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Digital skills of therapeutic radiographers/radiation therapists – Document analysis for a European educational curriculum

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ABSTRACT

Introduction: It is estimated that around 50% of cancer patients require Radiotherapy (RT) at some point during their treatment, hence Therapeutic Radiographers/Radiation Therapists (TR/RTTs) have a key role to play in patient management. It is essential for TR/RTTs to keep abreast with new technologies and continuously develop the digital skills necessary for safe RT practice. The RT profession and education is not regulated at European Union level, which leads to heterogeneity in the skills developed and practised among countries. This study aimed to explore the white and grey literature to collate data on the relevant digital skills required for TR/RTTs practice.
Methods: An exhaustive systematic search was conducted to identify literature discussing digital skills of TR/RTTs; relevant grey literature was also identified. A thematic analysis was performed to identify and organise these skills into themes and sub-themes.
Results: 195 digital skills were identified, organised in 35 sub-themes and grouped into six main themes: (i) Transversal Digital Skills, (ii) RT Planning Image, (iii) RT Treatment Planning, (iv) RT Treatment Administration, (v) Quality, Safety and Risk Management, and (vi) Management, Education and Research.
Conclusion: This list can be used as a reference to close current gaps in knowledge or skills of TR/RTTs while anticipating future needs regarding the rapid development of new technologies (such as Artificial Intelligence or Big Data).
Implications for practice: It is imperative to align education with current and future RT practice to ensure that all RT patients receive the best care. Filling the gaps in TR/RTTs skill sets will improve current practice and provide TR/RTTs with the support needed to develop more advanced skills.

Introduction

The discovery of X-rays and radium in the 1890s impacted the trajectory of healthcare, with the Radiotherapy (RT) speciality evolving and growing exponentially in complexity since then.[1] The evolution reached such an extent that current statistics suggest that approximately 50% of all cancer patients will benefit from RT during their illness.[2,3]

The increase in complexity, together with the exponential growth of the computer's processing power, boosted RT precision, leading to many changes in clinical practice and contributing to better outcomes for cancer patients. Hence, modern RT increases the need for specialised skills and responsibilities of the professionals who most often deliver radiation treatments to patients: Therapeutic Radiographers/Radiation Therapists (TR/RTTs). This

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increase in competence leads to better efficiency, quality and safety of patients' procedures.[3]

Faced with the fourth industrial revolution (the era of society's digitalisation), TR/RTTs deal with new digital skills requirements, which must be included in their initial training or developed through continuous training after graduation. These requirements come from a large amount of software used to perform a range of tasks such as image acquisition and evaluation, treatment planning and delivery, and quality control, which are all constantly evolving.

Nevertheless, there is no common regulatory framework for TR/RTTs professionals across the European Union (EU), leading to a difference in skills acquired across member states.[4,5] This hinders professional mobility and may result in heterogeneity in the level of care offered to patients, creating a need for more standardised requirements regarding training programmes for TR/RTTs across the EU territory.[6]

Identifying the digital skills relevant for TR/RTTs may help standardise and enhance training in this area, improving patients' care across the EU but also increase technical and digital knowledge transfer, boosting the European economic competitiveness.

The European Qualifications Framework (EQF) for lifelong learning aims to harmonise the description of education across the EU. This framework is widely used by educational institutions and professional associations when designing educational programmes or reference documents.[7–9] Given the European context of this study, the EQF definition of ‘skill’ was used as a reference. The EQF defines skill” as follows:

> “ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments)".[10]

However, there are several definitions for the concept of "digital skills”. The definition used was presented in the Final Report of the Education Working Group “Digital Skills for Life and Work”. This definition establishes a broader description of digital abilities that professionals can develop as part of their training, therefore, best suited for this study.

