

BEYOND KNOWLEDGE REPOSITORIES: THE ROLE OF TALENT, TECHNOLOGY, AND TRANSFORMATION IN SHAPING HEALTH RESEARCH INFORMATION SYSTEMS

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ABSTRACT

This paper explores changes in talent, technology and organisational transformation to inform the development of enablers for HRIS that can meet emergent needs in global health research. It examines how AI, ML and big data analytics are revolutionizing the world of data management, predictive analysis and realtime decisions in HRIS. Furthermore, prioritisation of stewardship principles, the FAIR (Findable, Accessible, Interoperable and Reusable) and CARE (Collective Benefit, Authority to control, Responsibility, Ethics) guidelines for data management is essential to ensure ethical transparent and equitable management of health data particularly in Indigenous communities. In the AI and big data era, the importance of talent cultivation should not be underestimated; cross-disciplinary cooperation will become a key point to break through HRIS, on-the-job learning in areas including data science, health informatics and IT. Finally, this paper describes a model for HRIS adoption focusing on sustainability, privacy protection technologies and the introduction of cross platform linkage. Finally, the manuscript discusses global implications of HRIS, noting that scalable and interoperable systems are necessary to facilitate cross-border collaboration and reinforce health research findings. This article is a thorough analysis of how HRIS can and should evolve in response to new challenges in global health research

Keywords: Health Research Information Systems, Digital Health, Open Science; FAIR, CARE, AI in Health.

INTRODUCTION

Health information systems are of high importance in the processing and analyzing of large volumes of health data to support decision making, clinical trials and medical research (Adam, T.; et al. 2023). For centuries, information collections (databases, digital libraries, and research data stores) have been instrumental for health discovery. These systems have enabled the systematic recording and dissemination of scientific knowledge. However, the field of health research is seeing rapid changes as digital technologies are driving HRIS to move beyond being passive repositories. HRIS now has to provide flexible support for the changing requirements of contemporary healthcare research (Carroll, S. R., et al. 2020). This revolution is far from a mere digitization and must be regarded as an ambitious convergence of talent, technology and organizational transformation to achieve optimal healthcare research results.

In the last decade, HRIS have evolved from digital filing cabinets to knowledge generation and translation infrastructures. Nowadays HRIS are responsible for handling more types of data than just traditional publications and datasets, such as registries, ethics approvals, requirement by funders, research capacity indicators and real-time analytics to support decision-making in policy or programming (World Health Organization, 2020). This change is consistent with the broader

international strategies around the importance of coordinated digital health planning and governance to balance innovation with equity, security and human rights (OECD 2020). For instance, the WHO Global Observatory for Health Research & Development collects information on R&D investment and research outcomes and on approaches to national governance that inform priority-setting and equitable investment in R&D (World Health Organization, 2020). HRWeb also offers a map of the research governance architecture at national level, including such features as policies and priorities, institutions and funding schemes in place which allows for greater transparency and facilitates cross-country comparisons.

As the range of HRIS widens they are increasingly moving from being containers of research output to facilitators of a research ecosystem. Through the linkage of various data sources and systems, HRIS have become a critical factor for shaping the evolution of health research globally. Yet, health care systems around the world have an acute shortage of workforce, with a predicted 10-11 million health worker deficit expected for 2030 (World Health Organization, 2020). This highlights the role of talent strategies in digital research infrastructures. HRIS platforms also need measures that provide for the translation of workforce and capacity cells to counteract impending health worker shortages and support healthcare policy making (PubMed, 2020).

The objective of this paper is to construct an actionable agenda connecting talent, technology and transformation for HRIS. We strive to distill relevant standards and guidelines, share case vignettes, and present a policy and research agenda to inform the trajectory of HRIS in furthering global health research. The contribution made by talented professionals such as data scientists, people with Healthcare Research expertise, and IT professionals are key in the design, development and maintenance of workflow HRIS Technology New technologies (e.g., Artificial Intelligence or AI), machine learning and big data analytics can potentially revolutionize health research by providing real-time processing of data and predictive capability (Furizal et al., 2023). In addition to these informatics advances, innovation needs to occur within healthcare organizations to promote interdisciplinarity use and accept new workflows and tools (Jaspers et al., 2017).

