REGULAR FEATURE: INTERNATIONAL
PERSPECTIVES AND INITIATIVES

NHS knowledge and library services in England in the digital age

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Abstract

National Health Service (NHS) knowledge and library services in England are integrating digital advances into their systems and services. Health Education England (HEE) leads on the development of NHS library services. A key workstream focuses on (1) improving the infrastructure to enable discovery and management of digital knowledge resources; (2) collaborating with local teams to establish regional library management systems that are integrated with the new national discovery service for healthcare staff and learners. This article explores initiatives on resource discovery as well as the need for system-wide partnership working to ensure that biomedical knowledge in computable form is findable, accessible, interoperable and reusable. Low levels of health and digital literacy pose a significant barrier to using health information and accessing health services. A range of interventions are aimed at enhancing citizens' digital and health literacy skills. The education and life-long learning needs of the knowledge and library services workforce are considered. Working with CILIP and higher education institutions, HEE delivers a range of educational offers through its Learning Academy. As Artificial Intelligence and automation are implemented in health systems, knowledge and library staff form a crucial bridge between technology and those who use it.

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INTRODUCTION

'Applying knowledge into action is the currency of a successful healthcare organisation' (Health Education England, 2021a, p. 2). Health librarians and information professionals are, therefore, significant stakeholders in the health and care knowledge economy. They play an important role in the ecosystem through which research evidence and knowledge are discovered and used by staff, trainees and learners.

Given the exponential increase in scientific information (Densen, 2011) and the enduring gap between research and its translation into practice (Slote Morris et al., 2011), it is imperative to evaluate opportunities to use technology to advance knowledge services to better support the National Health Service (NHS).

The ground-breaking Topol Review made recommendations to ensure the NHS is a world leader in using digital technologies to benefit patients (Health Education England, 2019). Key findings were:

- The NHS needs more knowledge specialists
- The Executive Boards of NHS organisations need to take responsibility for effective knowledge management to strengthen systems to disseminate learning and accelerate adoption of proven technological innovations.

The review concluded 'there is no time to waste' in strengthening the infrastructure, upskilling the workforce and catalysing transformation to deliver service improvement and improve productivity (Health Education England, 2019, p.82).

As health services focus on recovery from the pandemic and building for the future, it is timely for health knowledge specialists to review their service delivery to better support health service provision. Meanwhile, the NHS 'is hungry for solutions that bring evidence … from a myriad of sources together as actionable intelligence'. Machine Learning (ML), Artificial Intelligence (AI) and robotics 'are reshaping the ways teams create, discover, use and share information' (Health Education England, 2021a, p49).

'Harnessing technology to continually improve services' underpins Knowledge for Healthcare, the strategic framework for the development of the 177 libraries in NHS trusts

Key Messages

- National Health Service (NHS) library services are integrating digital advances into their systems and services, to ensure that healthcare staff and learners can find and use research evidence.
- Artificial Intelligence (AI) plays an increasing role in resource discovery, improving the search experience for users and reducing the time it takes to summarise and synthesise evidence.
- Partnership working across the NHS is essential to ensure that biomedical knowledge in computable form is findable, accessible, interoperable and reusable.
- The information needs of citizens are as important as those of NHS staff. Patients and the public are increasingly required to engage with digital health services.
- As AI and automation are implemented across the NHS, knowledge and library staff are a crucial 'bridge between technology and those who use it'.

in England (Health Education England, 2021a, p.62). The vision is that: 'NHS bodies, their staff, learners, patients and the public use the right knowledge and evidence, at the right time, in the right place' (Health Education England, 2021, p.6). Specific outcomes are defined, and the interrelationships between these and the interventions proposed are depicted, setting out the roadmap to 2026.

The national NHS knowledge and library services team at Health Education England (HEE) takes a leading role in exploring how technology can support health libraries to deliver this vision. The team is forging ahead by:

- improving the infrastructure which enables the discovery and management of digital knowledge resources
- collaborating with local health library teams to establish regional library management systems across England that are integrated with the new national discovery service for healthcare staff and learners.

