Telepathology Implementation Challenges and Benefits: A Scoping Review

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Abstract

Telepathology is fundamentally altering the way pathology is delivered. As of today, research has paid a good deal of attention to technical feasibility and diagnosis accuracy, but less to other aspects essential to telepathology project success. The objectives of this review are to provide an overview of non-technical telepathology research and present a research agenda for future efforts. The proposed framework identifies two main thematic areas: telepathology benefits, expressed in terms of accessibility of care, quality of care and economic efficiency; and telepathology implementation challenges, expressed at the individual, organizational and legal levels. Researchers should strive to assess benefits through more rigorous methodologies and use more existing theories and frameworks to explain telepathology implementation challenges and success.

1. Introduction

Telepathology is a small but rapidly growing part of the telehealth market. More than $200M have been invested in telepathology equipment products [1], and the European market was assessed at $35 million in 2009, with an expected compound annual growth rate of 27% until 2016 [2].

Pathology is the "scientific field concerned with the study of the nature and causes of diseases" [3]; pathologists perform the essential role of diagnosing diseases such as cancers. The first permanent digital systems were pioneered in the 1980s. In this article, telepathology is defined as "performing pathology using digital images" [4], a simple definition covering several applications. First, a pathologist can provide a distance *primary diagnosis* to a place that has no pathologist. Intraoperative examination enables a diagnosis to be provided immediately during surgery. For a *second opinion* (or expert referral), a difficult case is sent by a pathologist for confirmation or subspecialist advice. Other applications include *quality assurance* and *education* (including training and research).

Unlike most forms of telemedicine, telepathology does not require the patient's presence, which makes it a more dematerialized and potentially asynchronous form of telemedicine. Teleradiology, telepathology's close cousin, does not require the patient's presence either, but its transition to digital is much less complex. While radiologists were already used to working with non-digital images, pathologists have traditionally worked directly with physical slides. Tellingly, the physical slide retains legal value and must be archived in most jurisdictions. Moreover, the transition to telepathology adds extra steps to the process and involves laboratory technicians and surgeons performing tasks that previously devolved onto pathologists, such as manipulating large pieces of tissues. Telepathology, more than other forms of telemedicine, involves radical changes in processes, collaboration and responsibilities and, hence, it requires a specific investigation.

Despite these specificities, research has so far focused on technical feasibility issues, addressing technical implementation concerns such as picture definition, bandwidth, hardware selection, and IT architecture (see [5] for a state-of-the-art status report). The second prominent theme is diagnosis accuracy, or "how accurate are all diagnoses made via telemedicine, and how does this level of accuracy compare with diagnoses made through conventional medical care?" [6]. Overall, this stream suggests that telepathology diagnoses are acceptable [7], though no systematic reviews have been identified (see [8] for a summary).

But as Furness and Bamford [4] note, "As technology advances, and as prices fall, the main barrier to implementation is increasingly a resistance to change amongst the humans rather than the limitation of the machines" (p. 281). These issues have elicited sustained interest, but the overall picture is difficult to grasp. First, these questions are

978-1-4799-2504-9/14 $31.00 © 2014 IEEE
DOI 10.1109/HICSS.2014.355

often addressed through anecdotal evidence in the discussion section of articles focusing on medical and technical concerns. Second, telepathology implementation questions are multifaceted, involving pathologists' behavior, organizational processes, financial concerns and regulations. These challenges appear idiosyncratic and hard to address with traditional medical research methods. As a result, the non-technical literature on telepathology is diverse and fragmented in methods as well as in concepts.

The objectives of this review are twofold: to synthesize the extant literature on telepathology implementation and benefits evaluation and propose a research agenda to guide future efforts in this domain. In the next section, the method that guided the review process is introduced. The third section presents a general profile of the sample. In the fourth section, the themes emerging from the literature are presented and summarized. Lastly, we discuss the main findings and propose a research agenda to orient future efforts.

