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Abstract

Background

Increasingly, digital, and innovative eHealth solutions are being developed for the healthcare sector. However, the implementation of such e-health solutions is only moderately implemented in practice to improve work processes and save limited resources. Apart from structural challenges, the lack of comprehensive involvement of prospective users in the development process (van Limburg et al. 2011), another crucial aspect is that medical personnel do not have sufficient digital skills and the willingness and ability to implement solutions well across sectoral boundaries and in a multidisciplinary environment (Gagnon et al. 2012, Benson 2019). The ERASMUS+ project "Digital & Innovation Skills Helix in Health (DISH)" is developing a framework training concept to address this gap through the systematic training of digital skills and innovation among health professionals. As a first step of the project, this Baseline Report was conducted on the question "What are the underlying conditions in the participating countries in surroundings relevant to the health system?" and "Are there training programmes for health professionals to teach digital skill?

Method

A mixed method design was conducted. First part is a structured questionnaire named "Template-Survey", formulated from the results of the work of preceding working meetings and discussed with members of the project lead.

Subsequently a scoping review according to the framework of Arksey and O'Malley, 2005 was conducted. The search was carried out in the databases Medline, Embase, CINAHL and IEEE from March to June 2019, with a monthly update. Empirical articles from 2000 onwards are included. The reference screening and data extraction were carried out independently by two researchers, a third researcher was consulted in case of conflict. Apart from a categorisation by research interest, classification and type of publication/study, no quality criteria were applied.

Results template

The results of the template and the questionnaire respectively show fundamental divergences in the different countries of the DISH project as how issues are progressed at national, regional, and local level and with what degree of effect. In the evaluation of results of the template it is also apparent that very different conditions, on an international basis, with regard to adopted legal frameworks, for the digitization of the health professions, and already implemented curricula in educational institutions prevail.

Also, contextual factors such as barriers and drivers for lifelong and sustainable learning and acquisition of digital skills are weighted differently within the framework of the project partners from the different countries.

The elements, extracted from the template, evaluated as extremely important for a successful training to improve digital skills in health care professionals form the fundament of the three interlinked concepts in the DISH project: 1)Learning innovation unit, 2) Training on the job and 3) Assessment.

Results Scoping review

2,165 hits were included in the screening and n=25 trials were included. These were categorised according to 1) Measuring digital literacy among health professionals 2) Health professionals' attitudes towards new technologies, 3) Existing training programmes to improve digital literacy.

Discussion

In the participating countries a different context can be observed. Common to all countries is a lack of targeted support programmes for digital literacy, especially in the health sector. The

infrastructure in the individual countries is unevenly developed and the promotion of digitisation is a perceptible strategic goal for everyone, with varying degrees of state and legal support. The underlying form of government and the structure of the respective health care system are relevant characteristics in this context.

The literature shows that digital skills are increasingly demanded by all health professionals. The attitude to integrate new technologies into work processes is available. However, there is a lack of effective, implementable training programmes and their measurable evaluation. Germany, in particular, has not yet shown any sustainable, systematic efforts in this area.

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1 Introduction

Digitalisation increasingly supports the processes of the living world of people worldwide. This includes the private environment, but also professional work processes. However, digital strategies and the technical infrastructure vary from nation to nation. In general, it can be said that digitalisation is growing inexorably and has great potential to make processes more efficient in terms of resources. To successfully implement digitalisation in the working environment, i.e. to introduce technology or redesign processes digitally, digital skills need to be promoted. Digital competences are defined very specifically and not very generally. Therefore, we followed the definition of digital literacy defined as:
"Digital literacy is about 'having the knowledge and ability to effectively and critically navigate, evaluate and create information using a range of digital technologies. A digitally literate person can use technology strategically to find and evaluate information, connect and collaborate with others, produce and share original content, and use the Internet and technology tools to achieve many academic, professional and personal goals'" (Grech, 2014, p.79)
The DISH project aims to 1) create a framework programme, 2) test it, 3) adapt it to the respective context and 4) evaluate it to support the uptake of digital skills in the health sector. As an international project, knowledge can be gained from different systems. The consortium includes representatives from Denmark, Poland, Norway, Spain, Great Britain, and Germany. Each country is influenced by the prevailing framework conditions of political, health and educational system relevant factors, as well as aspects of the philosophy of attitude and culture.
To identify and explain the different framework conditions in advance and to make them visible for later effects, a comprehensive baseline survey was conducted at the beginning of the DISH project. This survey was developed as work package (WP) 2 under the direction of the German DISH Helix with the support of all project participants.
The objective of WP 2 is twofold; 1) to ensure that the project builds on already know research results and innovation projects within the same field and 2) presenting a training needs analysis, focusing on present and future skills, through a close collaboration with all partners in the triple helix partnerships.
According to Kotter (1996), it is often underestimated how difficult it is to make people leave their comfort zone and their habits, and overall to convince them that a change is needed. If the organisation is complacent however, it will be tough to complete the changes. It means, for example, that if you want your employees to work innovatively, developing and implementing new work methods and new eHealth solutions, as this project focuses on, you need to create a feeling of need or necessity within the target group. They should feel that there is a good reason to go through this process. This WP will through the close collaboration with the target group build up this feeling of need and necessity, focusing on the following three main factors:

1) ensuring good quality care, despite less resources available, through innovation and use of IT
2) supporting health care workers to ensure better collaboration and more transparent communication channels and
3) empowering patients and relatives to better participate in their own health.

Tasks

This work package consists of the preparation phase and will include the following tasks:

1) **Development of common templates**

The WP leader will, based on a workshop and discussions during the kick-off meeting present a set of common templates that all partners will use within this work package. The set of templates will include; a) a template to gather already existing material and experiences within the area, b) an interview guide to gather first-hand information from the target group about training needs and c) a reporting template in order to facilitate input from the partner countries into a common European baseline report (task 4)

2) Exchange of experiences and gathering already knew knowledge within innovation and digital skills.

Each participating country will make a "state of the art report" based on the common template. The report will show already known national, regional, and local material to gather information and knowledge about existing measures on national level in the participating countries together with knowledge, results and tools from former EU projects.

3) Detailed training needs analysis.

Based on the interview guide, local training needs are identified in each country through a close dialogue with staff and management in the local test sites. As some of the local test sites have been involved in the development of this project, we assume that the overall training needs will be as described in the list in section I.4 Expected Results, but this assumption has to be verified within all participating countries and test sites through the work in WP 2.

4) Baseline Report

Based on the gathering of already existing material and the local training needs analysis, a European Baseline Report will be developed, focusing on where already existing material can be reused and/or adopted for the project, where it is relevant to develop European training themes, and how to make sure that training themes are as close to the "real world needs" as possible. The baseline report analysis will be the foundation for the subsequent work package, which will focus on the development, gathering and presentation of the three concepts.

The WP lead is responsible to gather all material from the triple helix partnerships, and afterwards organizing and presenting the material as a common European report.

2 Template

2.1 Background

This template has been developed in the frame of the DISH project as a part of WP 2, where a Training Needs Analysis and a Scoping review was requested. The latter has its focus on the question whether there are education programs for (allied) Health Professionals, which impart digital skills, and if and how they are carried out.
The template is supposed to be used as a structured guide to gather information from the six helix partners in the DISH project. Partners are requested to answer questions, which were considered and discussed as essential within the DISH project group during the kick-off meeting, working groups and in further exchange.
Please bear in mind that the information we gathered are predominantly qualitative, focusing on organizational factors and needs, so there are expectedly quite some national differences in relationship to levels of development and sustainability in implementation and promotion of "Innovation readiness, digital skills implementation & change management".