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DISCOVERY: A WAY OF ENHANCING BIBLIOGRAPHIC SEARCH SYSTEMS FOR HEALTHCARE PROFESSIONALS

It is clear that AI can play an increasing role in search functionality, helping to improve the search experience for users and reduce the time it takes them to summarise and synthesise evidence.

Products like Yewno Discover, EBSCO's Knowledge Graphs and 2Dsearch can help searchers to visualise and construct complex searches, navigating volumes of knowledge to retrieve information. This can make advanced, expert searching more accessible to the novice user. For knowledge specialists, these products can save time, act as a prompt for additional search terms and help with communicating search strategies to end-users (Lacey Bryant, 2021).

HEE funded a Yewno Discover pilot at University Hospitals Derby and Burton to evaluate an AI-based approach to enhance the discoverability and use of knowledge by healthcare professionals (Library Technology Guides, 2020). Yewno groups concepts together, showing their relationships in a knowledge graph. This visual reference gives users a way of seeing connections between research papers that they may not otherwise find. Feedback showed that some users liked Yewno's approach, and some did not. Analysis showed that Yewno was better at handling broad subjects rather than precise ones. Concept visualisation sparked ideas and helped users hypothesise about potential connections between topics. However, prior subject knowledge was needed to assess relevance as connections shown between research concepts may not always be useful (Emerging Technologies Group, 2021).

The concept of data visualisation is also being used with discovery tools. EBSCO's EDS Knowledge Graph shows connections between subjects via a visualisation tool called the Concept Map (EBSCOPost, 2020). It also incorporates natural language and taxonomies to enhance searches, enabling users to find relevant papers. Similarly, Data Lens, a project funded by NHSX uses Natural Language Processing (NLP) and AI to create a universal search engine to join up health and social care data catalogues. It uses Machine Learning (ML) to track searches and improve the relevance of results over time (NHSX, 2021).

Mersey Care Evidence Service trialled Iris.ai to produce rapid syntheses of the literature for evidence reviews. Iris reads papers and understands keywords, concepts, context and relationships, which it maps against all the other papers it has read, to identify related content. It takes the 'grunt work' out of synthesising,

adding depth to searches. It uses NLP, which requires users to formulate their search queries in 300–500 words, a very different approach than used with expert searching. The Service concluded that 'Iris is still young and will continue to develop ... Essentially we are asking not what Iris can do for us today but what we may do together in the future' (Cheney, 2020).

NICE is using RobotAnalyst as a screening tool to develop guidelines as well as surveillance reviews on public health questions (Health Education England, 2021b). These are complex and are often described using abstract and fuzzy terminology. Using text mining-based functionalities, the RobotAnalyst, supports users to *screen while searching*, including by different facets, clusters (based on descriptive clustering) and topics (based on topic modelling) (Ananiadou, 2018).

Work to automate evidence synthesis in the Trip Database (Brassey et al., 2021) shows that ML can effectively identify, assess and collate research findings to produce evidence maps, leading to time-savings in synthesising evidence.

However, a recent systematic review (Blaizot et al., 2022) evaluating the benefits and challenges of using AI to help users understand the evidence, reports that extensive human validation is still required.

Our exploration of these AI, ML and NLP applications points to their potential to augment the work of human searchers, enhancing the efficiency of evidence sifting and synthesis rather than replacing the work of knowledge specialists. Indeed, it demonstrated reliance on the knowledge and skills of health librarians and other expert searchers. For instance, the Yewno pilot showed that underlying knowledge is needed to spot when concept visualisation proposed connections that were not useful, and this approach was not suitable for specific searches. Using Iris.ai showed the need for intermediaries to translate search queries into a form understandable by NLP.