2. Methodology

Scoping reviews "aim to map rapidly the key concepts underpinning a research area and the main sources and types of evidence available" [9]. They are relevant to domains with emerging evidence [10], to "extract the essence of a diverse body of evidence, giving it meaning and significance" [11], as they focus on breadth rather than in-depth analysis. All study designs are included in scoping reviews [9], and there is no assessment of quality in the primary studies [10]. This review follows Arksey and O'Malley's framework [9] which is composed of five steps: 1. Define the research question, 2. Identify the relevant studies, 3. Select the articles, 4. Chart the data, 5. Collate, summarize and report the results.

Two databases were queried, namely, Medline and ABI Inform. The following keywords were used: telepathology, digital microscopy, virtual microscopy, distance pathology, digital macroscopy, digital pathology, digital slide, virtual slide and whole slide imaging. Only peer-reviewed articles and conferences were considered. The search was performed on January 30, 2013. Medline returned 1,248 articles while ABI Inform returned 167. Our focus was on implementation challenges and benefits evaluation and, hence, we excluded articles focusing on technical feasibility and diagnosis accuracy. The full screening process is represented in Figure 1. The final sample consisted of 161 articles published between 1992 and 2013.

Data charting describes a technique for synthesizing and interpreting qualitative data by sifting, charting and sorting material [12]. The coding scheme was designed *a priori* to cover the objectives, methods, context and nature of the articles. As Levac et al. note, "the nature and extent of data to extract from included studies is unclear" in scoping studies [10], so following their recommendation, the charting process was iterative. A single coder executed the coding using Zotero. Next, our findings (stage 5) are summarized; first, the profile of our sample is described; and then an in-depth thematic analysis [10] is conducted.

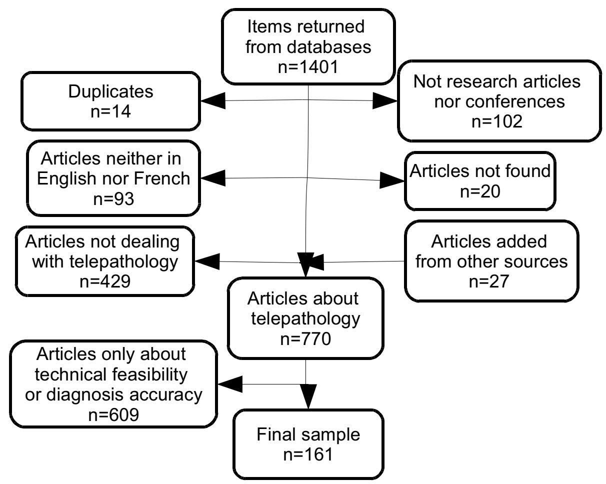


Figure 1. Diagram flow

3. Profile of the included studies

There is a clear upwards trend in telepathology research, from 5-6 articles a year in 1995-1999, to 8-9 in 2000-2010, up to 15 and 28 in 2011 and 2012, suggesting that as technology matures researchers' attention is turning to "non-technical" issues. Publication outlets, however, remain diverse; the 161 articles were published in 64 different publications, mostly in pathology journals (46%) and health informatics outlets (37%).

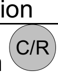
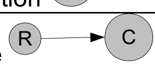
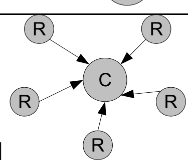
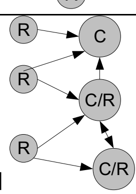
Less than half (44%) of the articles deal exclusively with telepathology applied to primary and secondary diagnoses (our sample did not allow a reliable distinction between them), while 31% are concerned with telepathology for education purposes. About 23% of the articles address various forms of telepathology applications.

One-third (34%) of the articles take the form of descriptive case studies. A typical article like this provides an account of a telepathology project and the lessons and observations derived from it, with no specific research question being addressed. The relative importance of this group of articles illustrates the exploratory nature of "non-technical" telepathology research. Further, 28% of the articles are evaluative in nature, while 38% are conceptual papers with no original empirical data.