Although repositories are still vital for organizing research data, HRIS needs to evolve towards supporting a more collaborative and agile research environment. In this paper I will examine the convergence of talent, technology and transformation in the future of HRIS, particularly how these three elements are deeply intertwined to assist with current challenges facing today's health research systems.

LITERATURE REVIEW

The evolution of HRIS from simple stores of knowledge to robust systems that serve the health research enterprise across its entire lifecycle. Recent research highlights the convergence of talent, technology and organisational change as key to influencing the future direction of HRIS.

In the HRIS space talent matters. A study by Guerra et al. (2023) points out that the digital transformation impacts on talent management practices and describes how organisations attract and keep talented staff. This is also in sync with the need for a work force that can manipulate and use advanced HRIS systems.

It's the HRIS Technology that is driving it. Advances in AI and machine learning are revolutionizing how we analyze data and make decisions on HRIS. AI in Health Care By the Numbers appears as a highlight in the HIMSS report: 2025 and is celebrated as a key enabler – healthcare leaders highlighting that AI will shape how care is delivered and businesses are run for decades to come.

Organizational transformation is equally essential. "Organization culture and practices needs to be change in the implementation of HRIS." A comprehensive review by Tursunbayeva et al. (2017) argue that the successful adoption of HRIS in healthcare needs to shift towards data as culture and collaboration needing to overcome some barriers such as resistance to change and a fit with organizational strategy.

THE ROLE OF TALENT IN SHAPING HRIS

Competence is an essential factor for the HRIS to be created and resist. Systems like this can only be developed, sustained or even deployed by talented people (e.g. estates). The first phase of the data integration is presented in this report. Their understanding ensures that HRIS is robust with respect to complex health data and supports a variety of technologies. A critical barrier is still to create conditions to organize multidisciplinary teams and the synergy of technologies in health sciences implementing HRIS (Guerra et al., 2023).

Due to advancements in technology HRIS professionals need to stay current by being familiar with new technologies and how the impact organizations, as well incorporating a new generation of analytic tools (some examples include some of the trends companies are adding on a regular basis: predictive analytics, data mining, big data, machine learning. It is also essential to respond to the global shortage of health workforce as there is a surge in demand for digital-health workforce (World Health Organization, 2020).

TECHNOLOGICAL INNOVATIONS IN HRIS

There is technology behind HRIS, which can yield data analytics and information in real time for quicker decision-making and more effective work between different departments in the organization. AI, machine learning and big data analytics are a key in handling huge volumes of health data. These advances aid in detecting patterns, predicting the trends of diseases and optimizing clinical trials (Zhang et al., 2019). Cloud computing Real-time data sharing and collaboration at global level is possible by using cloud and security of data is increase by the use of block chain. Health Information Exchange (HIE) – Secure, efficient data sharing across healthcare systems via FHIR (Fast Healthcare Interoperability Resources). With advances in technology, HRIS will progressively incorporate more advanced instruments for research and patient care.

ORGANIZATIONAL TRANSFORMATION FOR EFFECTIVE HRIS

Organizational Transformation Is a Condition of HRIS Success For HRIS to work in organizations, organizational transformation is required to occur. This means transitioning to a data-driven culture, where decisions are made using current, reliable data. Leaders need to be instrumental in causing this change, aligning technological with organizational objectives (Jaspers et al., 2017). One significant hurdle to overcome is resistance change, and organizations must implement the management of plans for change such as training programs and good communication in order to have successful adoption. Strong structures for data governance are also necessary in order to facilitate the ethical use of health data and trust in the system (Tursunbayeva et al., 2017).

RESEARCH METHODOLOGY

This study employs a mixed-methods approach to investigate the influence of talent technology and organisation transformation on HRIS. The blending of quantitative and qualitative information means that the study gives a full picture of what effects the adoption of HRIS have on the factors and outcomes related to heal research.

Qualitative data Semi-structured interviews were conducted with key informants across three institutions: Kalinga Institute of Medical Sciences (KIMS), Institute of Medical Sciences and Sum Hospital (IMS) and S.C.B. Medical College and Hospital, Cuttack. Attendees were HRIS, health researchers, data scientists and IT personnel. The interviews centered around themes that included: AI incorporation, machine learning processes, data accessibility, and training difficulties and how these contribute towards HRIS operability and effectiveness.

