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Chapter 11: Enabling cross-disciplinary collaboration between clinicians, data scientists, and healthcare technologists

11.1. Introduction

A fundamental premise can be made in favor of developing a virtuous integration of basic medical approaches. Such integration represents a severe challenge to the scientific community and, at the same time, an opportunity for improving patient outcomes. In recent years, particular attention has been placed on the development of interdisciplinary approaches capable of taking into account and integrating diverse expertise and knowledge for addressing complex issues, such as the challenges and problems posed by the healthcare system. Healthcare sector is becoming increasingly persistent on the integration of skill sets and knowledge deriving from different domains, such as clinical, engineering, and ICT. Administrative and patient side representation of such sectors has its roots in different % of knowledge and comprehension of the world; therefore, each sector has its own peculiar ability to tackle problems and to seek solutions.

Integration between medicine and information & communication technologies: Tackling challenges arising in the healthcare domain requires the enhancement of a patient's outcome by accumulating and integrating information and knowledge about the patient’s history, symptoms and signs, the actual diagnostic plan, and treatment to formulate the most probable therapeutic framework. This task is typically ascribed to medical doctors, also in the digital area, who use the computer’s ability to process and order large amounts of data. Thus, technology plays a fundamental role in screening processes; nonetheless the information that can be manipulated through computers comes from clinical trials. On the other hand, the patient-doctor interaction focuses on needs, perceptions, and context of care. The need is to bridge the gap between these different representations, looking onto cross-disciplinary methodologies. The need arises in both the medical and

the ICT sectors. Cross-disciplinary research questions could allow the medical side to optimize timing, protocol, and usage of technological tools, while the technologic side could challenge the system's ability to adapt the context of care and to investigate the expected patient outcomes. Moreover, such an investigation can support the better practice definition by means of process analysis and pathway detection regarding best practice management and technological control. The aim is to provide a formal framework to both medical and health-technologic operators for facilitating the comprehension, representation, and analysis of the reciprocal concordance.

Fig 11.1: Cross-disciplinary collaboration

11.2. Role of Technology in Enhancing Collaboration

Collaboration between clinicians, healthcare technologists, and data scientists is essential for enhancing health service research and delivery (Ghosh & Choudhury, 2020; Kumar & Singh, 2020; Patel & Cushing, 2021). The role of technology in fostering this collaborative relationship is explored from the viewpoint of three main stakeholders. Key issues in the effective use of data and IT for clinicians are accuracy, and cost-effectiveness. The current use of data and IT in clinical settings in Japan is reviewed,

contrasting it with the situation in Britain. The development and design of efficient tools and software—such as graph-based models for clinical decision support and visualization of clinical records—that enable quick insight to be gained from multiple sources of information is presented. The development of more effective and interactive clinical decision support tools can make clinicians feel the datasets and methods are both more reliable and accurate, as well as more digestible. At the same time, clinicians must also be aware of the importance of data integrity and behavior, and should they use data or IT, they need to better understand 'downstream' consequences, including staff time and patient anxiety. For healthcare technologists, a rigorous methodology in science to validate the usefulness of their technologies is critical. As the time and economic cost of healthcare grows, the innovative use of public big data can be a more cost-effective approach to investigating health service delivery. Different datasets and methodologies were considered for how various factors might affect access to healthcare services. It was shown that public transit access, travel time and distance to the clinic, elderly percentage, and economic deprivation all had substantial influences—individuals younger than 30 or older than 60 typically have more limited accessibility—but X-ray clinics were more accessible, quick, and located close to the main train station.

11.2.1. Data Sharing Platforms

In this section, suggestions will be made on how cross-disciplinary collaboration between clinicians, data scientists, and healthcare technologists can be triggered by addressing the needs of each stakeholder group. Participants in healthcare face difficult challenges in gaining a comprehensive view on patient health. The ubiquity and pervasiveness of digital devices and modern monitoring technologies has given rise to increasing data volumes that have the potential for transforming healthcare, such as pre-symptomatic, preclinical disease detection, progression tracking and predicting treatment outcomes. Clinicians, on the treatment side, most urgently need assistance in sifting through alternative treatments given personal genomics, proteomics, metabolomics, and health history/situation. They need guidance based on current study results.

Data Sharing Platforms

One approach to possibly addressing the needs of all parties involved is the setup of national/international data hubs encompassing all relevant data, potentially including insurance claims, and, crucially, making this data available to the data science community for further in-depth analysis. At the same time, the data science community should have the opportunity to list the most pressing unexplored health issues and/or existing data resources required to solve these through online platforms. It is suggested that the currently largely password-protected resources should be opened to the public.