Out of the empirical articles, 46% do not explicitly describe the source of the evidence presented, especially in descriptive case studies, where knowledge usually stems from the authors' first-hand involvement in the project. Empirical evaluative articles more systematically embrace a specific investigative method, with researchers using quantitative data in half of the empirical articles, mostly surveys.

The location of studies' evidence confirms the pre-eminence of Europe and North America (37% and 42% of empirical articles, respectively). There is also significant interest in international projects (16%) because of several developing-developed countries' partnerships, and because cross-border challenges, such as legal, cultural and sustainability issues, also draw researchers' attention. As shown in Table 1, we found a diversity of telepathology configurations in the extant literature.

Table 1. Telepathology configurations

Site configuration	% of articles
Single location 	23%
One to one 	21%
Centralized 	29%
Decentralized 	27%
C: consulting site; R: referring site	

In a *single location configuration*, slides are digitized in the context of a single setting, for local use only. Most of these sites use telepathology for education purposes, generally in a teaching hospital [10]. Telepathology can also be set up in single sites for quality assurance purposes [13].

In a *one-to-one configuration*, two healthcare institutions are connected; a consulting site provides pathology services to a referring site. This configuration is often used for experimenting with telepathology [14], providing quality assurance to a satellite organization [15] or substituting for a local or visiting pathologist [16,17].

In a *centralized configuration*, the most common form in our sample, a large institution usually provides pathology expertise to a set of smaller healthcare organizations. These are often more mature telepathology projects, such as a teaching hospital offering pathology consultations to sites located in a remote region [18,19], or in health care systems such as the US Veterans Integrated Service Network [20].

Lastly, the *decentralized* configuration connects multiple locations with no single hub for consulting pathologists (point-to-point network). In the Eastern Quebec project, for instance, a decentralized telepathology system extends pathology coverage to a whole region without a single consulting site [3].

4. Thematic analysis

We now turn our attention to the main themes investigated in the extant literature, namely, benefits evaluation and implementation challenges.

4.1. Benefits evaluation

Telemedicine projects are commonly assessed on their effects on accessibility of care, quality of care and economic efficiency, from the perspectives of patients, providers and society [21].

4.1.1 Accessibility of care. Accessibility in the healthcare context refers to "the relative ease or difficulty [for patients] in obtaining health services" [21] in the face of obstacles which can be geographic, economic, architectural or social [21]. Access to pathology is critical to enable the diagnosis of diseases such as cancer, and the absence of a local pathologist is palliated only by patient transfers, slow physical transfer of tissues, or a visiting pathologist, which generate delays, constraints on surgery planning and higher costs [3].

In most countries, pathologists are unevenly distributed as the presence of full-time pathologists may not be justified in low population density areas. Decentralized configurations (Table 1) in particular often widen access to pathology services in regions underserved in pathology [22] or prevent service loss when a pathologist leaves [23]. In fact, the earliest telepathology experimentations were conducted in scarcely populated areas such as Northern Norway.

Pathologists are also unevenly distributed around the globe, with half of trained pathologists residing in the United States, serving less than 5% of the world's population [1]. Telepathology has been used to provide pathology services to developing countries with no or limited access to pathology and subspecialty pathology [1,24], or to target a single service, such as tumour diagnostics, worldwide [25]. In sites with local pathologists, telepathology may also provide a substitute when the local pathologist is absent, sick or on vacation [26], or prevent service disruptions by sparing pathologists travels to remote locations [15].

Another frequently mentioned benefit associated with telepathology is better access to second opinions for isolated pathologists [27]. As the pathology discipline becomes increasingly subspecialized, we see increasing numbers of second opinions from subspecialists such as neuropathologists [28]. In the long run, telepathology may render pathology and its subspecialties available 24/7 by routing cases at night to pathologists in a different time zone [8,26], as is already observed in teleradiology. In short, while improved accessibility to health care services [28] is often claimed as a major benefit of telepathology, empirical evidence of such benefit is rather scarce and mostly anecdotal.

