

Our Time to Shine: Empowering the Data, Information and Knowledge Workforce as a Driving Force for Digital Health and Care

Appendix 1:

Scoping review of the literature on workforce
models, workforce planning and development
approaches

August 2019

A decorative graphic in the bottom right corner of the page, consisting of a network of white lines connecting various points, some of which are highlighted with small, glowing white circles, set against a dark purple background.



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Main report: [Our Time to Shine : Empowering the Data, Information and Knowledge Workforce as a Driving Force for Digital Health and Care](#)

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Appendix 1: Scoping review of the literature on workforce models, workforce planning and development approaches.

Introduction

This paper provides a scoping review of the literature on workforce models and workforce planning and development approaches relevant to the specialist data, information and knowledge workforce in health and social care¹.

The search of the bibliographic databases (see appendix B for search strategy) initially identified 69 potentially relevant papers; further focus identified 18 potentially relevant papers; detailed review identified 11 relevant papers.

The identified grey literature related wholly to public health workforce development (England and Scotland); and existing frameworks, which are covered in the paper providing the high level mapping of relevant existing capability/competency/ career frameworks (August 2018).

This paper outlines the findings of the published literature.

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¹ See Call for Proposals, Requirement 2

Changing roles

Four papers addressed the changing roles of librarians and library staff, and the concomitant need to develop new capabilities/competencies/skills sets/knowledge bases.

Vassilakaki and Moniarou-Papaconstantinou 2015 provide an analysis of a systematic review of the specific roles that **library and information professionals** have adopted in the past 14 years. They identified 114 relevant papers which identify new and evolving roles – mainly in the context of academic libraries. Six key roles were identified: teachers, technology specialists, embedded librarians, information consultants, knowledge managers and subject librarians.

- **Teacher**
Here the role is seen as one of developing information literacy and in actively engaging in teaching and learning processes, in particular in academic libraries.
- **Technology specialist**
The literature stressed the growing importance of digital repositories, with a need for library and information professional roles to involve:
 - Developing, managing and promoting digital repositories, including expertise in implementation of access rights and preserving digital content
 - Training authors, including on self-archiving issues and techniques, managing content and metadata
- **Embedded librarian**
The literature demonstrated the growing importance of having library and information professionals adopting a proactive role in delivering resources and improving information capacity by being embedded in teaching² teams
This is seen as “*the outcome of a growing movement for promoting collaboration among librarians, faculty and instructors*”; especially through the development of online courses such as Massive Open Online Courses (MOOCs), the adoption of Virtual Learning Environments (VLEs), and the integration of new technology in course management systems and social software (e.g. Facebook, Twitter) in course curricula.
- **Information consultant**
The literature identified a need (in academic libraries and business organisations) to develop a ‘consulting model’ which could lead to an increase in access to library and information resources as well as collaboration between library and information staff and teaching staff³.
- **Knowledge manager**
The literature identified a need to clarify terms ‘knowledge management’ and ‘knowledge manager’, with Vassilakaki and Moniarou-Papaconstantinou (2015) noting that it suggests that there is “no significant difference” between the competencies that a knowledge manager has and a librarian. These are seen as including design information architecture, taxonomy development, managers of knowledge repositories and facilitators of knowledge flow and communication
- **Subject librarian**

² Analogous with frontline service delivery teams

³ Analogous with frontline service delivery teams

The literature reviewed by Vassilakaki and Moniarou-Papaconstantinou (2015) noted the changing role of the subject librarian. This stressed the need

- To promote collaboration, adopting new ways of servicing users enquiries, promoting information literacy, identifying and managing information resources
- For librarians to develop their expertise and competencies to promote their presence in the teaching and learning process

Lawton and Burns 2014 outline key roles for **librarians working in health care** as including:

- Health librarian as educator
- Virtual reference services
- Clinical librarian and informationist
- Embedded librarian working within healthcare teams
- Health librarian working in data management
- Specialist subject knowledge
- Leadership and management skills

They conclude that:

“Advances in technology in the last 20 years together with societal change have had a major impact on both health care delivery and information management. This has put less emphasis on the physical space of health library and more on the health librarian.”

Cherinet 2017 looks at future roles and skills required by **librarians** to “*meet the ever changing users’ need in the modern library landscape*”. This qualitative study found that the “ultimate future role of librarians” is “re-socializing and shaping the young generations” – emphasising the role of librarian as teacher/educator.

Nix et al 2016 investigated responsibilities, skill sets, degrees, and certifications required of **health care navigators**⁴ in order to identify areas of potential overlap with health sciences librarianship in America. Through a content analysis of 100 health care navigator job descriptions and person specifications they identified that the most frequent skill set requirements identified were:

- Coordinate patient care
- Work collaboratively
- Providing and managing health information resources

⁴ Nix et al 2016 define a patient navigator as a person “who take[s] individual patients through the continuum of health care as it pertains to their specific disease, ensuring that any and all barriers to that care are resolved and that each stage of care is as quick and seamless as possible”

Frameworks

Librarians working in health

Lawton and Burns (2014) outline existing competencies for **librarians working in health care** as defined by library associations (Ireland, Canada, US, UK, and Australia), recent job descriptions (Ireland) and a mapping review of the library and information science literature which “*may lead to a baseline of skills for health librarians*”.

They reviewed competencies defined by the following professional associations:

- Medical Library Association (MLA) in the USA
- Health Libraries Group (HLG) of the Chartered Institute of Library and Information Professionals (CILIP) in the UK
- Irish Health Science Libraries Group (HSLG)
- Canadian Health Libraries Association (CHLA)
- Australian Library and Information Association (ALIA) Health Libraries Section

They identified ten key areas of competence which were common to three of five library associations, and also common to recent job descriptions, see table 1.

They conclude that “*the challenge for librarians moving into these roles will be to stay relevant and to keep skills updated in a rapidly moving health and information environment*”.