> “The term 'digital skills' refers to a range of different abilities, many of which are not only 'skills' per se, but a combination of behaviours, expertise, know-how, work habits, character traits, dispositions and critical understandings".[11]

Given the recognised importance of the need for digital skills in healthcare professionals, several European initiatives have emerged, such as the eHealth Action Plan (eHAP) or the Coordination Actions in the scientific era of Medical Education Informatics (CAMEI) project, which through multiple actions sought to promote Information Technology (IT) skills and digital literacy of health workers.[12–16] Another example is the Joint Action Health Workforce Planning and Forecasting, supported by the EU Health Programme, which established a network of experts in health workforce planning and forecasting and was designed to define the skills needed in education and training policies.[12,17] These projects signal the importance of digital skills in the future of the health workforce.

The rationale for this study was to support Higher Education Institutions (HEI) and other TR/RTT' training stakeholders, such as employers, by identifying the relevant digital skills to be included in the educational curriculum and continuous professional development (CPD) programs.

Aim

The aim was to identify the digital skills of the TR/RTTs through qualitative analysis of published documents. Since RT is an area of significant technological investment and rapid progress, the digital skills required for future practice were also assessed.

Methods

Document analysis is a research design that entails the critical analysis of documents.[18] In this study, a *qualitative* document analysis of peer-reviewed (white) literature and other relevant documents (grey literature) was undertaken to gather the relevant digital skills for TR/RTTs.

The identification of relevant literature for this document analysis was divided into two parts: a systematic search of the white literature from databases and journals, followed by an exhaustive identification of relevant grey literature. This search and analysis of relevant documents were conducted over six months (November 2018 to April 2019). After the collection of all literature, a qualitative document analysis was performed.

Systematic search of white literature

In the first phase, a systematic search was performed using the search query presented in Table 1, based on the following keywords and corresponding synonyms.

The keywords related to the professional titles were based on the literature review published by Couto et al.,[4] where these titles were identified with a European scope. The databases and journals used for this search were: PMC, Science Direct, PubMed, ERIC, Cochrane Library, IEEE Xplore, Radiography and tipsRO journals. The publications were selected according to the inclusion and exclusion criteria in Table 2.

For literature management, Zotero Software (v.12) was used. This systematic search was performed by two reviewers independently. A snowballing literature searching was performed.

Table 1
Search strategy.

Keyword	Search terms
Digital skills	a) digital AND (skill* OR competenc* OR task*)
TR/RTT	b) “therapeutic radiographer” OR “therapeutic radiography” OR radiographer* OR radiotherapist* OR RTT* OR “radiation therapist” OR “radiation technologist” OR “radiation therapy technician” OR “Radiological technologist” OR “Radiological technician”
RT	c) radiotherapy OR “radiation therapy” OR “radiation oncology”
Query	a) AND b) AND c)

Table 2
Inclusion/exclusion criteria used in the selection of publications.

Inclusion criteria	Exclusion criteria
- Published in the last 10 years; - English language; - Focus on digital skills or tasks performed digitally by TR/RTTs;	- Focus on other healthcare professionals; - Focus on non-digital skills of TR/RTTs.

Search of grey literature

In the second phase, a basic search was performed to include grey literature using the same keywords presented in Table 1. This phase aimed to investigate education and professional practice of TR/RTTs, such as educational guidelines, recommendations, benchmark documents[8,9,19], technical support manuals of radiotherapy information systems (from different vendors); and digital skills, such as reports, projects and frameworks related to digital skills in the European setting.[11–17,20–24]

Document analysis

The thematic analysis aimed to identify digital skills and digital-related tasks performed by the TR/RTTs. The digital-related tasks were then converted into a corresponding digital skill following the adopted definition of "skills" and "digital skills" presented before.[10,11]

This qualitative analysis allowed the compilation of a list of digital skills relevant to the TR/RTTs practice organised according to the different dimensions (themes) identified. The resulting list was reviewed by the research team and subsequently assessed by ten external experts with backgrounds and professional experience across all fields of RT, such as Planning Image, Treatment Planning, Treatment Administration, Quality and Safety, Education and Research. Each expert evaluated the relevance of the themes and corresponding skills (codes). To enhance the validity of this qualitative study and reduce research bias, a peer debriefing[25,26] was also performed by presenting the results and obtaining feedback from seven experts from RT professional practice (including two specialists and one manager), RT education and Medical Physics.