To encourage the submission of missing results, a system would need to be integrated. Offering rewards for creating urgently needed data sets might help make the needed information available to the broader research community. Besides, tailored development of new devices for meaningful data collection, such as for better cardiorespiratory monitoring, would also prove useful. Finally, a large portion of health data available within the modern health economy and potentially useful for health studies is stored with pharmaceutical companies or CROs. A creation of a framework for those data to be easily usable for the rest of the research community is suggested.

11.2.2. Telemedicine and Remote Collaboration Tools

The emerging coronavirus disease 2019 (COVID-19) pandemic represents a historical challenge to traditional disaster preparedness and healthcare delivery. Triggering a cross-disciplinary approach to optimizing care delivery, data science, technology, and health-system operations should become a high priority. To date, telemedicine remains underleveraged as a medical field and people worldwide to work together remotely.

Due to its boundary-crossing nature and public health importance, the COVID-19 outbreak marks an important use case for examining the potential of telemedicine to create telemedicine conversing a few different key components. A group of experts committed to advancing academic international medicine during the eruption of the 2019 novel coronavirus formed the COVID-19 PANDEMIC 2021 Telemedicine and Remote Collaboration Technology Implementation Framework Consortium. On January 30, 2020, the COVID-19 outbreak was designated by the WHO as a Public Health Emergency of International Concern under the International Health Regulations. Exploring future pandemics have a great potential to result in even more devastating consequences should they become rampant to less developed regions.

During face-to-face medical care, the potential for disease transmission between clinician and patient is of constant concern, necessitating the use of personal protective equipment. When applied incorrectly, it corresponds to increased risk of disease transmission. The unique feature of telemedicine can be utilized to enable remote simultaneous exchange of personal data, voice, and video to safeguard against nosocomial disease transmission, reduce the need of personal protective equipment, and widely increase the number of patients that may be treated relative to prior strategies. In the event of a large-scale infectious disease epidemic, immediate proactive containment strategies will prioritize health care providers and concentrators of infected patients as preferential vectors of the disease. Amid growing international concern, the need for immediate implementation of adaptive strategies has been prompted. Telemedicine has a demonstrated ability to deliver services to patients while minimizing the clinical risk of infection.

11.3. Current Challenges in Healthcare Collaboration

The increasing complexity of medical problems and technological advances are driving an ever deeper integration of healthcare professionals, and the data scientists, modelers, and analysts with whom they collaborate (Wang & Zhang, 2020; Singh & Gupta, 2021). This transdisciplinary team uses data for discovery, which requires a substantial infrastructure in order to manage, compute, and minimize the difficulties of understanding large and complex data sets. Challenges include the close involvement of and contradictory demands from multiple stakeholders, substantial hidden work of incumbents, and the difficulty of standardizing work progressing incrementally over an emergent trajectory. To overcome such barriers, collaboration typically relies on both formal management aimed at organizing conduct from above, and informal knowledge work through which stakeholders collaborate beyond bureaucratic boundaries. However, little is known about how such formal and informal levers relate in MO-MS collaboration systems (MMCSs). This study contributes a conceptual framework of how formal and informal levers may be related based on nine emergent archetypes of MMCS.