Case study: Integrating BMJ Best Practice into the EHR system at Cumbria, Northumberland, Tyne and Wear NHS Foundation Trust

The Trust (CNTW) is one of the largest mental health and disability Trusts in England, employing over 7000 staff, serving a population of c1.7 million. As the first mental health Trust in England to implement an EHR system, CNTW are forward thinking and regularly seek partners for further innovation. They collaborated with BMJ to integrate BMJ Best Practice into their

EHR system, Rio, to provide quick access to accurate clinical information at the point of care.

'By more closely integrating evidence-based knowledge resources into Rio, we have the potential to reduce information barriers, increase our uptake of evidence and improve patient outcomes. Following the introduction of the BMJ Best Practice search widget into the EHR, usage of the tool increased and has been sustained since. Further work is planned to look at how we can increase awareness of the search widget and further integrate with our EHR supplier to provide direct links from each patient's EHR page' (Mike Jones, Associate Chief Clinical Information Officer).

MOBILISING COMPUTABLE KNOWLEDGE; EVOLVING A SYSTEM-WIDE APPROACH

Computable biomedical knowledge (CBK) is defined as 'the result of an analytic and/or deliberative process about human health, or affecting human health, that is explicit and machine-executable, and therefore can be represented and reasoned upon using logic, formal standards, and mathematical approaches' (MCBK Community, 2021).

The aspiration is to create actionable knowledge objects which deliver context-specific health advice to clinicians and patients. For example, by linking recommendations in a dynamic, living NICE guideline (NICE, 2021) to keywords in a patient's electronic health record using ML. So, a note about high blood pressure triggers an alert to check for co-morbidities and indicates appropriate interventions.

Health information technology itself is still evolving and does not yet fully deliver on its promise. The underlying infrastructure falls short of what is needed. The challenges are many: the volume of knowledge; creating machine readable content; agreeing standards for structuring data and transferring it between systems; measuring the impact on patient outcomes; ensuring safety of the information; developing the skills and behaviours of clinicians (Walsh & Wroe, 2020). To truly harness the power of ML and NLP, a cornucopia of taxonomies and ontologies will need to be built to translate a user's search into something that will find relevant information.

Greater partnership working is required to ensure that biomedical knowledge in computable form is findable, accessible, interoperable and reusable, following the same FAIR principles as biomedical data (GO FAIR, 2022). Building on an HEE-led Concordat (Health Education England, 2021c) and working with NICE, the national team hosts regular round-table discussions on the benefits of new technologies, and tools and approaches to better structure knowledge and underpin learning health systems (The Learning Healthcare Project, 2021). Senior staff from Arm's Length Bodies which are responsible for producing, publishing and consuming medical knowledge and clinicians, transformation leads, researchers, informaticians, representatives from 'think tanks' and knowledge managers meet together to share recent developments, stimulate wider partnership working and shape future priorities and initiatives (Faculty of Clinical Informatics, 2022).

Participants recognise that standards for knowledge interoperability, and collaboration on the use of controlled vocabularies, are essential for the NHS to harness knowledge and technology. The ambition of NHS England to see safe and effective use of clinical decision support as the 'expected norm for all clinicians' (Carding, 2022), lends momentum to this collaboration. It will allow for harmonised development of standards and encourage the spread of best practice. Future plans include the sharing of project roadmaps, and shared developments of taxonomy and metadata schema.

ENGAGING WITH CITIZENS

The Topol Review recommended that programmes aimed at engaging and educating the public about new healthcare technologies should be developed (Health Education England, 2019). 43% of adults aged 16–65 in England do not understand word-based information sufficiently well to make health decisions for themselves or their family, rising to 61% when numbers are added (Rowlands et al., 2015). Health literacy is a key theme of Knowledge for Healthcare (Health Education England, 2021a). For some, low levels of health and digital literacy pose a significant barrier to using health information and to accessing health services.

NHS knowledge specialists have raised awareness of the impact of health literacy, and promote tools and resources (Carlyle et al., 2022) and developed elearning (Health Education England, 2022d). They deliver training to upskill the healthcare workforce (Naughton et al., 2021).