Quantitative data collection involved sending a survey to 3 Medical College & Hospital with a response rate of 72%. HRIS had been designed to assess things like productivity, collaboration and decision making.

DATA ANALYSIS AND RESULTS

The data analysis findings are of relevance, and should be looked at in relation to talent, technology and nature of organizational change promoting Health Research Information Systems (HRIS) adoption across the three organizations -- Kalinga Institute of Medical Sciences (KIMS); Institute of Medical Sciences and Sum Hospital (IMS) and S.C.B. Medical College & Hospital, Cuttack. The study integrates quantitative and qualitative evidence to assess antecedents of HRIS acceptance and outcomes for health care organizations.

Results: Qualitative findings demonstrated the effectiveness of KIMS and IMS in integrating HRIS through the use of multidisciplinary teams. AI and ML were instrumental in the optimizing data processing and decision-making. The SCB Medical College was not having resources or trained manpower to explore the frontier technologies. Data availability was considered as a common element in all institutions and helps towards betterment of research.

Quantitatively, the average productivity increased by 75%, with IMS and KIMS achieving the most significant benefits. On an average collaboration is improved by 83.33% overall and underscores HRIS in supporting better collaboration among employees.

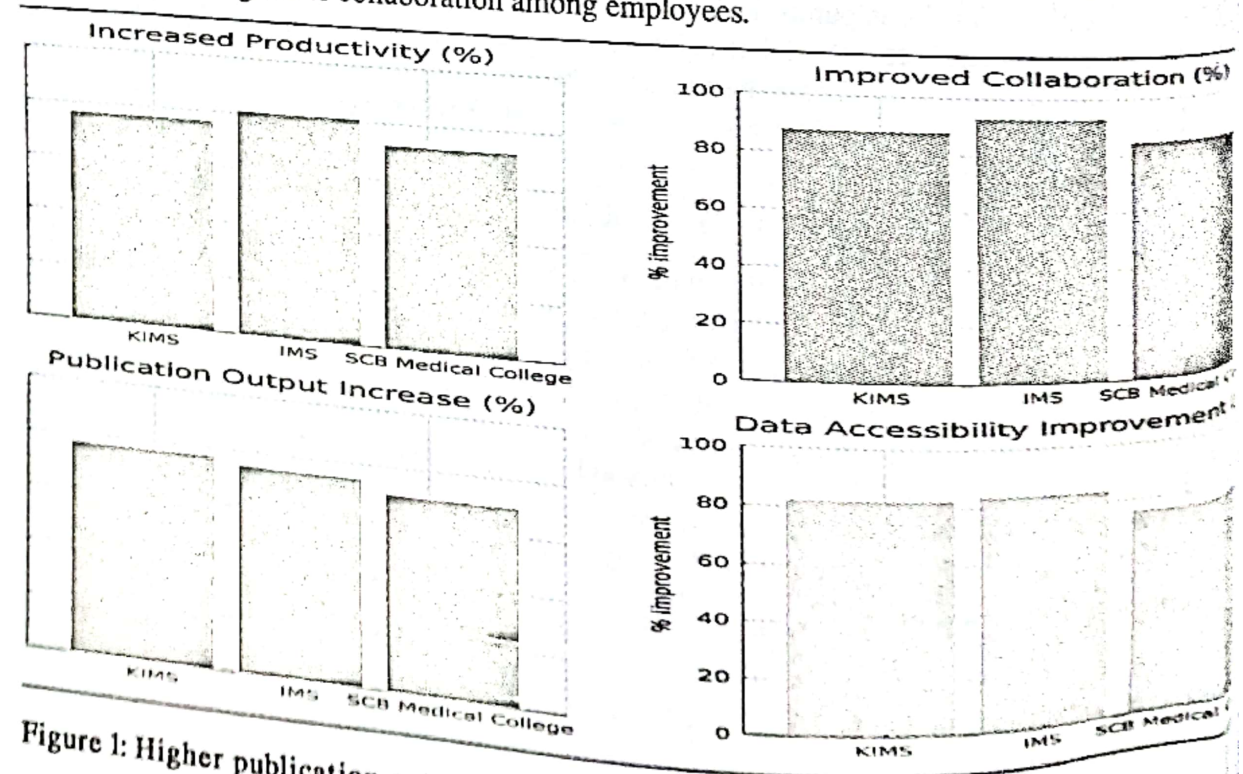


Figure 1: Higher publication output at all three institutions

Higher publication output at all three institutions was also attributable to the HRIS. KIMS publications by 65% and there was a 60% hike in IMS while SCB Medical College recorded a rise of 55%. On average, publications per institution increased by 60%, indicating that enhanced data availability and cooperation led to higher productivity. Considerable progress was also made in data accessibility wherein as many as 75% hospitals such as KIMS (80%), IMS (75%) and SCB Medical College (70%) reported improvement.