Results

A total of 216 sources were identified through the systematic search of the white literature. 12 duplicate papers were removed and 186 were excluded based on the inclusion/exclusion criteria (Table 2). Together with the eight papers found by snowballing, this search resulted in a total of 26 papers[1,3,4,27–49] for analysis (Fig. 1). Fifteen documents[8,9,11–17,19–24], namely educational guidelines, recommendations, benchmark documents for TR/RTTs as well as projects and frameworks related to digital skills in the European setting were included from the grey literature, and 52 technical support manuals were used for consultation.

From the analysis of these documents, 195 digital skills were identified, organised in 35 sub-themes and grouped into six main themes (Table 3):

(i) Transversal Digital Skills;
(ii) RT Planning Image;
(iii) RT Treatment Planning;
(iv) RT Treatment Administration;
(v) Quality, Safety and Risk Management;
(vi) Management, Education and Research.

Of these six themes, three were specific to the TR/RTTs, and the remaining three were non-specific to the profession, as shown in Table 4.

These non-specific themes are applicable in the TR/RTT profession but also in other professions due to the rapidly evolving technology and Information and Communication Technologies (ICT) innovation.[11–13,15,16,20–24]

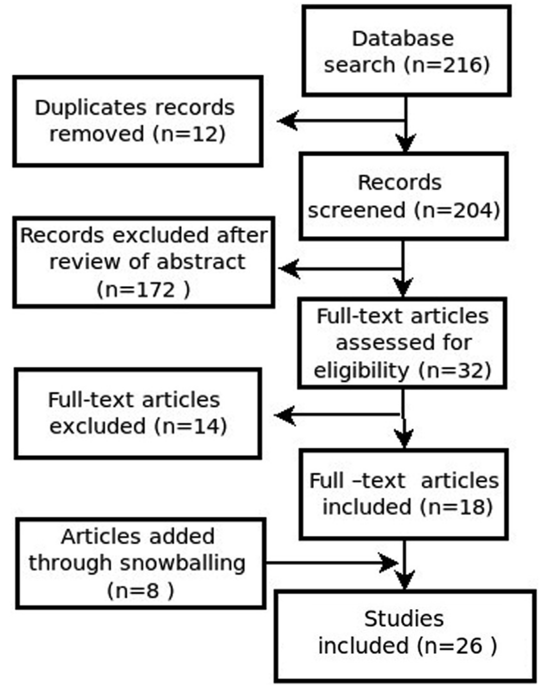

Figure 1. Systematic search results.

Discussion

None of the documents found directly identified a comprehensive list of the digital skills required by the TR/RTTs. Therefore, this paper is the first to synthesise a list of digital skills required for the TR/RTT professional practice/curriculum development.

However, further research is recommended to assess the level of development of these digital skills of TR/RTTs in professional practice across Europe and identify education and training gaps. This approach will give a snapshot of current practice and identify some outdated digital skills.

The white literature tended to have more in-depth research of specific skills rather than identifying the skills.[1,3,4,27–49] The Grey literature proved useful in identifying the digital skills relevant for TR/RTTs. Multiple documents itemised the skills of TR/RTTs (such as education benchmarking documents)[8,9,19] or digital skills in general (such as EU reports).[11–16,20–24]

White literature

The 26 papers described two areas of research: (1) current practice and training and (2) new technologies.

The papers discussing current practice and training included data describing different domains of intervention of the TR/RTTs in RT and the respective skills, tasks or roles associated.[4,27–31,33–37,39–44,47–49] For example, these roles included "prepare digital images" in the treatment plan domain, "use various imaging modalities" in the imaging domain, or "check radiation safety interlocks" in the machine quality assurance (QA) domain. Literature describing the skills that should be included in the curriculum of TR/RTTs as standard by identifying core roles was also included in this group. For instance, digital skills applied to "radiation administration methods" or "patient care".