Figure 1 : Missing link in relation to Innovation readiness, digital skills implementation & change management"

2.2 Method

A questionnaire was sent to all project partners, to base the needs analyses on information from the individual project partners with their national, regional and local background. The questionnaire was formulated from the results of the work of the above-mentioned working meetings and discussed with members of the Danish group (project lead). The evaluation is based on the statistical frequency distribution of the answers, as well as the extraction of keywords, from free text answers.
The questionnaire contained the following series of questions including sub items:

- Examples of implemented eHealth solutions
- Goals of education on innovative eHealth solutions
- Missing link: Innovation readiness
- Main drivers & barriers of eHealth innovation on national, regional and local level
- Missing link: digital skills
- Missing link: implementation & change management of eHealth solutions
- Training needs
- Context factors
- Case stories & photo

2.3 Results

A summary of the questionnaires Is presented In this section.

Q1: Can you provide examples of already Implemented Innovative eHealth solutions?

Tele-health-nursing-care	2 (DK), 2 (GER), 2 (GB), 2 (ESP), 1 (POL), 1 (NOR)
Apps	3 (GB), 2 (POL), 1 (ESP), 1 (DK), 1 (GER)
E-Health Record/Data	2 (GB), 2 (POL), 1 (DK), 1 (GER), 1 (ESP)
Education	2 (GB)
Internet of things	1 (NOR)
Infrastructure	1 (ESP)
Organisational Innovation	1 (ESP)

Q2: In education for health care workers what are important goals concerning innovative eHealth solutions? - Overview -

Provision of high care;	Extremly Important (EI)	5
Better collaboration:	Extermly important (EI)	5
	Important (I)	1
Transparent communication:	Extremly important (EI)	5
Empowerment of patients & consumers:	Extremly Important (EI)	4
	Important (I)	1
	Can`t tell (CT)	1
Other: Cost reduction:	Extremly Important (EI)	2
	No answer	3

Q2: Better collaboration through eHealth solutions - Keywords -

NOR (I): Interprofessional communication
DK (EI): Collaboration of all health groups to face challenges of patient care
GER (EI): Interprofessional communication- closing coordination gaps
GB (EI): Collaboration amongst health care workers and the patient- E-health solutions are mainly tools to reach the latter
ESP (EI): Collaboration - comprehensive view on diagnosis and treatment
POL (EI): Collaboration of all health groups – digital records – patient centered

Q2: Transparent communication through eHealth solutions - Keywords -

NOR (EI): Plans/test for digital solutions training
DK (EI): Digital training programs to enhance interprofessional common-shared language
GER (EI): Improvement of availability- access to health records

GB (EI): Part of education- E-health solutions are mainly tools to reach the latter

ESP (EI): Improvement of communication especially for cases with multimorbidities

POL (EI): Improvement of health status information for the patient and all sectors

Q2: Empowerment of patients & consumers through eHelath solutions - Keywords -

NOR (EI): Various solutions implemented or in test planning

DK (I): Involvement of consumers- opportunity to get information

GER (EI): Enhancement of e-health literacy & security and availability of care - apps, telecare-monitoring

GB (CT): Improvement of self management and self service of citizens- to realize these opportunities training needed on organizational - management level

GB- NOTE: Creation of **digitally critical staff** at all levels to enable cares of making and evaluating appropriate choices and judgements

ESP (EI): Achieving better adherence of chronically ill- increased quality of life

POL: (I): Planned dissemination, preventive measures and availability of specialists

Q2: Cost reduction through eHealth solutions - Keywords -

NOR : No answer

DK (EI): Through education- enhanced execution of digital solutions - reduction of costs

GER : No answer

GB: No answer

ESP (EI): Better adherence off medication intake- reduction of "unnecessary" visits to GP- reduction of costs

POL (I): Better access to monitoring of medical records, integrating the process of their verification and shorter time of settling

Q3: Missing link - Innovation readiness

Extremly prepared:	2	Norway, Denmark
Slightly prepared:	2	Great Britain, Poland
Slightly unprepared:	2	Germany, Spain

Q4: Drivers & Barriers of innovation - Summary -

National Level		Regional Level		Local/Municipal Level	
Drivers	**Barriers**	**Drivers**	**Barriers**	**Drivers**	**Barriers**
▪ National strategies/ ▪ Policies ▪ Funding ▪ Digitalized society and increased skills	▪ Missing collaboration, ▪ Replacing technologies ▪ Missing infrastructure	▪ Infrastructure, Strategies/ policies ▪ (Creative-) pilot projects ▪ Demand	▪ Lack of understanding/ motivation	▪ National strategies/ policies ▪ Pilot projects	▪ Lack of knowledge/ skills, ▪ Lack of resources in the implementation process

positive attitude ▪ Innovative and appropriate technologies	▪ Diversity and inappropriateness of technologies ▪ Missing strategies		▪ Diversity and inappropriate technologies ▪ Lack of funding		▪ Lack of strategies/ policies

Q5: Missing link- digital skills.
Are you aware of any national or regional initiatives to improve digital skills within the health care work force?

Country	Exampel/ Cross reference
NOR	6 links regarding degree programs
DK	Information that several Centers of Excellence established courses
GER	Information of the adopted law (E-Health Act 2017), various Universities and technical colleges offer the study /courses of medical informatic/eHealth (1 provided link)
GB	3 links regarding ALTAS (EU-Project), NHS recommendation how to prepare the healthcare workforce to deliver the digital future, Liverpool region Skills for Growth Action Plan Health & Care 2018 - 2020
ESP	4 links regarding ALTAS (EU-Project), a non-profit scientific society, of national scope and aimed at all professionals interested in the application of ICT to health and 2 University programs
POL	3 links regarding the project "Improving the quality of medical services provided by familiarizing and training employees of medical entities"

Q5: Missing link-digital skills.
Do professional bodies (as e.g. national nursing council) provide education on professional's digital skills?

Yes	**2**	ESP, POL
No or not compulsary	**4**	NOR, DK, GER, GB

Q5: Missing link- digital skills.
Is Improvement of digital skills for healthcare professional`s part of national or regional curricula?

Yes	**5**	NOR, DK, GB, ESP (in higher education), POL

No → -t yet put into practice	**1**	GER

Q5: Missing link-digital links.
Are there specific curricula e.g. for continuous education (e.g. CME/CNE) concerning digital skills education?

Yes	**3**	**NOR**: provided link - municipal health and care services **GB**: provided link - University of Central Lancashire simulation program to train the digital workforce of the future, reference to 2 devolped modules for ERASMUS plus ALTAS project. NOTE: they are inaccessible - the inaccessibility is due to the delivery format, which is not work-based, but instead it is university based (*maybe something we should have in mind for DISH*?) **ESP**: reference to the College of Nursing and Medicine of Valencia and EVES
YES/NO in between	**2**	**DK**: on theoretical educational level – no concrete skills training regarding new technologies is introduced **POL**: basic information technology anchored in the curricula of the Universities - provided link
NO	**1**	**GER**: only a CNE (Thieme) learning unit "on legal aspects and requirements", in particular in dealing with IT-supported documentation systems

Q5: Missing link-digital skills.
Are you aware of any local initiatives to improve digital skills within the health care work force?