4.1.2. Quality of care. "As [telepathology] vendors struggle to make the case for adoption by examining the savings to be gained in efficiencies and the potential quality improvements in patient care, others point to the lack of added clinical value as the principal barrier" [5]. Still, telepathology offers some direct and indirect clinical value. First, it can directly impact quality of care. Intraoperative examinations, for instance, allow less numerous, more timely, better informed and less aggressive surgeries [3]. Second, telepathology has long-term unique possibilities in terms of image treatment and aids to diagnosis [29]. Third, the main benefit suggested in the extant literature is related to learning and expertise building, as particularly noticed in one-to-one telepathology configurations. The discussion to explain the diagnosis provides an educational benefit to the referring pathologist. Competence building may even be the main goal in some cases, such as in telepathology projects in developing countries [30]. Pathologists in reference centres also benefit from telepathology through specialization [16]. Indeed, for "subspecialists to work together in a critical mass is essential for them to preserve their diagnostic and scientific acumen" [14]. Future research is required to investigate the extent to which these promises are effectively fulfilled.

4.1.3. Economic viability and efficiency. Economic benefits associated with telepathology are difficult to monetize [31], and they have not been investigated systematically enough [32]. Still, telemedicine projects increasingly need to be assessed and evaluated in economic terms [33].

From a cost perspective, hardware, software and support contracts costs are easy to monetize and, hence, the most often cited [29,34], along with costs of technicians, networks, and data storage [35].

Prior research has also identified cost reductions for healthcare organizations. The most prominent and widely cited saving is on pathologists' salaries when a full-time expert is not justified [16,28]. Telepathology also enables economies of scale and optimization of resources such as laboratories, microscopes and equipment [36]. Finally, it can reduce costs for slide transfer and archiving [35], although such gain is often downplayed as relatively minor, given that slides still need to be stored and archived for legal reasons [53].

Telepathology can also lead to increased productivity by reducing the effort and time required by pathologists to provide a diagnosis through easier and faster access to patient files [13], especially for case slide re-consultation, and reduced travel time for pathologists [36]. Time can also be saved by automating certain repetitive activities in slide processing, cytology screening or quality assurance [29]. These benefits depend on which perspective is taken. It can be faster for the consulting pathologist receiving the virtual slide but longer and require more effort for the referring clinician tasked with the scanning [37]. For students, time can be saved on accessing slides [38].

From a revenue perspective, a few healthcare institutions have invested in telepathology to increase the income generated by their leading specialists [31,39] and to boost their staffing levels by reducing their travel time [15].

One key finding is that no specific benefit stands out in the extant literature. "Telepathology slides, unlike the transition to digital radiology, have no immediate and readily identifiable payback that resonates with the holders of the purse-strings" [5]. Only telepathology for educational purposes consistently appears to offer benefits at all levels, improving access to learning materials faster and at a lower cost, and leading to improved learning and satisfaction from students. While some researchers argued that profitability is not a goal and should not be expected [e.g., 13], two approaches or methods have been proposed to investigate the economic viability of telepathology projects, namely, cost-effectiveness analyses and cost-benefit analyses [21,33].

In a *cost-effectiveness analysis*, telepathology costs are compared to those of alternative solutions providing equal quality service, such as sending slides by courier or keeping an onsite pathologist [17,37,41]. The business case is essentially financial, with telepathology offered as an economically efficient substitute; it fits smaller one-to-one and centralized configurations with pre-existing ties between a centre and a dependent site for benchmark. Findings suggest that profitability is context-dependent, such as activity level or distance between two sites. A long distance favors telepathology over courier [42], as does a medium level of activity: for low activity levels, courier may be preferable because of telepathology's high set-up costs; for high activity levels, a resident pathologist may be justified. However, decreasing IT costs mean that most existing findings are already obsolete [41], and such analysis has so far largely been limited to one-to-one telepathology configurations.