Table 1: Description of 10 areas of competence identified by Lawton & Burns 2014

Areas of Competence	Description
Communication	Effective communication skills (ALIA). The Library and Information Service must be positioned to communicate with decision makers at the highest levels throughout the organisation (CHLA). IT and communication as generic skills (CILIP). The Library and Information Service encourages open communication and inclusiveness (HSLG).
Systematic review	Systematically gather and analyse data and disseminate the findings to advance library and information science theory and its application to the provision of information services (ALIA). The accumulation, appraisal and evaluation of literature to a specific research question (HSLG). Understanding scientific research methods, and the ability to critically examine and filter research literature from many related disciplines (MLA).
Critical Appraisal	Critical appraisal skills (CILIP). Critical appraisal skills. The skills necessary to evaluate the validity, reliability and clinical applicability of current literature to support evidence-based practice (HSLG). The ability to critically examine and filter research literature from related disciplines including: <ul style="list-style-type: none">• using quantitative and qualitative methodologies and techniques and their interpretation

	<ul style="list-style-type: none"> • locating, organising, and critically evaluating the research literature • using principles of evidence-based practice to support decision making • conducting research and reporting and disseminating research findings either individually or in interdisciplinary research teams (MLA).
Management and organisational skills	<p>The Head of the Library and Information Service writes, implements and monitors a plan for the development of the Library and Information Service (HSLG).</p> <p>Management of people and the ability to manage strategically. Understanding the application of leadership, finance, communication, management theory and techniques (MLA).</p>
Manage and organise health information	<p>In-depth knowledge of print and electronic information resources (CHLA).</p> <p>Ability to organize information in a logical and straightforward way so that users can access the information they need as quickly as possible (CILIP).</p> <p>Have the ability to manage health information resources in a broad range of formats (MLA).</p>
Training and education	<p>Delivering training on information literacy in-person and online to a variety of healthcare professionals, students and managers at varying levels. Creating guides, training materials, etc. in a range of media. Training in evidence-based searching and use of information resources (CHLA).</p> <p>Providing training to assist staff in identifying information in support of both their professional and personal development (CILIP). Understanding curricular design and instruction and the ability to teach ways to access, organise, and use information including:</p> <ul style="list-style-type: none"> • adult learning theory and cognitive psychology • educational needs assessment, analysis and evaluation • instructional methodologies, technologies and systems design • management of education services (MLA).
Legal	<p>The Library and Information Service complies with relevant legislation, the CHLA/ABSC/MLA Code of Ethics http://www.chla-absc.ca/assoc/chlawhat.html and organisational policies, procedures and standards (CHLA).</p> <p>Compliance with relevant legislation, for example copyright law, health and safety law, etc. (HSLG).</p> <p>Understand the clinical care, research, medical education, cultural, ethical, economic, and legal issues and environments (MLA).</p>
Leadership	<p>Leadership and Advocacy (CILIP).</p> <p>The Head of the Library and Information Service provides effective leadership in the planning and development of library and information services (HSLG).</p> <p>Knowledge and understanding of the application of leadership theory and techniques (MLA).</p>
Technology	<p>Relevant information and communications technology and technology application skills. Hospital libraries have the ability to customise and brand resources for the benefit of their users, for example activate</p>

	<p>Ask-A-Librarian type features, add local holdings statements, add link outs to locally subscribed electronic full text journals, etc. (ALIA).</p> <p>Use of appropriate technologies to access and manage information resources (HSLG).</p> <p>Understand and use technology and systems to manage all forms of information (e.g. automated systems, database and website management systems, electronic health care systems and records; acquisition, use, and evaluation of information technologies) (MLA).</p>
Understand Healthcare environment	<p>Understand the policies, issues and trends that impact the healthcare environment including:</p> <ul style="list-style-type: none"> • current management and business practices • the parent organisation's (academic medical centre, hospital, government, corporate, etc.) major policy and programme sources • the health sciences professions • the clinical care, research, medical education, cultural, ethical, economic, and legal issues and environments • various health and health-related organisations (MLA).

Adapted from Lawton and Burns 2014

Myers & Rodrigues 2016 focus specifically on the US Medical Library Association (MLA) Competencies for Lifelong Learning and Professional Success 2007⁵ ⁶ to investigate self-perceived career preparedness of health sciences librarians. The MLA framework 2007 specified the following competencies:

- Health Sciences and Health Care Environment and Information Policies
- Leadership and Management Theory and Techniques'
- Health Sciences Information Services
- Health Sciences Information Resource Management
- Information Systems and Technology
- Curricular Design and Instruction
- Research, Analysis, and Interpretation

Myers & Rodrigues 2016 received 178 responses were received from an online survey of health science librarians in the US, with the majority (89%) saying that they had achieved all competencies.

They also investigated the various methods by which participants developed these competencies. Participants who responded positively to having acquired a competency

⁵ <https://www.mlanet.org/p/cm/ld/fid=1217>

⁶ The MLA subsequently updated the competencies in 2017 to the following:

1. Information services
2. Information management
3. Instruction and instructional design
4. Leadership and management
5. Evidence-based practice and research
6. Health information professionalism

see <https://www.mlanet.org/page/test-competencies> 6 key competencies 2017.

were then asked to indicate how they acquired it, using a multiple-choice and multiple answer⁷ list:

- Formal Library and Information Science (LIS) education
- Other formal education (e.g., degree or certificate program)
- Work experience prior to LIS career
- Internship, fellowship, residency, or other pre-professional formal training program
- Volunteering or other pre-professional informal training
- Mentoring relationship
- Peer or colleague relationship
- Employer-provided training
- MLA or other organization, continuing education
- Continuing education courses, etc.

Of the various methods used to develop competencies, the most frequently selected method was formal library and information education. Myers & Rodrigues (2016) conclude that

- *“As health sciences librarians deal with new and evolving issues regarding scholarly communications, emerging technologies, data management, and other areas of importance to their communities, they must be provided structured opportunities for development.”*

Knowledge workers

Mohammad Reza Ghezel Arsalan et al 2014 propose a new framework to **assess the value** of a knowledge worker (KWr) in his/her organization. They elaborate a method for determining the value of each KWr based on his/her contribution to “organizational value-added”. The framework includes two steps:

1. *“The contribution of each work process to the total organizational value-added is determined using Knowledge Value Added method*
2. *The value of each KWr is obtained based on the contribution of his/her operational knowledge to the value-added of the processes.”*

They consider that their proposed framework highlights the “*imperative role of KWrs*” in a knowledge-based economy. Also that it provides an opportunity to compare all types of KWrs through the framework, and “*manage KWrs effectively in terms of selection, planning, development, compensation, retention, promotion and financial reward*”.

Digital curation

Feng & Richards 2017 examine the concept of professional competency in digital curation literature through a multi-disciplinary literature review and qualitative content analysis. They note that digital curation is a relatively new concept that “*attempts to bridge boundaries among archivists, librarians, records managers and other information professionals*”; and define ‘digital curation’ as “*the range of activities required to manage, maintain, preserve and ensure access to digital information*”.

