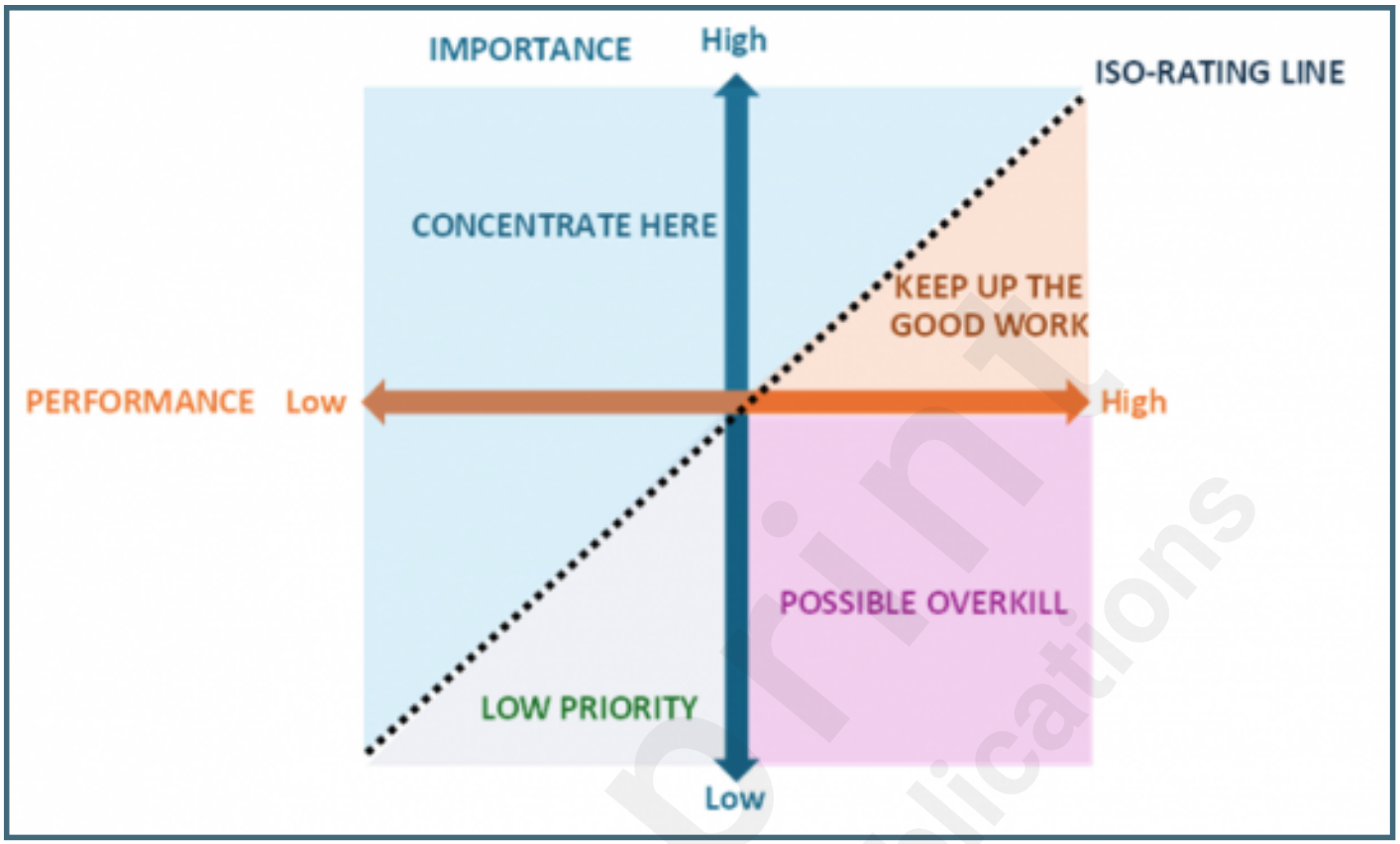
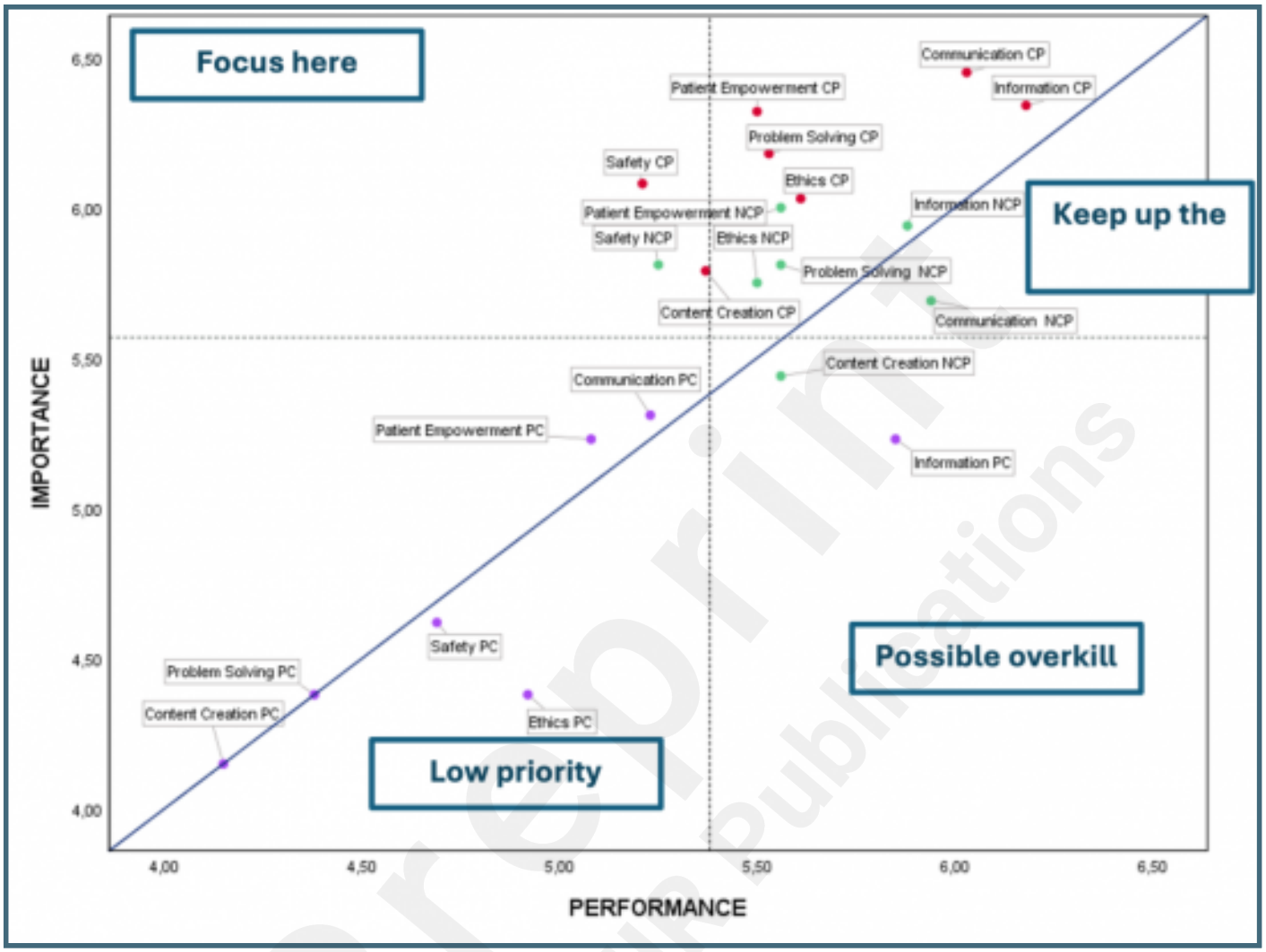
Supplementary Files

Figures

Representation of the alternative version of the IPA.



Comparative IPA graph CP vs. NCP vs. PC. Note. CP: clinical professionals; NCP: non-clinical professionals; PC: patients/caregivers.



Multimedia Appendixes

CP and NCP Survey.
URL: http://asset.jmir.pub/assets/54459d9e799be0f01e6072ef1cdc30b1.docx

Additional analysis of training needs.
URL: http://asset.jmir.pub/assets/49d57c6e001678948acc8bee76a36eea.docx