The second group of papers addressing new technologies included articles that refer to TR/RTTs skills associated with the new

Table 3
List of TR/RTT's digital skills, represented in dimensions (themes), after their identification through the published literature.

Dimensions (themes)	Skill
Transversal Digital Skills	
Technologies/Information Systems (IS)	• Open and close the Operating System • Log in and log out of applications • Save data (e.g. CD, DVD, Pen Drive) • Import and export data (e.g. DICOM images, DICOM RT objects, RT data) • Print plans/images/data • Create PDF documents
Communication	• Create an internal communication channel (e.g. chat, intranet) between TR/RTT and other professionals • Create an external communication channel (e.g. mobile applications) between TR/RTT and service users (patient/carers) • Use professional e-mail • Create and disable a patient alert/note • Create multimedia content for patient education
Electronic Patient Record (EPR)	• Create a new patient record • Import patient data from other IS • Edit patient's demographic details • Acquire identification photo • Access RT patient data • Assign patient to a clinical trial • Add clinical data (e.g. treatment side effects, occurrences)
Patient Agenda	• Create a new appointment (e.g. Computerised Tomography scan, RT treatment) • Create and edit patient agenda • Edit patient status (e.g. check-in, waiting time, treatment status) • Use data filters
Workstation	• Create "to do" worklist • Create staff agenda • Create charts flow and data graphics regarding all activities and tasks • Create and print out reports • Create template-based multiple appointments or tasks
RT Planning Image	
Computerised Tomography (CT)	• Create scan protocols • Set reference position (scan reference point) • Set the acquisition parameters (e.g. slice thickness, Field of View, kV, mA) • Acquire scout • Acquire and view CT scan • Set reconstruction parameters (e.g. algorithm, matrix size, coordinates) • Add patient setup notes (e.g. text, photo of patient positioning) • Create a clinical protocol for patient setup record
4D Computerised Tomography	• Add patient data into the respiratory motion control system • Create audio/video file for respiratory coaching • Define threshold values and acquire the respiratory cycle • Set acquisition parameters (e.g. amplitude, phase or breath-holding) • Synchronise respiratory cycle phase with CT image set
Image Processing and Enhancement	• Use visualisation tools (e.g. zoom, window level, scale, contrast and brightness) • Use editing tools (e.g. orientation, filters, reticle, graticule) • Use navigation tools (find and open patients' images)
Image Registration and Correlation	• Create a new registration • Select anatomical area/protocol • Select the set of images to be registered • Select registration method (automatic, interactive and manual) • Edit transformation results • Review and approve results
Image Segmentation and Contouring	• Add structures contours (automatic, semi-automatic or manual) • Edit contours' properties (e.g. name, colour, margins) • Use contouring tools (e.g. geometric shapes, tracing, rubber) • Select and group structures • Use processing tools (e.g. interpolation, threshold, translation, rotation) • Use support tools (e.g. atlas, case library) • Review and approve segmentation
RT Treatment Planning	
Plan Treatment	• Create a new course and/or plan • Set treatment parameters (e.g. LINAC ID, beam, energy, patient orientation) • Set isocenter and/or markers • Add dose and fractionation data

Table 3 (*continued*)