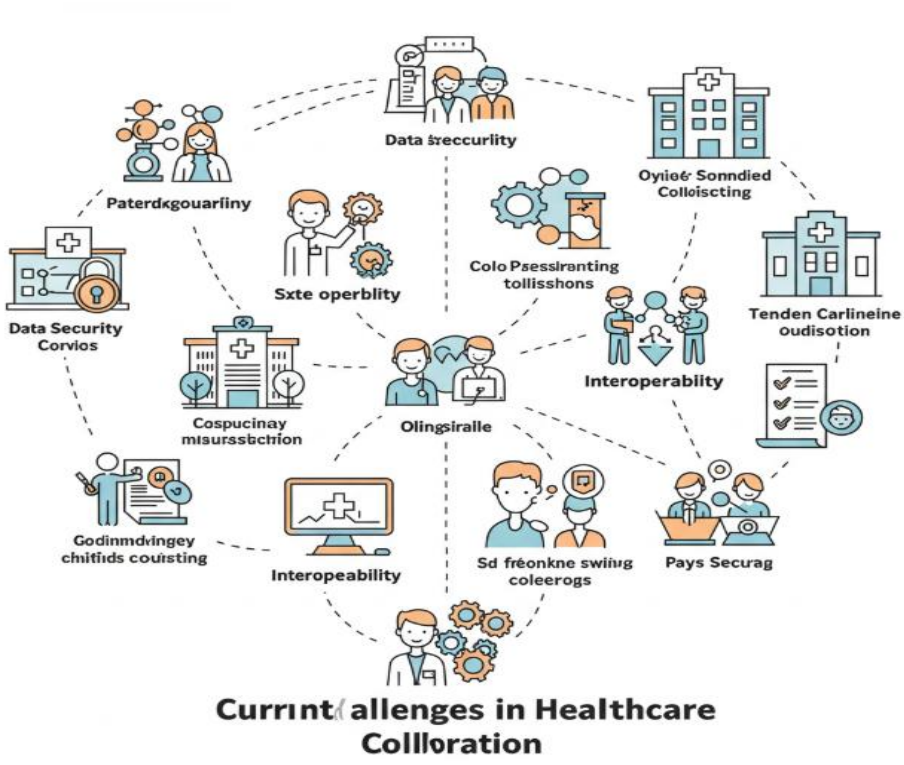

Fig 11.2: Current Challenges in Healthcare Collaboration

Research in Healthcare Services Management is still dominated by studies based on partial coordination through formalization, while neglecting other collaboration mechanisms. Collocated human-intensive care is an essential yet expensive form of healthcare provision. The role of collaboration in improving quality of acute care services even in critical wards has not been researched sufficiently. In a Healthcare Information Services intervention, two loosely coupled organizational stakeholders, healthcare professionals and IT experts, are not highly experienced in corresponding collaboration techniques. Collaboration technologies, often following a techno-centric approach, are developed focusing too much on on-demand problem-solving issues at the expense of more challenging ones such as need-driven innovation in clinical practice. Most concurrently, discrepancies, or in some cases mismatches, arise between the collaborative infrastructure requirements of the stakeholders and the ones empowered by existing Healthcare Information Services. The aim is to establish a research agenda comprising realist methodologies to (1) theorize how the collaborative intervention actions enforce the specific underlying mechanisms, and (2) empirically evaluate which intervention efforts are necessary to grow them. A current challenges discussion serves as a stepping stone providing a broader context concerning Healthcare Services providing.

11.3.1. Communication Barriers

To promote the better understanding between clinicians, data scientists, and healthcare technologists for efficient and effective cross-disciplinary collaboration, the misconceptions and communication barriers are identified. In clinical domains, variations with tasks for diagnosis or clinical study from physicians, irrationally increased expectations of digital health data research, and misuse of technical terms in the healthcare or data domain are common. In data science fields, the lack of abundant technologies to make healthcare data available for routine research, prejudice to a technologist or physician due to relatively poor theoretical backgrounds, and a difficulty to understand the jargon used by skilled clinicians are identified. Problems for healthcare technologist domains include the conceptual gaps in healthcare practice and technology development between clinicians and technologists, negative attitudes of clinicians or data scientists toward a commercial system under development, and the excess eagerness for researchers in technology developments, with underestimation in available time and resources for physician’s participation. Approaches of participatory design with the engagement of interdisciplinary teams of clinicians, researchers, data scientists, and software developers in the iterative development of data analytics tools to assure their ability to address real clinical queries are demonstrated. To enable cross-disciplinary collaboration between clinicians, data scientists, and healthcare technologists, misunderstandings and communication barriers providing misunderstanding between each two of the domains are identified and provided with guidelines on overcoming them.