⁷ Myers & Rodrigues did not provide definitions for these methods

They conclude that

“the concept of professional competency is not comprehensively used in digital curation in comparison with the disciplines where the concept is fully developed. The findings confirm the importance of articulating a broader notion of professional competency for digital curation because it helps to guide the advancement of digital curators as a new profession and to improve digital curation education and training. We also provide evidence that there is a need to expand professional competency in future digital curation research and digital curation professional education.”

Health Informatics

Hovenga & Grain 2016 argue for the need to establish a *“globally agreed well-structured framework representing the health informatics discipline’s body of knowledge”*. They observe that professions that relate to health informatics, such as software engineers, computer scientists, information and communication technologists, health information managers, clinicians, biomedical scientists, and others representing a number of different professions have *“each defined their own body of knowledge that describes their specific knowledge and skills domain.”* Further, they note that *“Due to the extensive breadth and depth as well as the overlaps between and blurring of the boundaries of a number of these well-established knowledge domains, it is difficult to gain consensus regarding a unique body of knowledge for the health informatics domain”*.

They consider that a formally documented body of knowledge *“sets the standard for professional practice, endorsement and accreditation criteria”*, and that it needs to have *“sufficient flexibility to enable the inclusion of new knowledge in a timely fashion”*. They also assert that if a formally document body of knowledge was to be developed for health informatics, it would enable it to identify key competencies and associated skills, knowledge and attributes to suit different types of health care organisations; to provide a foundation for health informatics learning, education and training; and as such, to develop its professional standing.

Hovenaga and Grain 2016 consider that the health informatics body of knowledge needs to be fully integrated within all of the more *“traditional”* professions that relate to health informatics *“as and where appropriate”*. They suggest that a health informatics body of knowledge may be viewed as an *“umbrella structure that accommodates, respects and calls on specialist contributions as and when required”* through *“strong multidisciplinary teamwork”*.

They review the following frameworks specific to health informatics professionals:

- International Medical Informatics Association Knowledge Base (2009) was developed as a joint project between IMIA, the British Computer Society’s Health Informatics Forum (BCSHIF) and CHIRAD (UK Health Informatics R&D intelligence)⁸
- The Canadian HIP competency framework (2012)⁹

⁸ <http://imia-medinfo.org/wp/imia-endorsed-documents/>

⁹ <https://www.coachorg.com/en/resourcecentre/resources/Health-Informatics-Core-Competencies.pdf>

- The UK Council for Health Informatics Professionals (UKCHIP)¹⁰ registration scheme for 3 levels of health informatics professional using standards and an agreed code of conduct¹¹.
- The Career Framework for Health Informatics Professionals (2011)¹², which shows how other frameworks, including UKCHIP are linked to the HIFC.

Hovenga and Grain 2016 looked particularly at the Skills Framework for the Information Age (SFIA). They consider that SFIA's success is demonstrated by its widely accepted global use: it provides a common language, is regularly updated, and is used in many contexts by educators, human resource managers (employers), professional organisations and individuals for career planning purposes in most countries around the world: *"It provides a common reference model incorporating unambiguous and clear definitions of IT based technical skills as well professional skills (totalling 96), along with definitions for up to seven skills role requirements"*. See table 2.

However, they conclude that the SFIA framework is

"not well suited for the health informatics body of knowledge and its applications, although the SFIA logical structure can be replicated. Health informatics requires formal naming and definitions of the concepts and fields represented within its domain together with clear definitions. The SFIA framework structure enables its use as a management tool as well as enabling the identification of suitable codes for the inclusion into a Standard Occupational Classification system. This is useful for the purpose of workforce planning and associated activities."

Table 2: Topics used in the SFIA Framework Structure

High Level Topic groups	Levels of responsibility	Generic skills defined for each level
Strategy and architecture – incl. governance, planning, consulting	1. Follow	Autonomy: Has authority and responsibility for all aspects of...
Business change –incl. staff development, project management	2. Assist	Influence: Makes decisions critical to organizational success....
Solution development & implementation – incl. socio-technical, data/system integration	3. Apply	
Service Management – all operational functions	4. Enable	Complexity: Leads on the formulation....

¹⁰ It must be noted that in 2018, UKCHIP announced that "BCS, The Chartered Institute for IT, the UK Council of Health Informatics Professions (UKCHIP) and the Institute of Health Records and Information Management (IHRIM) are working collaboratively to create a new federation for the Informatics profession. The three autonomous bodies will work closely together in a federation to ensure that UK health informatics is recognised as a valued profession."

http://www.ihrim.co.uk/index.php?option=com_tags&view=tag&id=56%3Aukchip

¹¹ http://www.ihrim.co.uk/index.php?option=com_tags&view=tag&id=56%3Aukchip

¹² <https://www.hicf.org.uk/AboutHICF.aspx>

Procurement & Management support – incl. supply chain, compliance, risk & quality management	5. Ensure/advise	Business skills: Has a full range of strategic management and.....
Client interface – incl. sales, client support, user interaction	6. Initiate/ influence	
	7. Set strategy, inspire, mobilise	

Adapted from Hovenga and Grain 2016

Overall, Hovenga and Grain 2016 conclude that

“most individual competency statements reviewed consisted of multiple concepts such as topic plus level of responsibility or role context in any one statement”;

But they also assert that

“making use of the globally endorsed SFIA structured framework as a model for developing a similar framework to suit the health informatics knowledge domain based on the IMIA educational guidelines and knowledge base would be beneficial”.

Information specialists

Fraser-Arnott 2016 provides an analysis of the competency profiles of librarians, records managers, information managers, archivists, and knowledge managers to develop a competency profile for information specialists that incorporates the knowledge and competencies from all of these areas. She notes that the volume of information resources is ever-increasing, and that there is a growing need for information specialists to work together and remove the barriers that have been established between them based on the types of information resources that they manage. She considers that

“This collaboration will require information specialists to develop a better understanding of each other’s roles and may ultimately result in the creation of new hybrid roles in which employees may need to be able to perform the functions of all of these disciplines as well as some new ones as we have seen through the newer discipline of knowledge management.”

The sources used by Fraser-Arnott 2016 for this analysis were 16 existing competency profiles developed by professional associations and employers of information workers such as government agencies.