Dimensions (themes)	Skill
Plan Parameters (forward planning)	• Create and edit fields (e.g. dimensions, gantry and collimator angles, segments) • Create reference images (Digitally reconstructed radiographs-DRRs) • Set accessories (e.g. MLC, blocks, compensators, wedges, bolus, cones) • Set field weighting • Create setup fields
Inverse Planning (IMRT/VMAT)	• Add fields (static or dynamic) • Select calculation models • Create support structures (e.g. “shell") • Set dose constraints and priorities (cost function) • Use geometric optimisation tools (e.g. angulation, sequence, direction) • Use dose optimisation tools (e.g. objective functions, fluencies) • Use templates (e.g. DVH estimation models) • Add checkpoints
4D Planning	• Set respiratory gating parameters (e.g. amplitude, phase or deep inspiration) • Set reconstruction for planning • Create setup fields • Add cine images to setup fields
SRS/SBRT Planning	• Set localisation device • Set treatment technique (e.g. stereotactic cones, IMRT, VMAT) • Set structure optimisation parameters • Set calculation properties
Dose Calculation	• Select the calculation parameters (e.g. grid size, calculation models) • Calculate dose distribution • Perform plan normalisation • Select the subtraction/accumulation imaging dose (Monitor Unit-MU)
Plan Evaluation	• Use visualisation tools (e.g. 2D/3D views, beam's eye view, room's eye view) • Use evaluation tools (cumulative or differential DVH, 3D dose distribution, isodoses, reference points) • Use review tools (e.g. plan sum/subtract, dose comparison) • Compare treatment plans • Use biological optimisation tools
Prerequisites for Treatment	• Calculate isocenter coordinates • Approve a plan for treatment • Create a plan revision • Sum treatment plans (e.g. Brachytherapy plans with external RT plans) • Change treatment machine • Replan (e.g. based on CBCT images) • Export a plan
RT Treatment Administration	
System Setup	• Start up and warm up linear accelerator (LINAC) and imaging devices • Shut down systems (e.g. LINAC, MLC) • Set to standby mode • Access the daily patient queue
Treatment Delivery Preparation	• Import and edit patient positioning data parameters (e.g. photos and setup notes) • Access the treatment plan (e.g. prescription, plan status, accessories and reference images) • Schedule treatment sessions • Schedule verification images • Set imaging parameters (e.g. imager position, collimation, filters) • Re-order and activate fields • Remove plans in cache
Treatment Verification: Conventional Techniques	• Acquire planar MV images (2D and 2D/2D) • Acquire planar kV images (2D and 2D/2D) • Optimise image quality (e.g. kV, mA, ms, MU) • Acquire CBCT images (3D/4D) • Set CBCT parameters (e.g. mode, filters and slice thickness) • Acquire scout and adjust scan range • Set reconstruction parameters (e.g. volume, slice interval and artefact removal) • Detect markers (automatic or manual)
Treatment Verification: Advanced Techniques	• Acquire images in integrated mode (e.g. during an IMRT treatment) • Acquire MV and kV images for respiratory gating treatments • Acquire ad-hoc images in a 4D treatment • Use fluoroscopy system • Use surface verification system • Use ultrasound (US) verification system • Use tracking verification system

(*continued on next page*)

Table 3 (*continued*)