Yes	**4**	**NOR:** provided link → Nordholand project „ together on welfare technology“ **DK:** 3 references- the Danish Ministry of health, the SHS Learning and Research Department, the concept of „super users“ (key person)- problem of job fluctuation **GB:** provided links to ALTAS and the Liverpool region Liverpool region Skills for Growth Action Plan Health & Care 2018 – 2020 **ESP**: reference to the College of Nursing and Medicine of Valencia and EVES
NO	**1**	**GER**: none, except in-house training and documents in regard to specific e-health applications- mostly documentation
No answer	**1**	**POL**

Q6: Missing link- implementation & change management.

Are you aware of any national, regional or local initiatives including funding bodies to support implementation of innovative eHealth solutions in health care?

NOR	3 provided links: „National welfare technology program“, „Roadside-roadmap for service innovation“, CONNECT- toolbox on welfare technology“
DK	Reference to various regional (Southern Denmark) funds available
GER	Reference to the national Central Association of Statutory Health Insurance Funds (GKV) and the German Hospital Federation (DKG), regional promotion of IT-supported achievements and telemedicine projects, recognized and supported via the “Schleswig- Holstein Fund”
GB	Provided link to the UK Research and Innovation- healthy ageing challenge NOTE: Change managements tasks require specific and dedicated input with a different role and skill set. Capacity and the required roles and skill sets are rare in UK services i.e. this is a gap
ESP	Reference to 4 (national) funding programs and 3 provided links → not specifically related to e-Health but they promote research, link to funding program at regional level for promotion of scientific research, technological development and innovation, link to local (Agencia Valenciana de la Innovación) funding program for strengthening and development of the Valencian system of innovation
POL	Reference to various projects (13 provided links)

Q7: Training needs

What are important elements of a successful training to improve digital skills in professionals?

Extremely important |Important | Less important | Not important

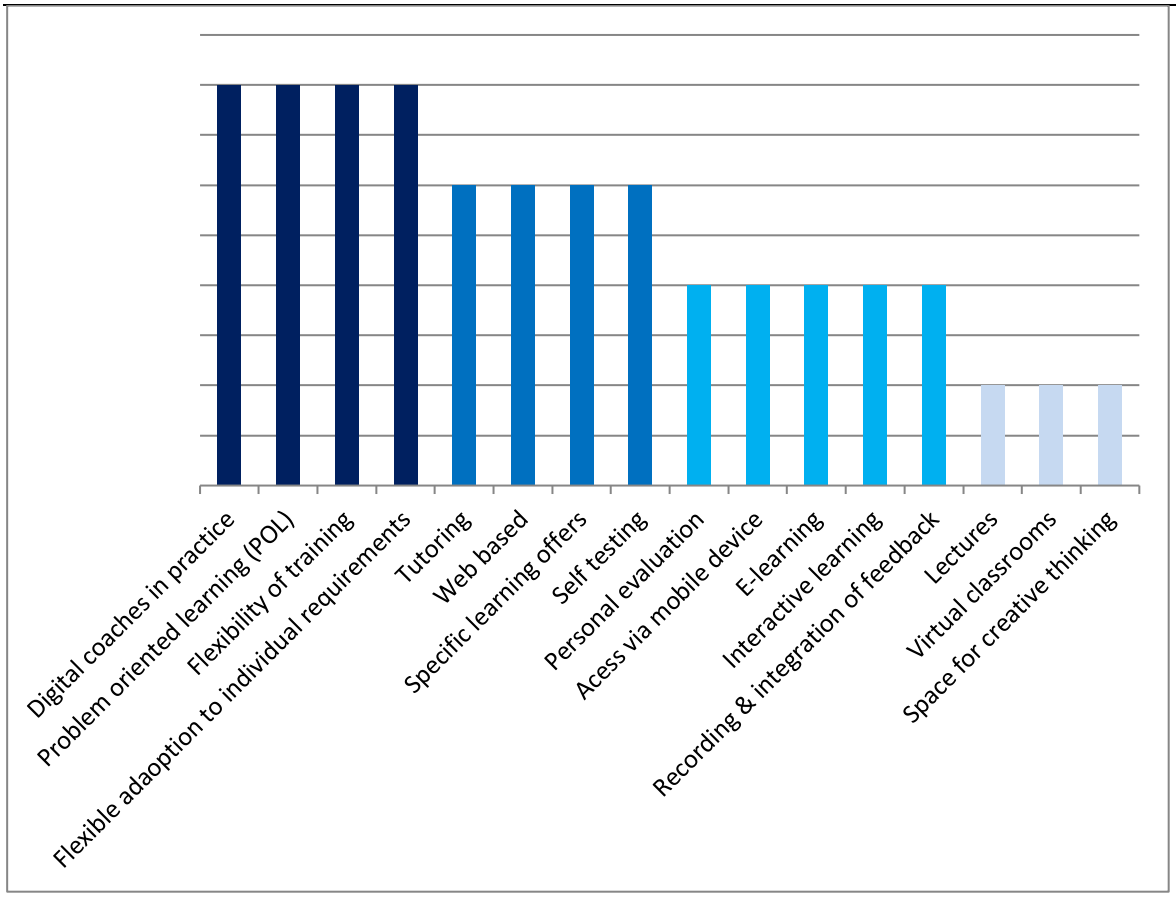

Figure 2: Overview of all items and how internationally scored

Q7: Training needs
What are important context factors of successful digital skill training?

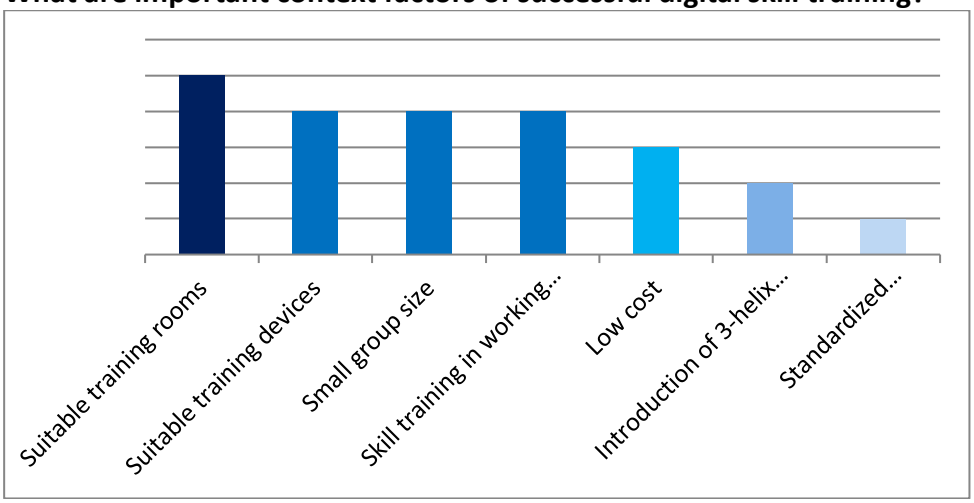

Figure 3: Important context factors, highest ranked- international overview

Other as extremely important scored factors:

- Leadership skills
- Organizational readiness
- Corporate strategy
- Concrete skill training in relation to concrete technologies and practice case related
- Critical appreciation
- Digital skill training as a required course