1. American Association of Law Libraries 2011: Competencies of law librarianship
2. American Libraries Association 2009: ALAs core competences of librarianship
3. ARMA International 2007: Records and information management core competencies
4. Association of Canadian Archivists: 2014 Competencies for archivists and records managers
5. Australian Society of Archivists & Records Management Association of Australasia 2010: Tasks, competencies and salaries for recordkeeping professionals
6. Australian Society of Archivists & RIM Professionals Australasia Joint Education Steering Committee 2011: Statement of knowledge for recordkeeping professionals
7. Canadian Association of Research Libraries 2010: Core competencies for 21st century CARL librarians

8. Canadian General Standards Board 2009: Competencies of the Federal Government Information Management Community (not freely available)
9. Government of Alberta 2004: Records management competency profiles
10. Government of Newfoundland and Labrador (no date): Information management competency framework
11. Library of Congress 2011: Competencies for Federal Librarians
12. Office of the Chief Information Officer (Canada) 2009: Technical competency framework for information management
13. Social Care Institute for Excellence (no date): Competencies for knowledge management
14. Special Libraries Association 2003: Competencies for information professionals of the 21st century
15. TFPL 2011: Knowledge and information management competencies
16. UK National Archive 2009: Government knowledge and information management professional skills framework [updated in 2016 to the KIM framework]

She found that the definitions of the types of information professionals covered by the competency frameworks and the types of roles they occupied were

“quite revealing about the nature of different information roles. In some cases, the targeted professionals were very clearly defined and represented a highly specialized function and in others the competency profiles suggested a broad definition of the roles carried out by information specialists and the professional or educational backgrounds of those who occupied those roles.”

The competency profiles that were found online for librarians, records managers, information managers, archivists, and knowledge managers revealed that the borders between these disciplines are highly blurred. Fraser-Arnott 2016 concluded that

“If viewed at a superficial level, the focus of the competency profiles were all very different in terms of the types of tasks performed, and the level of detail provided. When examined together, however, it was discovered that there was a significant amount of overlap in terms of the competencies required by the various information disciplines, even though the specific tasks, background knowledge, and emphasis of each of the disciplines may have been somewhat different.”

Table 3 provides Fraser-Arnott’s analysis, which identifies five “*competency groups*” for information specialists, each with several more specific competencies. Her objective was to create a brief list of competencies that apply to each of the groups **without favouring one discipline or hierarchical level**; and which can be used as a tool for information professionals in planning their learning and professional development activities and facilitating communication between information professions with various information backgrounds.

Table 3: Competencies for information specialists

Competency group	Specific competencies
Collaboration, client service	1. Advocates, markets, and promotes information programmes and services 2. Builds relationships with internal and external partners

and communication	<ol style="list-style-type: none"> 3. Provides customer service to internal and external clients 4. Communicates orally and in writing 5. Engages in active listening and ensures that communications with clients have been effective 6. Develops and implements communication strategies 7. Assesses the training needs of the organization 8. Develops and delivers training resources and sessions 9. Engages in effective change management activities 10. Resolves conflict 11. Knowledge of training principles and practices
Organisational understanding and strategic alignment	<ol style="list-style-type: none"> 1. Understands the organizational environment 2. Explores and analyzes the organizational environment and user needs 3. Engages in trends monitoring and analysis 4. Builds organizational and user needs knowledge into information tools and processes 5. Support effective decision making in the organization 6. Aligns resources with strategic goals
Programme and service delivery and management	<ol style="list-style-type: none"> 1. Knowledge of leadership and management principles and practices 2. Manages human resources 3. Manages budgets and procures necessary goods and services 4. Manages facilities and equipment 5. Engages in risk management, business continuity, and emergency management activities 6. Designs and develops new programmes and services 7. Delivers programmes and services 8. Monitors and evaluates programmes and services 9. Innovates to improve programmes and services 10. Ability to use technology in the workplace
Records, information and knowledge management technical competencies	<ol style="list-style-type: none"> 1. Serves as the organizational subject matter specialist on information services through an understanding of records and information principles, practices, and procedures 2. Physically processes information resources 3. Engages in digitization and image management activities 4. Ensures that information is managed throughout its lifecycle 5. Understands, evaluates, and promotes organizational compliance with information-related legal, regulatory, and policy requirements 6. Designs and implements information organization systems 7. Promotes and supports data and information quality 8. Supports research, knowledge sharing, and collaboration 9. Conducts research and retrieves information from a variety of internal and external sources
Personal qualities	<ol style="list-style-type: none"> 1. Adaptability and flexibility 2. Teamwork and collaboration 3. Values and ethics 4. Initiative 5. Time management and working under pressure

	6. Analytical thinking and decision making 7. Commitment to continuing professional development
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Adapted from Fraser-Arnott 2016

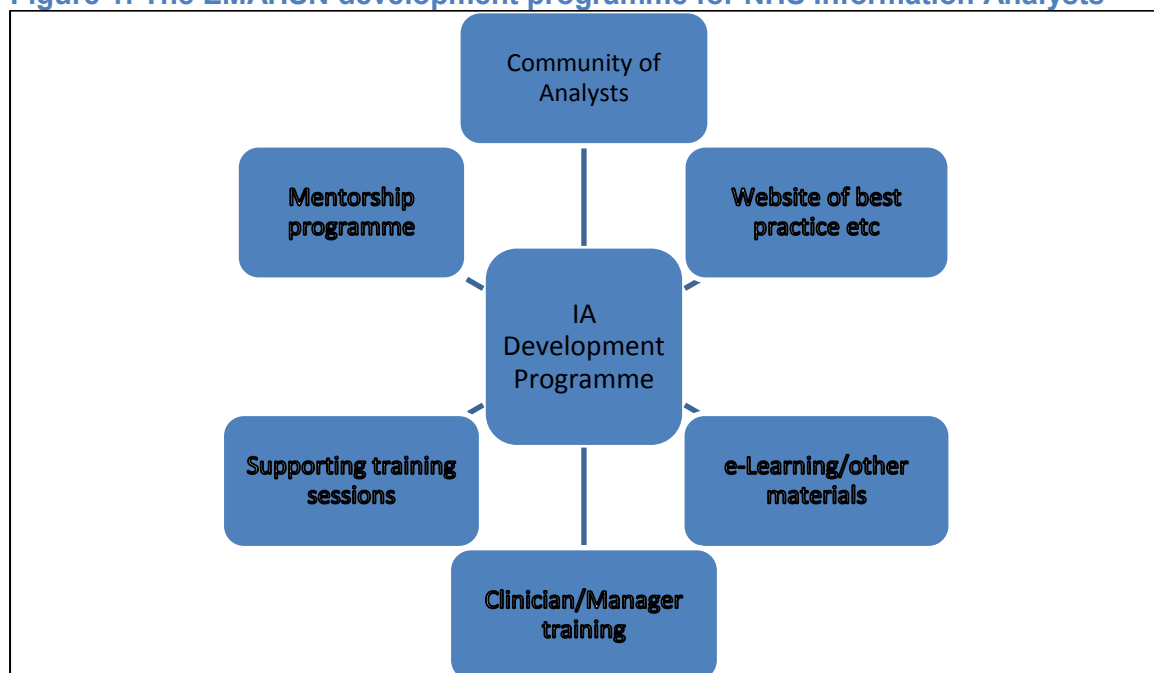
Workforce development approaches

Howard et al 2015 assess the extent to which a development programme designed to improve the skills of NHS Information Analysts has actually improved those skills. They note that historically, NHS Information Analysts have not had a defined training programme to develop professional skills and promote high quality analysis:

“Given that allocation of healthcare resource depends upon such analyses, this is a serious omission with potentially widespread repercussions. Moreover, the role of Analysts is evolving as new technologies improve access to data and Managers and Clinicians require more subtle and complex information to inform their decision making. This requires a transition from extracting data to presenting a clear data narrative. The changing nature of what is being demanded from NHS Information Analysts creates the requirement to invest in their development if we are to help them embrace these new roles.”

The 11-day programme was developed by the East Midlands Academic Health Science Network (EMAHSN) and provided ten days of formal teaching by industry and academic leaders ending with learners’ presentations of their own project on day 11. These sessions ranged from foundation skills in statistics to data science techniques, and included analysis and data presentation, supported by additional, optional sessions and networking opportunities. The course was delivered over approximately 20 weeks to facilitate Analysts’ release from their core role and to allow consolidation and application of the skills between sessions. There were two additional sessions available for participants. The first explored change management in the NHS. The second was a foundation presentation skills day to complement the material in the main sessions and provide additional support to those less confident or less experienced in presenting. See figure 1.

Figure 1: The EMAHSN development programme for NHS Information Analysts



Adapted from Howard et al 2015

Howard et al 2015 note that, at the time of writing, some of these areas are in development (such as e-Learning and the web site of best practice), however the core programme of training for Analysts, Managers and Clinicians, was well established.

During the first year, the programme was free to attend for the first five cohorts as this was funded by the EMAHSN. Four cohorts were initially planned and were significantly oversubscribed. The EMAHSN were able to fund an additional cohort, resulting in 60 funded places in the first year of the programme. NHS England purchased an additional cohort which was delivered in Leeds.

Howard et al 2015 concluded that the East Midlands Information Analysts' Development Programme is a valuable contribution to development of Analysts' skills.

“Using the best speakers from academia and professional practice has resulted in Analysts learning skills which are robust in evidence, but also practical in application. This is the foundation for both current practice and future development, something which the programme is fostering by developing Best Practice Groups to make sharing of good practice routine rather than the exception, and getting analysis out from behind the data and into the organisation where their skills can be fully exploited.”

Lim Keung et al 2015 explores the education and training needs of the members of the West Midlands Health Informatics Network (WIN). It was set up in 2013 and at the time of writing, had over 500 members.

“WIN aims to support the NHS and affiliated healthcare organisations in adopting information technology solutions to transform the care they provide for their patients. In order to improve outcomes for patients and citizens, WIN encourages and supports collaborative work among stakeholders; discusses and disseminates evidence-based practice; promotes projects and research in health informatics; supports the development of educational material and courses; and promotes the adoption of digital healthcare solutions. Through its website, virtual forum as well as face-to-face events, WIN shares good practice and encourages collaboration.”

In 2015, WIN used the UK Health Informatics Career Framework to survey members about what skills development they wanted: there was 5% response rate, 19 responses. Lim Keung et al 2015 concluded that the findings of the survey showed that while the interest in health informatics is high among network members, the awareness of opportunities for training and learning professionally as well as personally, remains low.

Summary

The literature addressing changing roles focused on librarians and library staff, and identified nine key evolving roles, with librarian as **teacher/educator** being identified by three out of four papers; embedded librarian by 2 out of 4 papers; and **subject/clinical** librarian identified by 2 out of 4 papers. See Appendix A: table 4.

The literature reviewed 26 'frameworks' setting out competencies/skills sets/standards, especially in relation to librarians, see Appendix A: table 5. The majority (21: 21%) of these

were developed and defined by **professional associations**. Hovenga & Grain 2016 argues strongly for the need to develop a **robust knowledge base** in order to define a new profession (health informatics) – and from this to develop key competencies and associated skills, knowledge and attributes to suit different types of health care organisations. Fraser-Arnott 2016 argues for the need to develop an inclusive, flexible definition/framework with **mutual respect for staff groups undertaking different but related work**.

It is clear that there is (potential) for the specialist data, information and knowledge workforce/s to become factionalised, with different groups representing different aspects/functions striving to establish specifically defined knowledge/capability terrains. However, the literature also identifies significant commonality across the competency/skills frameworks, with the following areas being identified by at least 2 out of 3 papers, see Appendix A: table 6.

- Collaboration, client service and communication (3)
- Leadership, business change, personal qualities (3)
- Librarianship, including systematic review, critical appraisal, records, information & knowledge management (2)
- Management, organisational skills and strategic alignment (2)
- Programme and service delivery and management, including procurement and management support (2)
- Solution development & implementation – incl. socio-technical, data/system integration (2)
- Technology (2)

Interestingly, despite the emphasis on the emerging role of the librarian as educator, only one paper (Lawton & Burns 2014) identified this as a key competency area in the frameworks that they reviewed. Further, although subject/clinical specialist was also emphasised as a key emerging role area, again only Lawton and Burns 2014 noted healthcare specific competence as a key area.

The East Midlands Academic Health Science Network (Howard et al 2015) and the West Midlands Health Informatics Network (Lim Keung et al 2015) have focused on workforce development through specific programmes and networks, despite Myers & Rodrigues 2016 finding that competency was most frequently achieved through formal education. This echoes the finding of Lawton and Burns 2014 that "specialist learning was gained 'on the job' developing competencies without a defined framework".