11.4. Frameworks for Effective Collaboration

Global pressures on health services continue to escalate. There is growing recognition that significant changes are needed in how healthcare is funded, how information is managed and used, and how services are organized, delivered, and measured. Complex health systems require creative approaches to planning and managing care through collaborations among clinicians, data scientists, and health technologists. Despite the increasing emphasis of funders and decision-makers on the need for collaborative processes, where best to start remains a daunting question. There are many different types of clinicians, data scientists, and health technologists, and across these professions, numerous specialties and disciplines. What is more, the rapidly developing changes in care delivery and health technologies mean that collaborations are needed across people working in these diverse fields, but with specific expertise and practice knowledge. A structured approach would suggest that there is a need to develop a range of tools, methodologies, and technological solutions that can support varying levels of collaboration. This framework can help streamline both the design and implementation of collaborations and support more effective and efficient outcomes. It can provide a starting point for clinicians and researchers aiming to develop collaborations; offer guidance on building multidisciplinary teams; foster innovative and appropriate solutions; promote different perspectives on healthcare challenges; and facilitate the overall management of health projects. Future research and implementation would suggest an evaluation of the effectiveness of structures and outcomes of collaboration frameworks over time to continuously develop and improve them. It is also recognized that a structured approach may not be appropriate for all project types and can suggest a range of options that are adaptable and can be used in different ways depending on time, resources, and project requirements. It is advocated that implementation of the frameworks involves early stakeholder engagement and inclusive decision-making, and that this is essential to build team dynamics and avoid common misunderstandings and division. Tools and technologies are also suggested as essential components in executing frameworks successfully. Evaluation plans should incorporate an assessment of teamwork and feedback from participants on a regular basis. Despite repeated calls for the establishment of more interdisciplinary research and problem-solving teams, the ongoing challenge is to understand how to foster effective teams that generate a clear value added, beyond contributions shared similarly by working individually or in parallel.

11.4.1. Interdisciplinary Teams

Cross-disciplinary collaboration between clinicians, data scientists, and healthcare technologists can be highly beneficial for evidence-based decision-making and the development and implementation of novel digital healthcare technologies. Agile principles and User-Centered-Design methodologies can be applied, and the necessary

insight is provided to increase familiarity between the three professional groups. The ultimate goal is to encourage a wider engagement in co-design and co-creation processes.

When a common issue is confronted, collaboration—bringing together professionals from different backgrounds—is often seen as a promising way to address complex problems. As one of the most comprehensive healthcare value propositions, clinical care flourishes as the most obvious example for cross-disciplinary collaboration. Here, healthcare professionals must work alongside imaging, laboratory, and other technical services to deliver appropriate patient care. Since health becomes more tech-driven, involving large health informatics, data sciences, and IoT services more than ever, health systems have been established.

As digital health becomes an increasingly diverse, interdisciplinary field, healthcare institutions can provide a wide range of advantages, perspectives, and empirical data. It provides knowledge and practical experience with healthcare procedures, standards, IT services, and data management in healthcare context. Moreover, they have direct contact with patients and a broad variety of healthcare problems. Data and computer scientists, as well as informatics professionals, are specialized in data management, data analysis, with a varied level of expertise, case-specific methodologies, and technologies. Typical of that is the matching of a particular method to specific data. By bringing the different expertise domains together, collaborative, unbiased problem assessment can be conducted, often revealing hidden biases approached by the only parties involved. Specialists from each domain are enabled to understand and evaluate subsequent processes and results fully, fostering mutual repeatability, re-evaluation, and reviewing. Proper management ensures goal accomplishment efficiency. So, while the solution is formulated without favoritism, fully appreciate it. Vital contribution of each party within collaboration is recognized, motivated, and activated.

11.4.2. Collaborative Tools and Technologies

The collaboration between disciplines is enabled by a range of tasks, which mapping provides an overview of projects in the healthcare domain. Tools and Technologies displays digital solutions that underpin the collaboration of clinical experts, data scientists, and healthcare technologists. Projects from the healthcare domain often use digital tools to help manage and communicate. A project management system reduces the time spent on-site, increases in the quality of the equipment supply and decreases the completion time of a project. Collaborative execution keeps a consistent status for tasks and of the workload projected for the future. The status of these tasks is shared transparently with the entire partner chain. Tasks are periodically reviewed on-site, and there is a concern about the quality of the materials and workmanship. Moreover, delays in the completion of tasks require workload changes in the future. Suitable digital platforms are selected for task management. Two case studies are presented for further

illustration. In the early stages of cross-disciplinary projects, it is important to expedite understanding and to devise a solution for the project to progress. Therefore, supply chain enterprises may host workshops to brainstorm solutions after creating an improved workspace conducive to discussion.

11.5. Case Studies of Successful Collaborations

ABSTRACT: In healthcare and health services research, there is an increasing demand for synergistic collaborations between clinical researchers, data scientists, and healthcare technologists. To enable these collaborations, groups of frontline clinicians, healthcare researchers, and academic researchers were brought together to identify opportunities for joint research. The experiences of the authors in facilitating these discussions, and the views that emerged from them, are presented in this study.