- Peer support & evaluation
- Assessing of baseline skills before starting training
- Follow AFL principles = Specific description of a) desired behavior; frictions; solutions

Q8: Context factors
What could be potential barrier of a successful implementation of the digital training skill training? Overview from the answers of the project partners
Lack of:

- dialogue and involvement of the related stakeholders
- contextualisation and agreement of how and when the implementation will take place
- follow-up and evaluation systems not addressed
- flexibility- staff involvement- clarification related to staff`s commitment
- Off time on the practice side of/for the health care professionals
- Skilled coaches in theory and practice
- Training materials and concepts up-to-date and useful for different levels of skills

- lack of advertising and awareness of their existence
- lack of support/sponsor by the health institutions or societies
- lack of commitment by the health institutions

- Training practice is not adopted to actual needs
- Staff protests are not taken seriously, instead reduced to health care staffs' default technology and change opposition
- Learning does not currently reflect unique workplace requirements
- High price of the training

Case stories (examples):

GB: ALTAS (Assistive Living Training and Skills) Programme – in collaboration with UK, ESP, NOR, DK, NL, ES - finalised

ESP: MyCyFAPP (My Cystic Fibrosis Application) aimed to get a scenario in which self-management of enzyme replacement in the European CF (cystic fibrosis) patients by means of a mobile application (APP) - finalized

GER: KoLeGe- Interacting, Coordinating and Learning - Opportunities and Challenges of Digitalisation in Outpatient Care - Final presentation June 2019

2.4 Results - summary

The results of the template and the questionnaire respectively show a picture of very different conditions, on an international basis regarding adopted legal frameworks, for the digitization of the health professions, and already implemented curricula in educational institutions.
There are fundamental divergences in the different countries of the DISH project as how issues are progressed at national, regional, and local level and with what impact.
Also contextual factors such as barriers and drivers for lifelong and sustainable learning and acquisition of digital skills, likewise in the sense of acquiring digital skills at different levels of knowledge, are weighted differently within the framework of the project partners from the different countries.
The elements evaluated as extremely important for a successful training to improve digital skills in health care professionals are:

- Problem oriented learning (POL) → Foundation for " ***Learning innovation unit (LIU)"***concept
- Flexibility of training → Foundation for "***Learning innovation unit (LIU)"*** concept
- Digital coaches in practice → Foundation for " ***Training on the job"*** concept
- Flexible adaption to individual requirements → *Foundation for the* " ***Assessment"*** concept form the base of the training needs analysis, to be clarified in WP2, and the fundament for the further procedure in the DISH project.

In addition, the DISH project partners could formulate a clear rating regarding important context factors of successful digital skill training:

- Suitable training rooms
- Suitable training devices
- Small group size
- Skill training in working time
- Low costs
- Introduction of Triple-helix construction
- Standardized qualification points which should be implemented, based on, and adapted to national, regional, and local levels/framework and individual projects.

3 Scoping Review

3.1 Background

In addition to the specific survey of the DISH partner countries, it is of interest to answer the question: "Are there education programs for (allied) Health Professionals to impart digital skills?". Therefore, a systematic literature scoping review was conducted, which is described in this part of the Baseline Report.

3.2 Method

The systematic scoping review of the literature has been done according to the concept of Arksey and O'Malley (2005). The search was carried out in the databases Medline, Embase, CINAHL and IEEE, in each database with an adjusted search string (see appendix). Initial search time was between March and June 2019, since then a monthly update is being done. Empirical articles published since 2000 are included. The screening of references and data extraction are performed by two researchers independently of each other. The information from the included articles is synthesised narratively. Inclusion and exclusion criteria were established to ensure study selection.

3.2.1 Inclusion and exclusion criteria

The research team has defined binding criteria for the systematic, comprehensible study selection:

Inclusion criteria:

- Population: Nurses, allied health professionals, therapists, speech pathologist, etc.) (Physicians only if subject contains attitudes or education program)
- Language: German or English
- Study location: Australia, EU, New Zeeland, North America

Exclusion criteria:

- Robotic- assisted surgical methods (e.g. Da Vinci, robot- assisted laparoscopy)
- Topics: Dental, “patient self-management “, "patient empowerment"
- Publication form: Only conference, only abstract available
- PDA Devices

We decided to exclude medical surgical procedures that are digitally or robotically supported from the search, as these are preliminary tasks for physicians. Likewise, the skills to be learned are very specifically adapted to the specific technique of the operation but also of the robot. Accordingly, they are not relevant for the named target population. However, if training programs or higher-level didactic measures were described, the exclusion did not apply.
PDA (Personal Digital Assistant) devices are another exclusion criterion. This technology is considered obsolete in the present and was the generation before today's smart handheld devices. The usage and the features are antiquated according to the current state of the art, which is the reason for the exclusion of the studies.

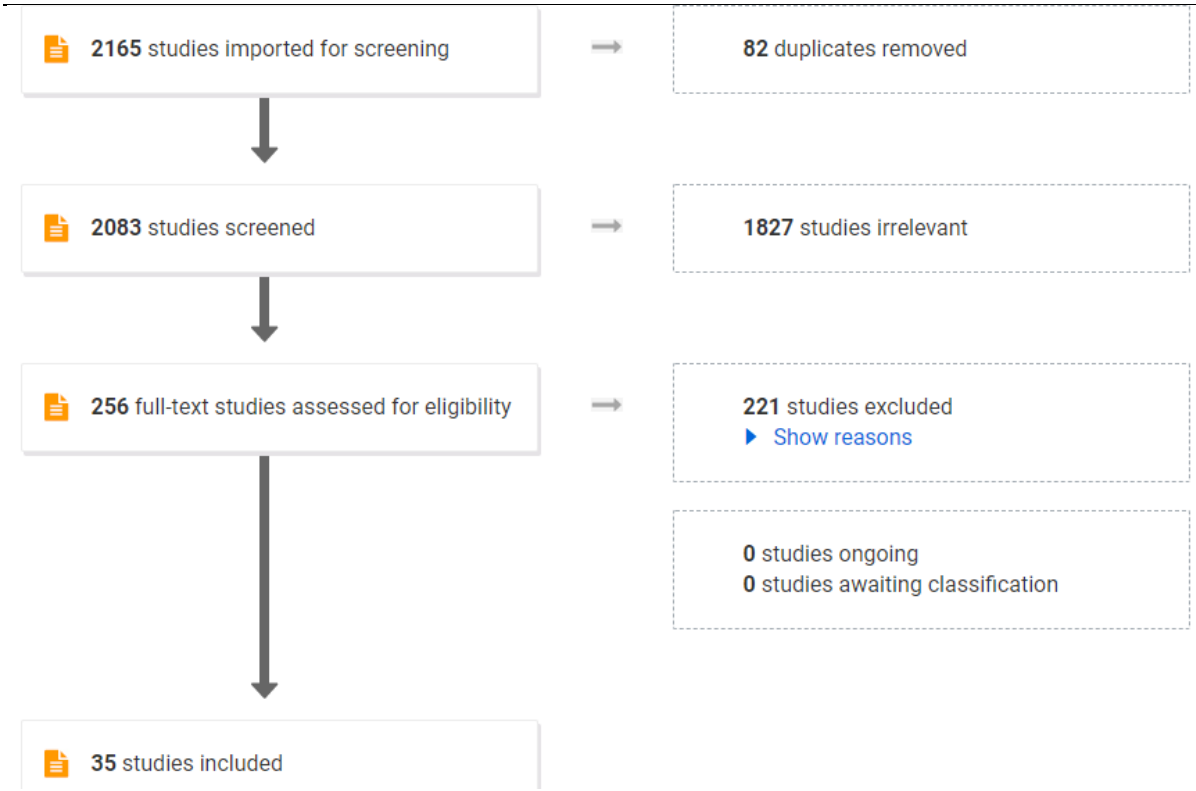

Figure 4: Flowchart of the review process

3.2.2 Results

2,165 hits have been identified. To manage all results, we used the Covidence review management tool. After removing duplicates, results were viewed in three stages by two independently screening researchers. Conflicts were solved with a third researcher. First all titles were screened. Of the remaining hits, the abstracts were read and in the case of applicable studies the full text was finally read.