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APPENDIX A: Tables

Table 4: Key roles for librarians and library staff

Role	Vassilakaki & Moniarou-Papaconstantinou 2015	Lawton & Burns 2014	Cherinet 2017	Nix et al 2016
Care navigator				1
Embedded librarian working within service delivery teams	1	1		1
Data management		1		
Information consultant and provider	1			1
Knowledge manager	1			
Subject/clinical librarian	1	1		
Teacher/educator	1	1	1	
Technology specialist	1			
Virtual reference/information services		1		1

Table 5: Frameworks reviewed in the literature

Framework	Country	Lawton & Burns 2014	Myers & Rodrigues 2016	Hovenga and Grain 2016	Fraser-Arnott 2016
Australian Library and Information Association Health Libraries Section	Australia	1			
Australian Society of Archivists & Records Management Association of Australasia 2010: Tasks, competencies and salaries for recordkeeping professionals	Australia				1
Australian Society of Archivists & RIM Professionals Australasia Joint Education Steering Committee 2011: Statement of knowledge for recordkeeping professionals	Australia				1
Association of Canadian Archivists: 2014 Competencies for archivists and records managers	Canada				1

Canadian Association of Research Libraries 2010: Core competencies for 21st century CARL librarians	Canada				1
Canadian General Standards Board 2009: Competencies of the Federal Government Information Management Community	Canada				1
Canadian Health Libraries Association	Canada	1			
Canadian HIP competency framework (2012)	Canada			1	
Government of Alberta 2004: Records management competency profiles	Canada				1
Government of Newfoundland and Labrador (no date): Information management competency framework	Canada				1
Office of the Chief Information Officer (Canada) 2009: Technical competency framework for information management	Canada				1
Special Libraries Association 2003: Competencies for information professionals of the 21st century	Canada				1
ARMA International 2007: Records and information management core competencies	International				1
International Medical Informatics Association Knowledge Base (2009)	International			1	
Skills Framework for the Information Age	International				
TFPL 2011: Knowledge and information	International				1

management competencies					
Irish Health Science Libraries Group	Ireland	1			
Career Framework for Health Informatics Professionals (HIFC) (2011)	UK			1	
Health Libraries Group of the Chartered Institute of Library and Information Professionals (CILIP)	UK	1			
Social Care Institute for Excellence (no date): Competencies for knowledge management	UK				1
UK Council for Health Informatics Professionals (UKCHIP) registration scheme for 3 levels of health informatics professional	UK			1	
UK National Archive 2009: Government knowledge and information management professional skills framework [updated in 2016 to the KIM framework]	UK				1
American Association of Law Libraries 2011: Competencies of law librarianship	US				1
American Libraries Association 2009: ALAs core competencies of librarianship	US				1
Library of Congress 2011: Competencies for Federal Librarians	US				1
Medical Library Association (MLA)	US	1	1		

Table 6: Competency areas identified in the literature

Competencies	Lawton & Burns 2014	Hovenga & Grain 2016/SFIA	Fraser-Arnott 2016
Collaboration, client service and communication	1	1	1
Leadership, business change, personal qualities	1	1	1
Librarianship, including systematic review, critical appraisal, records, information & knowledge management	1		1
Management, organisational skills and strategic alignment	1		1
Programme and service delivery and management, including procurement and management support		1	1
Solution development & implementation – incl. socio-technical, data/system integration	1	1	
Technology	1	1	
Healthcare specific, including understanding healthcare environment and manage and organise health information	1		
Training and education	1		

APPENDIX B: Search strategy

Search terms identified

These are keywords only and doesn't include subject headings used in the various databases

Digital technology, Digital Health*, Digital skills, Big Data, Director of informatics, clinical coding/coder*, clinical audit, clinical informatics, librarian, library assistant, librar*, information governance, data analyst, data analytics, data manager, data management, researcher, research and evaluation, patient information assistant, clinical facilitator, data scientist, data science, information technology, IT, ICT, ICT test analyst, ICT Support technician, telehealth, telecare, mhealth, mobile health, health analytics, business analyst, senior managers, project manager, sales, marketing, finance and communications personnel; specialist nurses, clinical consultants, clinical directors; testers of quality assurance, user-experience people; graphic designers, knowledge managers, knowledge man*, knowledge staff, mobile applications, app development/developer, cloud, cyber security, computer consultancy, computer programmer*, web design*, business intelligence, mobile applications, software testing, software engineer*, computer scien*, data and intelligence, software marketing, digital marketing, health informatics, health records, patient administrators, project and programme management, clinical informaticist, health records, systems developer, training administrator, training managers, trainer(all health informatics), network manager, planning and performance manager, programme manager, web-based technology, knowledge worker, clinical facilitator, records management/manager, data quality, database administrator, business intelligence

Combined with:

1. Capability, competencies, competenc*, skills framework*, career development, career*
2. Workforce model, service model, ways of working, changing models
3. Workforce planning, future workforce, workforce analytics, demand
4. Workforce development, staff development, skills, skills development, professional development
5. Changing employers needs, future requirements, employer needs, skills requirements – workforce skills, change etc

Databases

Health Management Library, Library search (Keyword search, 2013-2018 English language)

Digital & Competenc*	9 results, 1 kept
Digital & Capabilit*	1 result, 1 kept
Digital & Framework	9 results, 1 kept
Digital & Skill*	11 results, 0 kept
Digital & Framework	9 results, 0
Digital & Career*	2 results, 0 kept
Digital & Workforce	5 results, 1 kept

Digital & workforce analytics	0 results
Digital & “ways of working”	0 results
Digital & Service model	4 results
Digital & Model*	15 results, 1 kept
Digital & demand	3 results, 0 kept
Digital & Staff development	6 results, 0 kept
Digital & Skills	11 results, 0 kept
Digital & Professional development	7 results, 0 kept
Digital & Planning	17 results, 0 kept
Digital & Business needs	1 results, 0 kept
Digital & Future	21 results, 6 kept
Digital & Service Development	5 results, 0 kept
Digital & “future workforce”	2 results, 0 kept
Digital & Requirements	4 results, 0 kept
Digital & Emplo*	6 results, 0 kept
Competency framework	19 results, 1 kept
Capability Framework	9 results, 0 kept
Skills Framework	47 results, 1 kept
Career* AND framework	12 results, 0 kept
Workforce planning	73 results, 4 kept
Workforce analytics	4 results, 0 kept
Workforce development	56 results, 0 kept
Staff development	153 results, 0 kept
Future skills	68 results, 1 kept
Future workforce	36 results, 0 kept
Professional Development	178 results, 1 kept
Service model*	126 results, 0 kept
Workforce model*	24 results, 0 kept
Employer needs	5 results
Employer requirement*	3 results, 0 kept