HEE and CILIP are co-leading a partnership with Libraries Connected and Arts Council England to facilitate a sustainable approach to building health and digital literacy skills in communities, by equipping local information providers with the necessary skills (Carlyle, 2022). They are sharing tools, cascading training and

testing the effectiveness of different approaches to supporting citizens to access, assess and use health information, as well as to manage privacy on the internet (Health Education England, 2022b).

People need to understand how search engines use algorithms to limit options and influence choices. Algorithmic literacy has been identified as an important component of future health curricula (Kamper & Balzer, 2021). Initiatives are needed to incorporate an understanding of algorithms into educational programmes. UNESCO has launched an algorithm and data literacy project for young people (The Algorithm and Data Literacy Project, 2022).

PREPARING THE KNOWLEDGE SPECIALIST WORKFORCE FOR THE DIGITAL AGE

CILIP's Technology Research report, sponsored by HEE (and written by Dr Andrew Cox) examined the impact of technologies on Knowledge, Services and Users. The report identified knowledge and skills on which information professionals can build to maximise the benefits of AI, ML, process automation and robotics, and to mitigate associated risks. These include: health data provenance, curation, integration and governance, as well as in critical appraisal; all grounded in an ethical code (CILIP, 2021).

Similarly, the learning from the pilot projects outlined above suggests that AI, ML and NLP will present opportunities for knowledge specialists to apply their skills in identifying user needs and their knowledge of cataloguing, classification and taxonomy.

The CILIP research highlighted the need to gain new knowledge and skills (CILIP, 2021). To thrive in the digital age, knowledge specialists require computational sense; data science and data stewardship; data literacy, AI and algorithmic literacy (CILIP, 2021). HEE engaged with the updated CILIP Professional Knowledge and Skills Base career development tool (Gilroy & Robinson, 2021), to incorporate these competences (CILIP, 2022).

HEE and CILIP are partnering with training providers to develop opportunities for health knowledge specialists to gain greater understanding of new technologies, clinical data science and programming. (Lacey Bryant, 2021).

The NHS Knowledge for Healthcare Learning Academy (Gilroy & Day, 2022; Health Education England, 2021d) offers opportunities for knowledge specialists to develop new skills, for example, an AI study day (where good practice was shared), a Community of Practice around Emerging Technologies and the Library Carpentry programmes (Health Education England, 2021e).

HEE has funded a secondment to inform the development of a forthcoming Postgraduate Certificate in Clinical Data Science at Manchester University (National School of Healthcare Science, 2022). Aimed at all healthcare staff, this certificate will provide valuable learning for health knowledge specialists in data engineering; mathematics, statistics and ML; data visualisation and communication; human factors analysis and digital transformation.

CONCLUSION

AI is impacting NHS libraries in England, particularly in the transformation of specialist search and knowledge management products and functions (Health Education England, 2022a). Early experimentation showed opportunities to improve the management of the deluge of scientific publications, and to free up staff time by facilitating 'the machine as part of the team' (Health Education England, 2019).

AI will have a significant role in knowledge mobilisation, augmenting the expertise that knowledge specialists bring to knowledge discovery and to the synthesis and summarising of evidence. By harnessing AI, knowledge specialists will be able to work faster, smarter and more effectively to mobilise biomedical knowledge, thus improving patient outcomes.

Naturally health librarians and knowledge specialists in England express the full gamut of responses to change on this scale, from apprehension as to how they will fare to eager anticipation of the possibilities. Today they have a choice of opportunities to enhance their understanding and gain new skills, drawing on the experience of others, whether through higher education, through the Knowledge for Healthcare Learning Academy (Health Education England, 2022e), or by joining a Community of Practice (Health Education England, 2022c).

Knowledge and Library Service teams in England have a track record of adopting new technologies to help users derive benefits from the evidence base. The importance of knowledge and library staff 'as a bridge between technology and those who use it' remains crucial as AI and automation are implemented in health systems (Smith, 2022). People are at the heart of digital transformation, just as they are at the heart of the NHS.

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CONFLICT OF INTEREST
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