We choose a sensitive strategy and found a variety of results. Therefore, we categorised the included studies according to subject of interest and study type. Apart from this classification and the type of publication/study, no quality criteria are considered. A total of n=35 papers have been included (Table 1).

	Title	Authors	Year of Publication	Cate-gory	Type
1	Notes for Actions to Empower Digital Competences in Healthcare Workforce: A Qualitative Approach.	Konstantinidis ST.; Li S.; Traver V.; Zary N.; Bamidis PD.	2017	I	Rv
3	The Imperative of Solving Nurses' Usability Problems With Health Information Technology.	Staggers N.; Elias BL.; Makar E.; Alexander GL.	2018	I	Ca
7	Healthcare staff digital literacy levels and their attitudes towards information systems	Kuek, A.; Hakkennes, S.	2019	I	Ca
8	The utility and impact of information communication technology (ICT) for pre-registration nurse education: A narrative synthesis systematic review	Webb, L.; Clough, J.; O'Reilly, D.; Wilmott, D.; Witham, G.	2017	I	Rv
22	Improving the digital literacy competence of nursing and midwifery students: A qualitative study of the experiences of NICE student champions.	Terry J.; Davies A.; Williams C.; Tait S.; Condon L.	2019	I	Ca
31	Integrating an Academic Electronic Health Record: Challenges and Success Strategies.	Herbert VM.; Connors H.	2016	I	Ca
32	Factors influencing nursing students' acceptance of electronic health records for nursing education (EHRNE) software program.	Kowitlawakul Y.; Chan SW.; Pulcini J.; Wang W.	2015	I	Ca
34	Time for TIGER to ROAR! Technology Informatics Guiding Education Reform.	O'Connor S.; Hubner U.; Shaw T.; Blake R.; Ball M.	2017	I	Ca
2	Digital skills training in care homes: achievement.	Wild D.; Kydd A.	2016	Co	Ca
5	Nursing informatics competencies: assessment of undergraduate and graduate nursing students.	Choi J.; De Martinis JE.	2013	Co	Ca
13	A Review of Clinical Informatics Competencies in Nursing to Inform Best Practices in Education and Nurse Faculty Development.	Forman TM.; Armor DA.; Miller AS.	2019	Co	Rv
6	Integrating Informatics Content into the Nursing Curriculum.	Weiner E.; Trangenstein P.; Gordon J.; McNew R.	*2016*	Co	Ca
21	Competencies for nursing in a digital world. Methodology, results, and use of the DACH-recommendations for nursing informatics core competency areas in Austria, Germany, and Switzerland.	Egbert N.; Thye J.; Hackl WO.; Müller-Staub M.; Ammenwerth E.; Hübner U.	2018	Co	Ca

	Title	Authors	Year of Publication	Cate-gory	Type
25	Factors Associated With Canadian Nurses' Informatics Competency.	Kleib M.; Nagle L.	2018	Co	Ca
33	Healthcare professionals' competence in digitalisation: A systematic review.	Konttila J.; Siira H.; Kyngäs H.; Lahtinen M.; Elo S.; Kääriäinen M.; Kaakinen P.; Oikarinen A.; Yamakawa M.; Fukui S.; Utsumi M.; Higami Y.; Higuchi A.; Mikkonen K.	2019	Co	Rv
4	Gamification of Nursing Education With Digital Badges.	White M.; Shellenbarger T.	2017	M	Ca
11	Interventions to increase the use of electronic health information by healthcare practitioners to improve clinical practice and patient outcomes	Fiander, M.; McGowan, J.; Grad, R.; Pluye, P.; Hannes, K.; Labrecque, M.; Roberts, N. W.; Salzwedel, D. M.; Welch, V.; Tugwell, P.	2015	M	Ca
12	E-learning & information communication technology (ICT) in nursing education: A review of the literature	Button, D.; Harrington, A.; Belan, I.	2014	M	Rv
16	Mobile Digital Education for Health Professions: Systematic Review and Meta-Analysis by the Digital Health Education Collaboration.	Dunleavy G.; Nikolaou CK.; Nifakos S.; Atun R.; Law GCY.; Tudor Car L.	2019	M	Rv
17	Blockchain Technology: A Data Framework to Improve Validity, Trust, and Accountability of Information Exchange in Health Professions Education.	Funk E.; Riddell J.; Ankel F.; Cabrera D.	2018	M	Ca
18	Digital Problem-Based Learning in Health Professions: Systematic Review and Meta-Analysis by the Digital Health Education Collaboration.	Tudor Car L.; Kyaw BM.; Dunleavy G.; Smart NA.; Semwal M.; Rotgans JI.; Low-Beer N.; Campbell J.	2019	M	Rv
19	Digital Education for Health Professions in the Field of Dermatology: A Systematic Review by Digital Health Education Collaboration.	Xu X.; Posadzki PP.; Lee GE.; Car J.; Smith HE.	2019	M	Ca

	Title	Authors	Year of Publication	Cate-gory	Type
20	It's important, but not important enough: eHealth as a curriculum priority in medical education in Australia.	Edirippulige S.; Brooks P.; Carati C.; Wade VA.; Smith AC.; Wickramasinghe S.; Armfield NR.	2018	M	Ca
26	Online professional development for digitally differentiated nurses: An action research perspective.	Green JK.; Huntington AD.	2017	M	Ca
29	How is eHealth literacy measured and what do the measurements tell us? A systematic review	Karnoe, A.; Kayser, L.	2015	M	Rv
9	Technology Readiness of Early Career Nurse Trainees: Utilization of the Technology Readiness Index (TRI)	Odlum, M.	2016	A	Ca
10	Systematic review of factors influencing the adoption of information and communication technologies by healthcare professionals	Gagnon, M. P.; Desmartis, M.; Labrecque, M.; Car, J.; Pagliari, C.; Pluye, P.; Fremont, P.; Gagnon, J.; Tremblay, N.; Legare, F.	2012	A	Rv
24	Learning, technology and intellectual property: a survey of the philosophies and preferences of our trainees and peers	Bedoya MA.; Back SJ.; Scanlon MH.; Delgado J.; Darge K.; Reid JR.	2016	A	Ca
27	E-Literacy in health care	Klecun, E.; Lichtner, V.; Cornford, T.	2014	A	Rv
14	A conceptual framework related to ICT-AT competence development: The theoretical foundations of ENTELIS.	Mavrou K.; Hoogerwerf EJ.; Meletiou-Mavrotheris M.; Kärki A.; Sallinen M.	2015	Fr	Ca
15	An eHealth Capabilities Framework for Graduates and Health Professionals: Mixed-Methods Study.	Brunner M.; McGregor D.; Keep M.; Janssen A.; Spallek H.; Quinn D.; Jones A.; Tseris E.; Yeung W.; Togher L.; Solman A.; Shaw T.	2018	Fr	Ca
28	A qualitative exploration of the EU digital competence (DIGCOMP) framework: A case study within healthcare education	Evangelinos, G.; Holley, D.	2014	Fr	Ca