**Health Management Information Consortium Database (HMIC)
(English language, 2013-2018)**

- 1 exp Digital technology/ (22)
- 2 digital health.mp. (56)
- 3 exp Information technology/ (4805)
- 4 digital skills.mp. (1)
- 5 big data.mp. (26)
- 6 exp Data analysis/ (697)
- 7 data analyst.mp. (0)
- 8 data manager.mp. (0)
- 9 director of informatics.mp. or exp Informatics/ (309)
- 10 clinical coder.mp. (1)
- 11 exp Coding/ or clinical coding.mp. (360)
- 12 exp Health informatics/ (212)
- 13 exp Clinical audit/ (3759)
- 14 clinical informatics.mp. or exp Medical informatics/ (78)

15 exp Librarians/ or exp Health service librarians/ (125)
 16 library assistant.mp. (0)
 17 knowledge worker.mp. (3)
 18 information communication technology.mp. (8)
 19 exp Communication technology/ (825)
 20 exp Information governance/ (25)
 21 ict test analyst.mp. [mp=title, other title, abstract, heading words] (0)
 22 data management.mp. [mp=title, other title, abstract, heading words] (92)
 23 researcher.mp. [mp=title, other title, abstract, heading words] (1720)
 24 patient information assistant.mp. (0)
 25 clinical facilitator.mp. (6)
 26 data scientist.mp. or exp Information scientists/ (25)
 27 data science.mp. (2)
 28 exp telehealth/ (474)
 29 exp telecare/ (694)
 30 mhealth.mp. (29)
 31 m-health.mp. (8)
 32 mobile health.mp. (129)
 33 health analytics.mp. (2)
 34 business analyst.mp. (0)
 35 quality assurance personnel.mp. or exp "Quality of patient care"/ (10147)
 36 user experience.mp. (74)
 37 graphic designer.mp. (0)
 38 graphic design.mp. (5)
 39 exp Knowledge management/ (246)
 40 knowledge staff.mp. (4)
 41 mobile applications.mp. (6)
 42 app developer.mp. (0)
 43 cloud.mp. (41)
 44 cyber security.mp. or exp Computer security/ (99)
 45 computer consultancy.mp. or exp Computer services/ (29)
 46 exp Computer programmers/ (3)
 47 web design*.mp. (5)
 48 exp Internet websites/ (1348)
 49 business intelligence.mp. (10)
 50 exp Data handling/ (6540)
 51 exp Computer software/ or software testing.mp. (676)
 52 software engineer*.mp. (6)
 53 exp Computer science/ (5179)
 54 software marketing.mp. (0)
 55 digital marketing.mp. (3)
 56 exp Health records/ (3375)
 57 patient administrator.mp. (0)
 58 clinical informaticist.mp. (8)
 59 exp Library & information services/ (803)
 60 system developer.mp. (5)
 61 training administrator.mp. (0)

62 training manager.mp. (1)
63 training manager.mp. (1)
64 network manager.mp. (4)
65 (planning and performance manager).mp. [mp=title, other title, abstract, heading words] (0)
66 programme manager.mp. (14)
67 web-based tech*.mp. [mp=title, other title, abstract, heading words] (3)
68 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 (34300)
69 competency framework.mp. or exp Frameworks/ (2516)
70 exp Competences/ (913)
71 capability.mp. (480)
72 exp Development/ or exp Skills/ or skills framework.mp. (22391)
73 capability framework.mp. (3)
74 exp Career development/ (1322)
75 workforce model.mp. or exp Workforce planning/ or exp Workforce/ (5364)
76 exp Models/ (3181)
77 workforce development.mp. or exp Skills development/ (497)
78 service model.mp. (151)
79 future workforce.mp. (70)
80 business need*.mp. (9)
81 exp Skills development/ (308)
82 exp Service development/ (1871)
83 workforce skills.mp. (7)
84 "methods of working".mp. [mp=title, other title, abstract, heading words] (63)
85 "future requirements".mp. [mp=title, other title, abstract, heading words] (31)
86 "employer needs".mp. [mp=title, other title, abstract, heading words] (3)
87 "employer requirements".mp. [mp=title, other title, abstract, heading words] (1)
88 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 or 83 or 84 or 85 or 86 or 87 (33415)
89 68 and 88 (2399)
90 limit 89 to (yr="2013 -Current" and english) (215)

Health Business Elite (2013-2018, English language)

S61 S45 AND S59 Limiters - Published Date: 20130101-20181231
Search modes - Boolean/Phrase 379
S60 S45 AND S59 1,353
S59 S46 OR S47 OR S48 OR S49 OR S50 OR S51 OR S52 OR S53 OR S54 OR S55
OR S56 OR S57 OR S58 23,466
S58 professional development 2,741
S57 skills development 415
S56 staff development 317
S55 workforce analytics 39
S54 future work* 452
S53 service model* 403

S52	workforce development	873
S51	workforce planning	1,198
S50	workforce model*	16
S49	capability framework	35
S48	career development	17,948
S47	skills framework	30
S46	competency framework	110
S45	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42 OR S43 OR S44	191,966
S44	knowledge staff	1
S43	software	100,757
S42	web-based	7,615
S41	network manager	239
S40	training manage*	520
S39	system developer	129
S38	patient administrator	0
S37	patient information assistant	0
S36	software marketing	220
S35	clinical informaticist	6
S34	web design*	889
S33	computer progr*	43,448
S32	cyber security	2,170
S31	cloud	8,032
S30	app develop*	400
S29	knowledge manage*	3,382
S28	graphic design*	681
S27	business anal*	1,220
S26	health anal*	256
S25	m-health	240
S24	mhealth	259
S23	telecare	1,713
S22	telehealth	689
S21	data scien*	444
S20	digital tech*	4,238
S19	communication technology	9,795
S18	knowledge work*	683
S17	knowledge mana*	3,385
S16	librar*	14,096
S15	clinical informat*	856
S14	clinical coder	1
S13	clinical coding	2,951
S12	health informatics	268
S11	director of informatics	38
S10	data management	1,816
S9	data manager	91

S8	data analysis	10,853
S7	data analyst	159
S6	big data	2,108
S5	digital skills	35
S4	information and communication technology	3,519
S3	information technology	39,770
S2	digital health	358
S1	digital technology	1,896

Library, Information Science & Technology Abstracts (English language, 2013-2018)

S25	S11 AND S23 Limiters - Publication Date: 20130101-20181231	
	Search modes - Boolean/Phrase	75
S24	S11 AND S23 Search modes - Boolean/Phrase	232
S23	S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22	786
S22	SU service development	0
S21	service model	396
S20	SU skills development	3
S19	SU staff development	0
S18	SU workforce development	0
S17	competency framework	20
S16	SU competencies	307
S15	skills framework	18
S14	capability framework	4
S13	SU capability framework	0
S12	SU workforce planning	44
S11	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10	63,124
S10	SU information technology	16,066
S9	SU digital communication	670
S8	SU digital technology	1,361
S7	data manager	77
S6	SU knowledge management	6,563
S5	SU knowledge worker	712
S4	TX director of informatics	14
S3	SU library managers	0
S2	SU library assistants	132
S1	SU librarians	40,131

MEDLINE (2013-2018, English language)

Note: I limited the search terms used for the second part of the search (competency/workforce etc) as there were too many results to look through in the time available.