In a *cost-benefit analysis*, costs and benefits are both assessed using standardized measures, including operational elements of cost, time savings and enhanced patient care [e.g., 41]. Benefits are maximized when the medical conditions (e.g., tumors) the system is used to detect have a high incidence, high risk in case of early detection failure (or high benefits of early detection), and are not trivial [6]. We posit that more cost-benefit analyses are required at this stage of technology adoption and diffusion, especially since accessibility of care represents a key motivation for investing time and money in telepathology projects. This would require taking a more comprehensive and long-term approach to benefits evaluation, including changes in pathology practices and in broader healthcare structures [56].

4.2. Telepathology implementation challenges

Once a decision to invest in telepathology is made, practitioners face a variety of implementation challenges beyond technical ones. Indeed, telepathology projects represent sociotechnical changes that require overcoming various challenges and barriers [39,43,44]. As shown below, such challenges can be found at various levels, namely, individual, organizational and legal.

4.2.1. Individual level. Telepathology implementers need to ensure that targeted users (i.e., pathologists and technicians) and their counterparts (i.e. surgeons) accept the new system and/or work environment. Attitudes of pathologists towards telepathology have been largely investigated for a long time [40]. As in other forms of telemedicine, project champions play a key role in overcoming implementation challenges and ensuring overall acceptance [39]. Laboratory technicians are also concerned with telepathology, especially in intraoperative examinations [45]. Surprisingly, their views and reactions have hardly been taken into account in prior research. Surgeons, finally, are often the direct requesters of telepathology diagnoses and need to actively solicit telepathology and be convinced of its usefulness. Their views and attitudes toward telepathology also need more thorough investigation.

Referring clinicians are asked to use telepathology to make complex clinical decisions, so they need to trust not only the technology but also the other stakeholders involved in the process. Trust in the system is crucial, as shown in the extant literature on diagnosis accuracy; but it also involves other issues such as confidentiality, security and privacy [46] which would deserve more attention in future research. Pathologists can be reluctant to base a diagnosis on images sent by another pathologist [47], technicians need to trust distant pathologists to guide them through the digitization process, and surgeons mistrust the diagnosis of a pathologist they may not be familiar with. To build that trust, face-to-face introductions of pathologists [14], capping the number of healthcare entities a single pathologist interacts with [48], and more generally defining roles clearly [49] may help. The introduction of telepathology can have a positive effect on interpersonal trust between the connected sites [16]. Prior research has shown that trust is associated with IT use [50], a finding whose application to telepathology needs to be investigated.

While pathologists in general find telepathology acceptable to perform various pathology duties [51], attitudes towards telemedicine remain polarized [78]. This has been explained by fear that telepathology "could turn pathology services into a geographical unbounded community" [34], and by the significant changes in practice involved [31]. To alleviate these concerns, researchers have suggested focusing not on the system but on the needs of the users, for instance by involving medical opinion leaders supporting the project on governance boards [18]. Usability, training and support are also critical to ensure acceptance. Each of these will be discussed in turn.

First, a major and recurring usability concern is that telepathology can be time consuming [40], a widely investigated topic. Although the long-term potential to enable time savings was mentioned, in most cases telepathology slows workflows by adding steps to the pathology process. It requires logging into a patient file, scanning slides, uploading and downloading the virtual slide and navigating through a not always ergonomic application, as opposed to simply picking a slide, positioning it in a microscope and focusing on the area of interest in a matter of seconds [31]. While the switch to teleradiology reduces efforts and delays for radiologists, a similar switch increases them for pathologists, which may partly account for telepathology slower diffusion.