	Title	Authors	Year of Publication	Cate-gory	Type
30	Assessing competencies needed to engage with digital health services: Development of the eHealth literacy assessment toolkit	Karnoe, A.; Furstrand, D.; Christensen, K.B.; Norgaard, O.; Kayser, L.	2018	Fr	Ca

Table 1 Results (Categories: A=Attitude, I=Implementation, Co=Competence, M=Method, Fr=Framework; Types: Rv=Review, Ca=Case study)

3.3 Content-related results

Due to the variety of topics of interest in the included studies, a categorisation was made based solely on topic and study type. This sensitive approach was maintained from the beginning, based on the understanding that the topics should be related to each other to promote digital literacy through a framework. This has been the basis of the DISH project work and has been continuously agreed upon.

3.3.1 Implementation

The Implementation category contains studies that examine the process of introducing a new technology in the workflow. Here we found n=8 studies. Most are case studies (n=6) and n=2 reviews.

3.3.2 Method

N=10 studies were found which were assigned to the category "method". These studies focus on teaching and learning methods to promote digital competences or to work with digital implementation. n=5 of those studies are case studies; the other five studies are reviews.

3.3.3 Competences

"Competences" contains studies which have the digital competences as main focus. Here we found n=8 studies. This is mainly concerned with the development of measurement tools and/or the distribution of digital literacy in different populations in the field of health professionals. N=5 are case studies and n=3 are reviews.

3.3.4 Attitude

In differentiation to the concept of competences, the category of "Attitude" was formed. Here, the attitude of health professionals towards new technologies is relevant in terms of their innovation readiness. N=5 studies were allocated to this category, of what n=3 are reviews and n=2 are case studies.

3.3.5 Frameworks

N=4 studies focus on frameworks to promote digital competencies. All four studies are case studies.

4 Conclusion and Implications

The impact of the template in WP 2 is on the one hand the gained overview of the differences of the status quo of digitization of the health care professions in the countries of the project partners. The overview relates to the implemented technology, status of the hard- and software development and implementation, innovative projects as well as approaches in the assessment of skills for dealing with digitization and pedagogical training and sustainability.
The results of the template (Chapter 2) clearly present the barriers in and for the individual nations, but also the common working basis and the goals that are being aimed at.
Furthermore, the results of the questionnaire serve as a basis for the internationally (Europe-wide) applicable concepts of the DISH project framework.

- Learning innovation unit
- Training on the job
- Assessment

However, the results of the template present common weightings in the requirements of these three pillars, as well as the need to be able to adapt the concepts, if necessary, at national, local and individual project level to promote sustainable implementation of the DISH framework.
The Scoping Review (Chapter 3) shows that there are a lot of activities to promote digital processes in the health sector. We chose a sensitive approach to have a wide scope of results. Nevertheless, the criteria for data extraction were clearly defined and consistently adhered to. Our core interest was to show frameworks which are already existing. Therefore, we only found n=4 case studies in different characteristics.
In the following we summarize the main findings:
Barriers and drivers for digital learning and acceptance in the implementation process:
In the literature, barriers are described whose existence has already become clear in the template survey of the participants. Specific issues concerning the progressing of the project are:

- User Experiences (UX) pain points are: (i) Technological designs do not support nurses' workflow, (II) Health IT Systems Lack Internal and External Interoperability (Staggers et al. 2018)
- Nurse Educators need (enough) time for developing (efficient) material and/ or (online) courses and perceived requirements to support ICT adoption (Webb et al. 2017)
- “Need for faculty training and support using these technologies” continues to be a barrier to integration. Challenges related to training and support themes include lack of teaching and learning strategies, coordination with other disciplines, and technology issues. Drivers may be further development of pilot projects, faculty mentors, increased training resources for faculty and students, and providing technology support. (Herbert et al. 2016).
- In the implementation process (here AEHR, academic electronic health record), the missing funding is seen as a barrier and leads to missing access to programs and technologies (Herbert et al. 2016).

Education Methods:
The largest allocation was in the category training methods. This category includes the use of digital teaching methods.

- Digital problem-based learning (DPBL, digitally delivered as well as blended problem-based learning, wherein digital and face-to-face learning are combined) is as effective as traditional PBL and more effective than traditional learning in improving knowledge. (Tudor Car et al 2019)
- On-the-job-training: Training has to be appropriate to time (usage device/ EHR/ etc.) and to workflow, this means realistic training is more efficient than purposeful training (Klecun et al. 2014)

Digital competencies:

- Staggers et al. (2002) generated a research-based master list of informatics
- competencies for nurses validated using a Delphi study approach. 281 out of 305 were defined as digital competencies. Staggers et al. (2002) proposed 4 levels of nursing practice, with a corresponding scope of digital practice. Level 1: Beginning nurses, Level 2: Experienced nurses, Level 3: Informatic specialists, Level 4: Informatics innovators. Six categories: Computer Skills, Informatics Knowledge, Informatics Skills → Informatic Competencies, Human Information Processing Skills → Information Management Competencies, were considered components of valid competencies but the appropriate level of practice could not be agreed upon.

- Framework for a Social Semantic Registry of IT skills for healthcare workforce: Konstandinides and Bamidis (2014) developed a framework for a network based registry that focuses on recording the IT skills for the healthcare workforce, based on the collaboration of individuals, organizations and policy makers. This foundation ensures that all the required IT skills for a certain healthcare profession- on an individual level- will be included.
  Concept is comprised of: (i) an ontology that describes the IT skills and their connections with the different healthcare professions in order to provide a coherent structure of IT skills for healthcare workforce depiction; (ii) a SPARQL endpoint in order to make available all the registry information to all interest parties; and (iii) links with Linked Open Data 102 cloud Datasets in order to enable the connectivity of information that exists in the registry.

- Nurses could benefit from a more focused informatics education on competencies related to information and knowledge management and ICT use in the delivery of patient care, and to support evidence-based clinical practice in technology enabled work environments. The utilization of competence measuring instruments (here: C-NICAS) can help, to determine nurses' educational needs and to plan focused in-service informatics educational programs that meet the needs of various generational group (Kleib et al. 2018)

- Information Literacy Competency Standards for Nursing (American Library Association 2013). Five standards with specific performance indicators were defined. The

information literate nurse 1) determines the nature and extent of the information needed. 2) accesses needed information effectively and efficiently, 3) critically evaluates the procured information and its sources, and as a result, decides whether or not to modify the initial query and/or seek additional sources and whether to develop a new research process, 4) uses information effectively to accomplish a specific purpose, and 5) understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally (in: Weiner et al. 2016)

- Core competency areas in nursing informatics regarded as relevant in Austria, Germany and Switzerland conducted in a triple iterative process (Egbert et al. 2018):

Table 2. List of 24 core competency areas (Document D1) – Result of the comparison of the national and international model.