- 1 Telemedicine/ or Mobile Applications/ or Internet/ or Electronic Health Records/ or digital health.mp. (96805)
- 2 m-health.mp. (360)
- 3 mhealth.mp. (2456)
- 4 digital technology.mp. (715)
- 5 digital skills.mp. (29)

- 6 SOFTWARE DESIGN/ or SOFTWARE/ (101635)
- 7 big data.mp. (4053)
- 8 Data Mining/ (6579)
- 9 Medical Informatics/ (10663)
- 10 director of informatics.mp. (1)
- 11 clinical coding.mp. or Clinical Coding/ or Information Systems/ (20542)
- 12 Librarians/ (946)
- 13 Libraries, Medical/ or library assistant.mp. (4948)
- 14 information governance.mp. or Computer Security/ (6864)
- 15 data analyst.mp. (103)
- 16 data analysis.mp. (56523)
- 17 data analytics.mp. (552)
- 18 Database Management Systems/ or Information Systems/ or data management.mp. or Computers/ or Data Collection/ (160630)
- 19 Medical Records Systems, Computerized/ or Information Technology/ (18883)
- 20 Communication/ (76158)
- 21 patient information.mp. (6826)
- 22 patient information assistant.mp. (0)
- 23 telehealth.mp. (3525)
- 24 telecare.mp. (659)
- 25 Knowledge Management/ (307)
- 26 graphic designer.mp. or Computer Graphics/ (13379)
- 27 web design.mp. (91)
- 28 ict support technician.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] (0)
- 29 clinical consultant.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] (31)
- 30 user experience.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms] (965)
- 31 quality assurance tester.mp. (0)
- 32 Quality Control/ (45657)
- 33 User-Computer Interface/ or software developer.mp. (34692)
- 34 Computers/ (50018)
- 35 Computer Communication Networks/ or network manager.mp. (13337)
- 36 programme manager.mp. (25)
- 37 clinical informaticist.mp. (9)
- 38 trainer.mp. (3999)
- 39 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 (570764)
- 40 Competency-Based Education/ or competency framework.mp. (3692)
- 41 capability framework.mp. (32)
- 42 Professional Competence/ (22970)

- 43 skills framework.mp. (58)
- 44 Models, Organizational/ or service model.mp. (18622)
- 45 employer needs.mp. (22)
- 46 skills development.mp. (756)
- 47 "Personnel Staffing and Scheduling"/ (16235)
- 48 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 (61118)
- 49 39 and 48 (7744)
- 50 limit 49 to (english language and yr="2013 -Current") (1504)
- 51 limit 50 to humans (1174)

ASSIA (Keyword search 2013-2018, English language)

Note: I did not have time to do a comprehensive search or to review all of the returned results in this database.

Digital AND competenc* OR capabilit* OR framework OR career development
1551 results

Information technology AND capability framework 928 results

Information technology AND skills framework 2138 results

Information technology AND competency framework 789 results

Information technology AND Workforce 1,167 results

Digital economy AND skills 143 results

Data analyst skills 418 results

Business intelligence skills 1,629 results

Web develop* 443 results

Information governance

Knowledge Manag* 17,868 results

Programme manager skills 3,059 results

Employer needs digital 158 results

Employer requirements digital 60 results

Emerald (English Language, 2013-2018)

Note: Results were sorted by relevancy and browsed, I was not able to search this database extensively.

Digital Health	4,503 results
Digital Skills AND Competen*	2,489 results
Data analy* AND Skill*	26,378 results
Data AND Competencies	11,632 results
Data AND Capabilit*	25,191 results
Data AND Skill*	27,677 results
Analyst AND Competenc*	14,216 results
Analyst AND Capability	18,007 results
Digital skill* AND requirement*	3,032 results
Future AND skills AND digital	5,126 results
Skills framework	19,927 results
Digital AND Service Model	7,796 results
Capability Framework	19,386 results
Digital AND Workforce	1,360 results
Data AND workforce	7,554 results
Competency framework	9,556 results
Competency framework information specialist	3,166 results
Future skills demand	14,996 results

Note:

ABI inform would be a useful database to search but we don't currently have access.

Databases that could also be searched:

ELISA, Social Policy & Practice, Cochrane, Health Systems Evidence, NIHR Journals database, Social Care Online

Search Strategy – Websites/Grey literature

The following websites were looked at. Generally, the content of the sites was browsed but in some cases a search was conducted on the site. Where searches were conducted search terms were taken from the list at the start of the search strategy section.

Websites searched:

King's Fund (including the King's Fund Library)
Health Foundation
Health Education England
HEE Knowledge for Healthcare
Public Health England
Skills for Health
Skills for Care
Nuffield Trust
GOV.UK Civil Service
British Computer Society
GOV.UK Workforce planning for health, public health and social care
GOV.UK Digital, Data and Technology Profession (DOH)

CILIP
CIPD website
CFWI (moved to DOH workforce planning for health etc (above) in 2016, content still available from the National Archives website)
SIFA
NHS Digital Academy
NHS Digital
Digital Scotland
Archives & Records Association
HCPC
NHS Confederation
NHS Employers
Scottish Centre for Telehealth and Telecare (SCTT)
The Data Lab
The Skills library (US)
Digital Health and Care Institute
Office of the Chief Information Officer (US)
Apprenticeship frameworks online
JISC
European Commission
Internet search

Websites that could also be searched:

Scottish Government website
IHM website
Digital Analytics Association
NHS Education for Scotland
NHS24
and Technology Enhanced Care group
Farr Institute
Stratified Medicine Scotland
National Association for Healthcare Quality
NHS Careers
Academy of Medical Royal Colleges