Fig : Collaborative and partnership research for improvement of health and social services

These views call for a shared understanding of the collaborative potential among clinical researchers, data scientists, and healthcare technologists, and a transformation of the clinical environment to enable the rapid prototyping of alternative scenarios of care. By building on currently available information, tools, and platforms, this describes a

strategy for accelerating cross-disciplinary collaboration in healthcare service. Case studies of successful applications are discussed, highlighting implications for practice on how such research can be successfully initiated and conducted.

11.5.1. Case Study 1: Integrating Data Science in Clinical Trials

Cross-disciplinary teams are key in generating ideas from themselves and others that can lead to more breakthrough innovations. Over the last 20 years, the increasing amount and complexity of healthcare data has presented an environment ripe for the development of deep interdisciplinary collaboration between healthcare professionals, data scientists, and healthcare technologists. Unfortunately, working across such interdisciplinary teams can become akin to the fable of the blind men and the elephant, where each has their own insights and wants to be heard. Furthermore, collaboration technology tools (CTTs) themselves have large amounts of untapped value potential in supporting team collaboration and the development of common ground required by such teams. This work leverages data from healthcare professionals in interviews, a focus group and a survey, in combination with a review of collaboration frameworks from the literature, to generate a series of design considerations that both developers of CTTs and those attempting to use them in health teams would be wise to consider to foster collaborative efforts, within and between, the healthcare professions and data science. Case studies are made to build a predictive model with limited data science collaboration time that was then used for a blinded experiment with differing clinical expertise team configurations, successfully predicting results consistent with more traditional clinical study outcomes. The results suggest that CTTs could facilitate the development of a priori common ground and the fostering of a more collaborative environment.

11.6. Conclusion

This essay has sought to shed light on how clinicians, as users of ever more sophisticated technologies that monitor or intervene in the health status of individuals, could benefit from a more active understanding and involvement in technological development. The key issues, challenges, and possible future ways forward have been outlined by focusing on the single point of view of one category of users, the developers of the technologies at the interface with human health. This essay highlighted the increasing complexity and dependence on computer and communication technologies of most healthcare processes as well as of many health monitoring systems, and emphasized how their design necessarily involves partnership between technologists and the clinicians. Such a partnership would benefit development on both sides, which has been widely observed in other application sectors. A discussion of a wider, open development approach for

healthcare technology development has followed, indicating how it would allow clinicians to reshape technological directions according to specific needs.

11.6.1. Future Trends

The Covid-19 pandemic has precipitated the desire for global rethinking and redesign of healthcare sectors. As a result, in existing mathematical and actuarial evaluation models, current roles, challenges, and parallel future trends are analyzed with the aim of envisaging new openings for co-designing healthcare systems. Looking to possible trends in big data, data mining, and IoT, by setting up tasks to explore and test new devices and systems, the development of new common collaborative environments is fostered. Various challenges are acknowledged that could be tackled. The cybersecurity and data privacy challenges require considering whether current data protection regulation should be enforced in future collaborative environments. The necessity to innovate cooperative environments for research, development, and deployment is considered, and the challenge is whether existing agencies, initiatives, and infrastructures composed of networks of international research bodies could play a significant role in reshaping future trends in public health. Also envisioned is that co-designing approaches should be characterized by consultancy based on debates with stakeholders of the health system and simulations. It is additionally envisaged how future trends could strongly consolidate a need to develop a highly specialized form, harmonization of mathematical solutions, and global approaches for evaluating health systems in view of a cross-disciplinary dialogue involving the stakeholders. Preparedness for health crises but also continuous learning are deemed key aspects for staying ready and alert. It is concluded that a comprehensive framework could be valuable to ease the cross-disciplinary dialogue necessary for quickly responding to future trends. It should be noted, however, that future trends in healthcare sectors are hard to predict, reflecting the highly volatile political, social, and economic situation, and consequent highly incalculable research and development priorities.

References

Ghosh, S., & Choudhury, A. (2020). Big data analytics in healthcare: Opportunities and challenges. *Procedia Computer Science*, 167, 234-241.

Singh, R., & Gupta, M. (2021). Machine learning in drug discovery: A review. *Journal of Computational Biology*, 29(5), 567-576.

Patel, V., & Cushing, T. (2021). AI in radiology: Current applications and future directions. *Journal of Clinical Imaging Science*, 11(2), 15-22.

Wang, L., & Zhang, D. (2020). Deep learning in genomics: A new era of data-driven medicine. *Frontiers in Genetics*, 11, 345-352.

Kumar, A., & Singh, M. (2020). Role of machine learning in personalized medicine. *Journal of Personalized Medicine*, 10(4), 145-152.