D1: Informatics core competency areas for nurses		
Applied computer science	Financial management	Nursing documentation (incl. terminologies)
Assistive technologies	Human resource management	Principles of management
Biostatistics/statistics	Image and biosignal processing	Principles of nursing informatics
Change and stakeholder management	Information and communication systems for nursing (incl. interoperability)	Process management
Data protection and security	Information and knowledge management in patient care	Project management
Decision support	Information management in research	Quality assurance and quality management
eHealth, telematics, telehealth (incl. interoperability)	Information management in teaching, training and education	Resource planning and logistics
Ethics and IT	IT risk management	Strategic management and leadership

Figure 5: Core competencies by Egbert et al. 2018

No significant differences between the countries evident.

- **Conceptualizing e-Literacy** underpinning effective use of information systems (IS)and digital devices in health care (Klecun et al. 2014):

Dimensions e-Literacy as:	Description
Self-efficacy, Motivations and Attitudes to IT	Attitudes to using IT. Beliefs regarding having (or not) the appropriate skills / abilities.
Computer skills	Set of (abstract) skills that an individual needs to acquire to use the system, such as typing, navigating sites, etc.; ability to 'input data'.
Purposeful use /Practical knowledge of IS in work context	Ability to use the system to perform health care related work. Higher level: understanding system's idiosyncrasies, anticipating problems, knowing what to look for and where.
Whole-system understanding	Understanding interdependencies of the socio-technical system. This may include understanding how the data will be used by other parts of the system, and by other HCPs, managers, researchers, etc.
Sense making	Sense making or working out meanings and implications of ITs for individuals, groups, or organizations (e.g. for professional identity).
Innovating and transformation processes	Understandings and beliefs regarding IT potential to transform health care. Ability to innovate with IT.

Figure 6: Dimension of e- Literacy by Klecun et al. 2014

E- literacy (or digital literacy) replaces IT-literacy and signifies a useful shift from a narrow focus on technology and its direct use (e.g. being able to use a keyboard or a word processor), to a focus on purposeful use (e.g. using IS to make an appointment for a patient, to code a diagnosis or treatment, or to send an electronic note to another HCP).

Digital competences and assessment of eHealth literacy:

- **DIGICOMP (assessment)** is a 21-items in 5 competence areas ((a) Information b) Communication c) Content Creation d) Safety and Privacy and e) Problem Solving)) comprising assessment, measuring digital competencies of citizens.
  In 2016 Evangelinos and Holley used the DIGICOMP to investigate nursing students e-literacy and showed that on average those students had just over an intermediate self-declared competency in the information competence area.
- **SANICS** (Staggers et al. 2001, 2002) is a 30-Item *self-assessment* of Nursing Informatics Competencies Scale. It was developed based on a set of informatics competency statements for beginning and experienced nurses (along with additional items associated with standardized terminologies, evidence-based practice and wireless communications). It includes 30 items over the categories: a) clinical informatics role, b) basic computer knowledge c) skills, d) applied computer skills e) clinical informatics attitudes f) wireless device skills. It is well supported through a factorial validity, and high internal consistency reliabilities and scale responsiveness (Yoonet et. al., 2009)
  Choi et al. (2012) examined undergraduate and graduate nursing students (n=289) whether informatics competencies differed between the groups. Findings indicate that the use of this assessment selects specific topics for nurse educators to consider when designing informatics curricula. These results emphasize nurse educators in defining specific areas of informatics content to address greater needs and generate involvement in the design of better nursing education programs.
- **C-NICAS**: **Canadian Nurse Informatics Competency** *(Self-)***Assessment** Scale (Kleib et al. 2018), 21-item representing the three main categories/domains of informatics competency as defined by CASN. While foundational ICT skills are not part of the core informatics competency domains, the two main areas related to “use of ICT devices” and “use of ICT applications” were added to the scale to elicit nurses' perceptions of their computer literacy skills. The measurement is done by 5-point Likert scales based on Benner's model of novice to expert. These items were further grouped into the following subscales to assess subdomains of informatics competency: (1) foundational ICT skills (FS: two items); (2) information and knowledge management (KM: seven items); (3) professional and regulatory accountability (PA: six items); (4) and use of ICT in delivery of patientcare (ICT use: six items). Content validity of the C-NICAS was deemed adequate because experts in the field of NI have identified competency indicators based on an extensive literature review and nationwide consultations with stakeholders before CASN approved them.

Frameworks:

- The **eHealth capability for a framework** (Brunner et al. 2018) recommended to inform development of higher education curricula for health students and professional development opportunities for the current health workforce. 4 overarching domains of eHealth capabilities: (1) digital technologies, systems, and policies; (2) clinical practice and applications; (3) data analysis and knowledge creation; and (4) system and technology implementation. Each domain is supported by a capability statement that articulates what learners need to be able to know and do to demonstrate achievement of this capability. This eHealth capability framework will inform how tertiary health programs deliver and assess essential eHealth education.
- **ENTELIS** (The European Network for Technology Enhanced Learning in an Inclusive Society) (Mavrou 2015). The conceptual framework regarding ICT-Assistive Technology (ICT-AT) competence development, designed to gain awareness of the elements involved and to facilitate the understanding and exchange among stakeholders of the ENTELIS project. The framework is designed based on the basic principles of Activity Theory. It includes a map of actors and other parameters functioning in a person surrounding "ecosystem", and it allows us to understand and map roles, expectations, barriers, as well as to devise solutions to tackle digital divide. The conceptual framework represents two interacting learning activity systems: (a) the internal system of the end-user, which includes the end-user and his/her needs, the setting where learning takes place and the other actors involved, and (b) the external system, which embraces the internal system but also wider issues of policy and practice and experiences and 'actors' that contribute to the development and use of ICT and ICT-AT skills in all areas of life.

- **Evangelinos 2019**
  The DIGCOMP framework has its focus on competence areas. They can be used as a guide to characterise the digital competence profiles of groups and individuals (Evangelinos et al. 2014). Core part of this framework is the DIGICOMP assessment.

- **Karnoe 2018**
  eHLA is a validated, robust toolkit consisting of 7 tools that each highlight a specific component of the competencies and resources in eHealth literacy that are necessary for a person to achieve the optimal outcome in projects involving eHealth solutions. eHLA is suitable for studies that need tools for screening participants' knowledge and skills related to eHealth literacy

- Particular thematic relevance has the **TIGER Initiative.** We could not integrate this project as a framework as there are issues concerning the publication focus and type. That's why we included this education programm in the categorie "Implementation" (3.4.1).O`Connor et al. (2017) present a tandem Collaboration between the European Union (EU) and the United States (US)- based on the TIGER Initiative - which focuses on developing IT skills of the health workforce in order to ensure that technology can be adopted and applied in healthcare. The group developed a web-based, open access searchable database/ tool, to assist people in compiling information on skills and competencies needed at 5 levels: a) Baseline, b) Basic, c) Intermediate, d) Advanced

and e) Expert, in eHealth/IT. The tool encompasses 5 domains of practice: 1) Direct Patient Care, 2) Administration, 3) Engineering or Information Systems, 4) Informatics and 5) Research or Biomedical to cover all possible professions who contribute to eHealth. The tool Health Information Technology Competencies (HITComp), (2017) can be assessed online: http://hitcomp.org/. O`Connor et al. (2017) conclude that the TIGER Initiative can help to create tailored solutions for each country to suit the needs of the local health workforce.