Second, telepathology also changes the way pathologists, laboratory technicians and surgeons work. Familiarity with the system and training reduce resistance and improve efficiency [28,31]. The learning is about technology, but also about adapting to the new practices involved: surgeons to the immediate availability of pathology, and pathologists to cooperating with distant colleagues [23]. Surgeons and laboratory technicians need to be trained to take over some pathologists' roles in referring sites, and the laboratory technician training curriculum requires specific adjustments in telepathology environments [52]. Training has been shown to improve interpersonal communication in virtual teams [53]. Given that interpersonal communication represents an issue in telepathology projects, more research must be conducted on the nature and effectiveness of the training strategies in use.

Third, technical support helps ensure that clinicians and technicians who are less familiar with IT are not dispirited or stopped by technological hurdles. Support is provided at two levels. For one thing, targeted users need to have access to qualified people to troubleshoot problems and ensure the system is operational and reliable whenever needed [28]. Further, health care organizations need to partner with reliable IT providers to support and update the systems [54], and to tailor the technological solutions to their particular needs. More research must be devoted in order to better understand the role of mediating institutions (e.g., consulting firms, integrators) in helping healthcare organizations overcome technological knowledge barriers [39] when implementing telepathology.

4.2.2. Organizational level. Organizational challenges refer to issues such as financing, workflows reengineering and accountability. Each of these challenges will be discussed in the following paragraphs. For one thing, financing involves two distinct challenges: first, funding the upfront investment and second, and possibly more difficult, funding operational expenses [44]. Each stakeholder needs to be properly compensated, be it in state-funded healthcare systems [54] or in private systems [39]. The issue is generally simpler for single location projects (like educational telepathology) and one-to-one configurations (Table 1). The issue becomes more complex and, consequently, more widely investigated for centralized and decentralized configurations, as they are larger and have more mature projects [44]. As investment is spread over more institutions [55], the issue of running costs becomes more prominent, and divergence of interests is more likely between multiple stakeholders. Several authors take a prescriptive stance in response, asking for governments to step in and finance telecommunication costs [19]. Further research needs to clarify viable financing models in both public and private health care systems.

Second, the introduction of telepathology involves the revision and modification of existing workflows and processes [23,56]. A telepathology system is both a content management tool and a collaborative platform connecting non-experts (referring clinicians) to experts (pathologists or subspecialty pathologists) [49]. As a content management tool, the system is increasingly embedded in existing clinical information systems and their workflows [7], such as laboratory information systems or electronic medical records. This involves interoperability questions requiring considerable integration efforts [53] and harmonization of standards and practices [57]. As a collaboration tool, the system should provide functionalities such as working drafts and prioritization [58], and above all assign cases efficiently. In that regard, three distinct models of case assignment are suggested [8]. First, in the subspecialty model subspecialist pathologists directly sign out centralized cases. It is considered an appropriate model for large and centralized institutions (see Table 1) with sufficient staffing of subspecialty experts, like the Armed Forces Institute of Pathology [20]. Second, in the case triage model, a pathologist assesses the case and, if need be, routes it to a subspecialty pathologist. As a single pathologist is needed, it is adequate for one-to-one or small centralized configurations (Table 1). Third, in the virtual group practice model, cases are assigned automatically on the basis of pathologists' characteristics, such as availability or relevant experience. It is mainly used to provide specialty pathology services to underserved organizations [23] and is appropriate for decentralized configurations.

Lastly, telepathology raises a series of accountability issues relating to information privacy, contractual arrangements with other organizations involved and the extent of coverage provided. One particular salient issue is whether the consulting pathologist is accountable for the diagnosis [15]. In expert groups, consulting pathologists commit to diagnoses. This is appropriate for more structured configurations such as centralized or one-to-one configurations (Table 1), where the institutions are integrated and are able to set up the conditions to transfer accountability across sites. Expert groups can further be structured into expertise centres [25], where pathologists have a rotation duty plan ensuring a continuity of service. Alternatively, in discussion groups, consulting pathologists do not necessarily reach a conclusive diagnosis, leaving the final interpretation and diagnostic accountability to the referring clinician. Discussion groups are relevant for decentralized configurations such as the iPath project [24].