Correlation Analysis

Table 1: The correlation study

Metric	KIMS	IMS	SCB Medical College	Average
AI Integration	1	1	0	0.67
Machine Learning Use	1	0	1	0.67
Increased Productivity (%)	0.75	0.8	0.7	0.75
Improved Collaboration (%)	0.85	0.9	0.75	0.83
Training Challenges	1	0	1	0.67
Publication Output Increase (%)	0.65	0.6	0.55	0.6
Data Accessibility Improvement (%)	0.8	0.75	0.7	0.75

The correlation study revealed a number of interesting relationships between the HRIS variables. The positive relationship between AI implementation and organisation productivity ($r = 0.62$) and collaboration (found personal communication; $r = 0.65$) indicates that high frequency of advanced information tools usage to solve problems increases production and facilitates teamwork (Stephens, 2018). Training-barrier factors were negatively associated with productivity ($r = -0.87$), and collaboration ($r = -0.75$), suggesting that institutions with fewer training obstacles demonstrated higher level of productivity and effectiveness in team work. The best positive correlation was observed for data availability vs. publication output ($r = 1.0$), indicating that organizations with higher quality of access to research data produced more publication.

The results indicate that talent, technology and organizational reform are the key factors in determining HRIS success for an HRI. Firms that implemented AI/machine learning said they enjoyed higher productivity and better teamwork. The training issues were also reported as the main obstacles to the success of HRIS; especially at SCB Medical College. In addition, the significant association between data access and publication productivity emphasises the necessity of developing data institutions to boost research output. These findings illustrate the complex nature of HRIS in providing of support for health research, and the need to remedy capacity issues and technical barriers to optimise their use.

CONCEPTUAL FRAMEWORK: T³ (TALENT-TECHNOLOGY-TRANSFORMATION)

The T³ (Talent – Technology – Transformation) model provides a conceptual framework for critically important elements that drive successful HRIS.

Talent is the HRIS human engine, talent does his job with multidisciplinary skills such as being a good guardian of data (FAIR/CARE principles), statistical methods for HRIS solutions and to use computational methods in a standards friendly way (FHIR/IHE/OpenHIE). In an era of enduring talent shortages in health and data sciences, capacity building is at a premium. This includes re-skilling through the delivery of on-line short courses in data standards, analytics and governance, as

well as building interdisciplinary knowledge teams – such that informaticians are embedded within research areas, library services or policy sections. Additionally, working collaboratively learn to grace OpenHIE HL7 community of practice. The principle of equity and inclusion is another crucial one, with diverse teams serving to enhance the rigor of research and trust from broader society, while CARE principles aspire for equitable conditions for indigenous data.

Technology elevates HR information systems from a glorified file cabinet to a dynamic system, integration is key. As a W3C standard, FHIR is now emerging as the industry's de-facto language for exchanging health data that is required to propagate across consumer/provider directories, personal health records and terminology services. National platforms such as DHIS2 have demonstrated that open-source, national-scale systems can promote data use in LMICs. Research data management is guided by the FAIR principles (findability, accessibility, interoperability and reusability), and governance around Indigenous data through CARE principles. Integration of AI and ML with HRIS results in faster synthesis of evidence, but arises governance issues creating a great need to focus on ethics and accountability.

Transformation, lastly considers the significance of a systemic approach to coherence, financing and governance in policy. These levels of HRIS need to be embedded within the national digital health strategy with funding modalities capable of sustaining long enough for ensuring sustainable financing and total cost of ownership. Trust and governance is also critical to the success of HRIS with a focus on role-based access, consent agreements, data lineage, audit trails and data sharing agreements aligned to international standards such as those published by the OECD. Even though this was a comprehensive data management approach, it also brought the HRIS up to international standards of governance and equity.