Dimensions (themes)	Skill
Image Matching	• Use pre-analysis tools (e.g. scale and field alignment) • Use matching tools (automatic, manual or 3D reference markers) • Use matching view tools (e.g. split window, spyglass, reverse) • View kV or MV images in cine mode • Match 2D images (kV or MV) with reference image (DRR) • Match 3D images (CBCT) with reference image (planning CT) • Match 3D surface images with a reference surface • Match 3D US images with a reference position • Match real time tracking images with reference images
Image Analysis	• View online/offline images • Use analysis tools (e.g. grid, measurement parameters, graphics) • Add notes to images • Select and compare current and previous images • Change the shift between the scan reference point and the isocenter, based setup errors observed in previous images (e.g. NAL correction protocol) • Edit image status (e.g. approved, revised)
Treatment Delivery	• Apply couch shifts • Acquire treatment parameters (e.g. couch position and imaging device position) • Deliver treatment using manual or automatic mode • Set field sequence mode • Save the treatment session (e.g. automatic, manual or partial)
Respiratory Gating Treatment Delivery	• Setup respiratory gating system on the patient/treatment room • Select the respiratory cycle reference session • Adjust threshold, scale and audio/visual instructions • Use analysis tools for pre-treatment verification • Perform and record the treatment with respiratory control • Check the history of the respiratory gating treatment
SRS/SBRT Treatment Delivery	• Perform verification procedures (e.g. isocenter, X-ray system) • Set X-ray system parameters • Set patient positioning parameters (e.g. tolerances, detection accessories) • Perform patient positioning using robotics • Acquire verification images • Use tools for anatomical match analysis • Perform geometric corrections
Quality, Safety and Risk Management	
Quality Assurance	• Perform daily checks (e.g. isocenter, dose output) • Evaluate equipment performance • Record occurrences related to the equipment and accessories • Create quality assurance programmes • Create protocols/templates (e.g. treatment site, treatment technique, image verification)
Security	• Record all procedures concerning the radiation delivered • Review acquired, edited and replaced parameters • Review LINAC, MLC and imaging system failures/interlocks • Review import/export history • Use barcode reading system (e.g. patient, accessories, cones) • Check occupational exposure dose
Risk Management	• Use collision detection systems • Report accidents and incidents on a platform (e.g. SAFRON, ROSEIS) • Develop risk management programs • Audit the workflow and treatment courses (e.g. plan changes, schedules) • Create evaluation and prevention reports
Data Protection	• Create new user and/or group • Edit user and/or group permissions • View patient data access records • View operating system and application access logs
Information Integrity	• Detect data recording failures • Recover data from backup files • Confirm MU delivered in case of emergency/loss of power • Use backup tools (e.g. complete/incremental/scheduled) • Review the consistency of checks, file wipes and backups
Management, Education and Research	
Department Administration and Management	• Use data collection tools of the activities performed (export data, productivity) • Code activities (e.g. procedures, diagnostics) • Use billing tools (billing codes) • Create automatic reports (e.g. daily activities, billing) • Perform market research (e. g. supplies, technology) • Use tools to automate work schedules (weekly/monthly) • Create organisational systematisation tools

Table 3 (*continued*)

Dimensions (themes)	Skill
Education	• Create multimedia content for new professionals/trainees education • Create training programs (for students and professionals) • Create dissemination platforms (e.g. webinars, newsletter) • Perform awareness-raising actions related to radiotherapy (e.g. videos, presentations, social networks)
Research	• Use search engines and digital libraries (e.g. white and grey literature) • Collect and evaluate data for research • Use data analysis software (e.g. spreadsheet, statistical software)

Abbreviations: DICOM: Digital Imaging and Communications in Medicine; LINAC: Linear Accelerator; MLC: Multileaf Collimator; IMRT: Intensity-modulated Radiation Therapy; VMAT: Volumetric Modulated Arc Therapy; DVH: Dose-volume Histogram; CBCT: Cone-beam Computed Tomography; NAL: No action level; SAFRON: Safety in Radiation Oncology; ROSEIS: Radiation Oncology Safety Education and Information System.

Table 4
Specific and non-specific themes of the digital skills relevant to the TR/RTT profession.

Specific	Non-specific
- RT Planning Image; - RT Treatment Planning; - RT Treatment Administration.	- Transversal Digital Skills; - Quality, Safety and Risk Management; - Management, Education and Research.

and advanced technologies, such as the applicability of Machine Learning in volumes delineation and artefacts reduction, the use of Big Data for building databases (digital libraries), scripting or code repositories, or the impact of Artificial Intelligence in image segmentation and analysis.[1,3,32,38,45,46]

Common skills were identified across all these documents, such as “communication” (between professionals and patients), “data sharing”, design of “training programmes” and “protocols”, development of new tools for data recording or decision-making support (e.g. libraries, optimisation tools), underpinned by programming/computer science knowledge.

Grey literature

Despite the several European initiatives on digital skills for the different health professionals,[12–17,20] no framework specifically for TR/RTTs, has been presented so far. However, through the analysis of these documents, it was possible to identify digital skills transversal to all health professions, such as “managing data”, “programming”, “protecting personal data”, “creating digital content”, or “browsing and filtering data".