This shows the close relation of the topics concerning digital skills and innovation readiness. Although we were able to clearly assign the included publications to the categories based on the reported focus, an examination of the content reveals numerous overlaps. Especially when considering the term "digital competences". This includes the area of measurement, the importance of attitudes in differentiation to competence, the teaching of competences through didactic methods and the willingness to open up to new, digital technologies, innovation readiness.

4.1 General implications

Digital competences are a complex concept, which is already evident from the fact that there is no unified definition. The term is also always adjusted in the context of usage. For the health care environment, there is an increasing amount of activity in this area.
There is a correlation that digital competences must not be considered in a general and singular way. This makes defining and targeted training difficult. A key factor is the readiness to be innovative. Without this readiness, digital technologies find little acceptance. Innovation readiness needs knowledge and the certainty of being prepared for the challenges of applying the new technology (Konttila et al. 2019).
Furthermore, there is a broad variance in the range of digital competences, which are often not measured validly. To prepare learners effectively and specifically for new technologies, however, a valid assessment of their competences is required. This is the only way to ensure a sustainable increase in knowledge.

4.2 Implications for the DISH Project

This Baseline Report shows the range of factors to be addressed promoting digital competencies and the different baseline conditions in which the participating countries are situated. All findings will be included in the development of the DISH concept (WP3). In summary, it can be said that a concept must allow for openness and flexibility to adapt to the respective contexts. Only then will it be possible to find acceptance on all levels of the users of the concept.
After the concept has been tested, which will be done in WP4 of the project work, the country-specific findings must flow into the revision and adaptation of the concept.

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6 Appendix

Searchstrings

P	Nurses Nurses[Mesh] “Health Personnel” 16312 Health Personnel[Mesh] allied health personnel [Mesh] “allied health personnel” “Health Professionals” “Allied health professionals” “Allied health professions” Therapeutic Therapist “Nurse Assistant” "Care assistant" “Speech and language pathologist” “Health care staff” “Health care professionals”	**((((((((((((((Nurses) OR Nurses[Mesh]) OR “Health Personnel”) OR Health Personnel[Mesh]) OR allied health personnel [Mesh]) OR “allied health personnel”) OR “Health Professionals”) OR “Allied health professionals”) OR “Allied health professions”) OR Therapeutic) OR Therapist) OR “Nurse Assistant”) OR "Care assistant") OR ((“Speech and language pathologist”))) OR “Health care staff”) OR “Health care professionals"**
I	1 training education [training, instruction] indoctrination schooling “education training” “course of instruction” “education training course” “computer-aided training” “advanced training” “further education” “further training” “staff training” “training program” “training programme” “training course” “computer course” “nursing curricula”	**((((((((((((((((**“nursing curricula” **) OR “computer course”) OR “training course”) OR “training programm”) OR “training program”) OR “staff training”) OR “further training”) OR “further education”) OR “advanced training”) OR “computer-aided training”) OR “education training course”) OR “course of instruction”) OR “education training”) OR schooling) OR indoctrination) OR education [training, instruction]) OR training**
	2 Digital „Digital technologisation“ „digital technologies“ „digital technology“ robotic	AND **(((((((“nursing informatics”) OR “digitally care") OR**

	“digital care” “digitally care” “nursing informatics”	**“digital care”) OR robotic) OR „digital technology“) OR „digital technologies“) OR „Digital technologisation“) OR Digital**
		I1 AND I2 **((((((((((((((((((“nursing curricula”) OR “computer course”) OR “training course”) OR “training programm”) OR “training program”) OR “staff training”) OR “further training”) OR “further education”) OR “advanced training”) OR “computer-aided training”) OR “education training course”) OR “course of instruction”) OR “education training”) OR schooling) OR indoctrination) OR education [training, instruction]) OR training)) AND ((((((((“nursing informatics”) OR “digitally care") OR “digital care”) OR robotic) OR „digital technology“) OR „digital technologies“) OR „Digital technologisation“) OR Digital)**
C O	“Digital literacy” “Digital skill” attitude “digital competence” skill expertise competence competency qualification	**((((((((((“Digital literacy”) OR “Digital skill”) OR attitude) OR “digital competence”) OR skill) OR expertise) OR competence) OR competency) OR qualification) OR authority) OR knowledge) OR know how**

authority
knowledge
know how
“technology readiness” (pubmed irrelevant))

Pubmed:
((((((((((((((((nurses) OR Nurses[Mesh]) OR "Health Personnel") OR Health Personnel[Mesh]) OR allied health personnel[Mesh]) OR "allied health personnel") OR "Health Professionals") OR "Allied health professionals") OR "Allied health professions") OR therapeutic) OR therapist) OR "Nurse Assistant") OR "Care assistant") OR (("Speech and language pathologist"))) OR "Health care staff") OR "Health care professionals")) AND (((((((("digitally care") OR "digital care") OR robotic) OR "digital technology") OR "digital technologies") OR "Digital technologisation") OR digital)) AND ((((((((((((((("computer course") OR "training course") OR "training programme") OR "training program") OR "staff training") OR "further training") OR "further education") OR "advanced training") OR "computer-aided training") OR "education training course") OR "course of instruction") OR "education training") OR schooling) OR indoctrination) OR education[All Fields] , instruction) OR training))) AND ((((((((((("Digital literacy") OR "Digital skill") OR attitude) OR "digital competence") OR skill) OR expertise) OR competence) OR competency) OR qualification) OR authority) OR knowledge) OR know how) [Treffer 1766]
Ieee:
(((Nurses OR "Health Personnel" OR “Health Care” OR"allied health personnel" OR “Health care professionals” OR “Health care staff”) AND education OR training OR schooling OR Program OR Programm) AND "digital literacy" OR digital OR "digital skill" OR attitude OR "digital competence" OR "digital competency" OR Qualification)
Web of Science:
"digital literacy" “digital skills” Topic
AND
education OR training OR schooling OR Program OR Programme topic
AND
Nurses OR "Health Personnel" OR “Health Care” OR "allied health personnel" OR “Health care professionals” OR “Health care staff" topic

TOPIC: ("digital literacy" OR "digital skills") *AND* **TOPIC:** (education OR training OR schooling OR Program OR Programm) *AND* **TOPIC:** (Nurses OR "Health Personnel" OR “Health Care” OR "allied health personnel" OR “Health care professionals” OR “Health care staff")
Scopus:
TITLE-ABS-KEY ("digital skill") OR TITLE-ABS-KEY ("digital literacy")
TITLE-ABS-KEY (nurses) OR TITLE-ABS-KEY ("Health Personnel") OR TITLE-ABS-KEY ("Health Care") OR TITLE-ABS-KEY ("allied health personnel") OR TITLE-ABS-KEY ("Health care professionals") OR TITLE-ABS-KEY ("Health care staff")

- ⇨ (TITLE-ABS-KEY (nurses) OR TITLE-ABS-KEY ("Health Personnel") OR TITLE-ABS-KEY ("Health Care") OR TITLE-ABS-KEY ("allied health personnel") OR TITLE-ABS-KEY (

"Health care professionals") OR TITLE-ABS-KEY ("Health care staff")) AND (TITLE-ABS-KEY ("digital skill") OR TITLE-ABS-KEY ("digital literacy"))