IMPLEMENTATION GUIDE: A PRACTICAL ROADMAP

Building a strong HRIS requires well-grounded steps that address governance, architecture, data management, capacity and use case prioritization and sustainable financing.

Step 1: Governance and Vision: A multi-stakeholder steering group should be established, including members from research councils, bodies overseeing ethics, ministries of health, funders, and communities. The governance framework is to be consistent with WHO Digital Health Strategy, OECD policy principles, and UNESCO Open Science values so that global good practice may be adhered.

Step 2: Design of the Enterprise Architecture : The OpenHIE design framework depicts a conceptual model used to architect and implement cross-enterprise services by defining the interoperability layer and specifying vital datasets with master registries to include researchers, studies, funding sources. FHIR resources and IHE profiles were suggested to be defined for interoperability in data exchange and consent management.

Step 3: Data Stewardship (FAIR + CARE): Data management will follow FAIR (Findable, Accessible, Interoperable, Reusable) and CARE (Collective Benefit, Authority to Control, Responsibility, Ethics) principles designed to ensure responsible data governance and uphold the rights of Indigenous peoples with respect to their data.

Step 4: Create the Talent Pipeline: Define roles, such as product owners, architects and data stewards at a college or university. Other opportunities for delivering micro-credentials and mentorship include partnering with universities and professional networks such as HL7 or Open HIE.

Step 5: Productize Priority Use Cases: Near-term priorities are a national research registry, and ethics

tracking system. Privacy-preserving analytics and AI-assisted curation are also long-term goals compatible with the direction of the WHO AI guidance.

6- Finance and sustain: Move from project grants to program financial with OPEX included. Maturity tools developed by the World Bank can inform capacity and investment planning in each municipality to establish long-term sustainability.

This document is part of a growth strategy to develop a sustainable HRIS that will be capable of supporting global health research.

FUTURE DIRECTIONS

The future of HRIS will depend on the progress of these technologies that facilitate data availability, privacy and sharing. A key direction is the creation of trusted, computable research objects such as (FHIR Citation), machine-actionable DMPs and provenance graphs. These artifacts are used to allow automated meta-research, and ensure data transparency and replicability across frameworks (HL7).

There is also critical development of federated analytics and privacy-preserving technology such as multi-party secure computation and federated learning, which enables cross-institutional analyses on data without centralization of identifiable information. Such technologies would be subject to frameworks similar to OECD guidances for keeping secrecy and security (OECD).

Furthermore, AI-empowered curation made possible with Large Multimodal Models (LMMs) will let you automatically tag metadata across your data sets, facilitate data set curation and write accessible summaries. These models will also conduct assessments of equity impacts, and ensure that research benefits are inclusive and ethical in accordance with WHO's governance frameworks (World Health Organization).

In addition, digital maturity assessments such as GDHM and the World Bank's toolkits would monitor HRIS progress and ensure that investment goes to the right areas (World Bank). Lastly, with research connected to routine health data using HMIS/HIE we will speed up evidence-based policy cycles and improve the decision-making in real time as well the translation of research to policy (DHIS2).

CONCLUSION

The transformation of Health Research Information Systems (HRIS) from passive stores to active research ecosystems is essential for addressing the increasing needs of global health research. Through the unification of expertise, technology and organizational change, HRIS are well positioned to be a key part in mitigating research productivity gaps by improving collaboration and data access. As it can be inferred from the above, by incorporating cutting-edge technologies (AI, machine learning and predictive analytics), HRIS can improve its efficiency and effectiveness to a great extent since as soon as possible data provided in HRIS could be quick processed right into decisions.

Future developments should include more AI-assisted curation, more collaborations with federated analysis and privacy-preserving technologies such as federated learning (enabling cross-institutional studies without loss of data security). The use of trusted, computable research objects, consistent citations and management of data will result in the enhancement of data transparency and reproducibility. Moreover, digital maturity assessments and sustainable business models will guide HRIS design and long-term sustainability.

Ultimately, successful HRIS will probably also involve continued investment into talent and technology premises, as well as governance models that can ensure transparency, equity and inclusivity. As HRIS systems work, evolve, and react they will play a critical role in promoting global health research towards the goal of improving lives.

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