4.2.3. Legal level. "Telepathology, as seen by the lawyer, is characterized by a geographical distance between the tissue or specimen to be evaluated and the pathologist himself" [59]. In such a context, which regulations apply, those of the consulting or of the referring site? Constituencies with an interest in telepathology, such as rural states or regions with underserved populations, have advanced laws, while other places are lagging behind [60]. Another essential legal matter is related to remuneration, as current regulations do not always allow telepathology reimbursement [14,61]. Other legal issues include licensing requirements [14,26], data protection and privacy laws and consent rules [59]. Overall, as many as "58% of pathologists may [feel] that the medico-legal implications of duty of care [are] a barrier to [telepathology] use" [62].

5. Discussion

Research in this particular area needs to move away from the exploratory/anecdotal mode and descriptive accounts to address in a rigorous manner a series of unanswered questions pertaining to telepathology implementation and benefits.

One area of improvement can be in leveraging existing theories. Indeed, telepathology research considered in this review is largely atheoretical, with only seven articles in our sample explicitly applying theories or conceptual models. For instance, the widely cited Delone and McLean's IT success model was used to investigate technology benefits [3]. For its part, the Technology Acceptance Model (TAM) served to explain telepathology adoption among pathologists [63]. As a final example, the theory of knowledge barriers was used to better comprehend telepathology implementation challenges [39]. Next, we propose some directions for future research in this area along with examples of theories that could serve as potential conceptual lenses.

For one thing, telepathology requires appropriate communication and collaboration between health care professionals who are geographically distant. In that sense, it represents a form of virtual teams. As presented earlier, telepathology projects can aim at different objectives and adopt various configurations. We believe that the nature of these projects needs further clarification so that researchers as well as practitioners can better differentiate among different configurations of telepathology projects and, hence, better identify the particular challenges associated with each arrangement. Precisely, we posit that prior work on virtual teams can guide such groundwork in order to allow for a deeper understanding of this novel form of work arrangements in the health care sector. As alluded earlier, another promising research avenue is related to the notion of mutual trust, which has also been extensively investigated in prior research on virtual teams [64]. In the context of telepathology, given that physical slides possess legal value, the role of mutual trust between pathologists, surgeons and technicians during intraoperative exams, for instance, becomes even more central.

Adopting a socio-technical lens or framework, as suggested by Orlikowski and Iacono [65], would also definitely help in understanding several of the challenges associated with telepathology implementation, such as the emergent changes in technology, workflows, roles, and accountability [66]. The more complex forms of telepathology configurations (Table 1) represent appropriate settings for investigating these topics more deeply. On a different note, given the idiosyncratic nature of telepathology projects, we posit that the concept of organizational mindfulness could also contribute to a deeper understanding of how complex telepathology projects are successfully implemented [67].

Lastly, we suggest that more rigorous evaluative research is also needed to determine the extent of improvement in accessibility of care. This requires quantifying the number and importance of cases in which telepathology provides care otherwise unavailable to patients by assessing the variations in terms of number of surgical procedures cancelled, medical complications or surgical procedures performed in two stages due to the absence of pathologists, and the extent to which telepathology actually substitutes for a local pathologist [3]. Research in multiple settings will also help refine under what conditions (site configuration, distance to the nearest pathologist, medical conditions treated, level of activity) telepathology is most valuable.

6. Conclusion

This scoping review provides an initial indication of the size and nature of the available knowledge about the benefits and implementation challenges associated with telepathology. These topics have not been explored comprehensively before into a single review. Our findings highlight the singularity of telepathology issues and challenges compared to those of other forms of telemedicine such as teleradiology. Our analysis also indicates that various telepathology configurations exist and that conclusions and recommendations should not be generalized across all types of telepathology projects. Instead, we encourage researchers to adopt a multidimensional view of telepathology configurations in order to compare empirical findings, accumulate knowledge and, ultimately, provide practitioners with a useful framework to help them implement telepathology effectively.

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