Table 5
Themes used by the IAEA, ESTRO and EFRS to organise the TR/RTTs' core competencies or learning outcomes.[8,9,19]

Themes	IAEA	ESTRO	EFRS
Anatomy, physiology & pathology	✓		✓
Positioning and immobilisation		✓	
Image acquisition and virtual simulation		✓	
Treatment planning	✓	✓	
Treatment verification	✓	✓	
Treatment delivery	✓	✓	
Radiation protection	✓		✓
Quality assurance		✓	✓
Professionalism	✓	✓	✓
Brachytherapy		✓	
Research		✓	✓
Education	✓	✓	
Information Technology/Risk management			✓
Numeracy			✓
Psycho-social patient care			✓
Communication		✓	✓
Pharmacology			✓
Ethics			✓
Professional development	✓		✓

Focusing on the organisation of the specific skills of TR/RTTs into themes, the educational guidelines, benchmarking, and recommendations documents of the International Atomic Energy Agency (IAEA), European Society for Radiotherapy and Oncology (ESTRO) and European Federation of Radiographer Societies (EFRS) were used to guide thematic analysis.[8,9,19] Table 5 summarises the themes used by these documents. It is important to note that a specific skill can be included in different themes, depending on how the document is organised. Therefore, the differences in the organisation do not automatically mean that the recommended learning outcomes are different.

Given that digital skills are strongly related to the software/technologies used, technical publications of the different RT systems used worldwide were also consulted. These technical documents allowed the identification of specific skills performed by TR/RTTs in a digital context, such as “create structures sets” or “generate the plan and define the beams”. However, non-specific skills are also described, such as “shutting down the system” or “running predefined reports for data analysis and extraction".

Since digitisation in healthcare will be a reality in the near future, digital skills become essential in the professional practice of TR/RTTs. If there is a lack of digital skills to operate the existing and future technology, or TR/RTTs do not attempt to keep up with technology trends, this may reduce the safety and quality of patient care offered. Hence, it is recommended that the educational curricula of TR/RTTs should be strengthened to provide them with training in digital skills appropriate to their current and future needs.

The list of digital skills presented in this study is intended as an educational guideline for this digital training of TR/RTTs. To ensure safe and effective professional practice and to cope with the rapid digital evolution and transformation, CPD programmes should be considered in addition to educational programmes, focusing on the new needs that will arise. Some of these skills can be developed through everyday practice and self-learning, which also constitute some forms of CPD.[50]

Limitations of the study

Documents submitted in languages other than English were not evaluated, so there is the potential that skills practised in non-English speaking countries were not included in this list.

Additionally, some of the skills listed may not yet be an established competency of TR/RTTs. This may be because, in some countries, these skills are assigned to other professionals or simply due to the absence of these technologies. Further research is recommended to identify which digital skills are currently being developed across Europe and which are considered essential in TR/RTT curricula.

Conclusion

The digitalisation of healthcare has long been on the European agenda. Continuing education of healthcare professionals regarding digital health technology has been central in European initiatives, improving healthcare in all member states. Nevertheless, the successful implementation of digital technology in healthcare depends on the healthcare professionals' digital skills.[12]

> "You can have the most technologically advanced device in the world, but if you don't know how to operate it, it will be as useful as a jumbo-jet without a pilot".[12]

The lack of a specific reference regarding the digital skills training needs of TR/RTTs hinders their development in the initial and lifelong training programmes. To the best of our knowledge, this is the first study to present a dedicated list of the digital skills of the TR/RTTs, which may promote their implementation in these professionals' training and practice.

The differences in regulation and education of healthcare professionals,[4] and different access to technology across European countries,[51] lead to gaps in digital skills. Including these skills into a standardised European curriculum could also promote a uniform education, facilitating the movement of TR/RTTs between countries. More importantly, it can improve the quality of practice, resulting in better patient outcomes.

Conflict of interest statement

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