

Teleconsultation and Clinical Decision Making: a Systematic Review

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ABSTRACT

Background: The goal of teleconsultation is to omit geographical and functional distance between two or more geographically separated health care providers. The purpose of present study is to review and analyze physician-physician teleconsultations. **Method:** The PubMed electronic database was searched. The primary search was done on January 2015 and was updated on December 2015. A fetch and tag plan was designed by the researchers using an online Zotero library. **Results:** 174 full-text articles of 1702 records met inclusion criteria. Teleconsultation for pediatric patients accounts for 14.36 percent of accepted articles. Surgery and general medicine were the most prevalent medical fields in the adults and pediatrics, respectively. Most teleconsultations were inland experiences (no=135), and the USA, Italy and Australia were the three top countries in this group. Non-specialists health care providers/centers were the dominant group who requested teleconsultation (no=130). Real time, store and forward, and hybrid technologies were used in 50, 31, and 16.7 percent of articles, respectively. The teleconsultation were reported to result in change in treatment plan, referral or evacuation rate, change in diagnosis, educational effects, and rapid decision making. Use of structured or semi-structured template had been noticed only in a very few articles. **Conclusion:** The present study focused on the recent ten years of published articles on physician-physician teleconsultations. Our findings showed that although there are positive impacts of teleconsultation as improving patient management, still have gaps that need to be repaired.

Key words: remote consultation, telemedicine, teleconsultation, decision making

1. INTRODUCTION

Teleconsultation is defined as synchronous or asynchronous consultation using information and communication technology to omit geographical and functional distance. Its goals are for diagnostics or treatment between two or more geographically separated health providers (for example physicians or nurses) or between health providers and patients (1). “Remote consultation” is the superior term of teleconsultation in MeSH (Medical Subject Headings) and is defined as “Consultation by remote telecommunications, generally for the purpose of diagnosis or treatment of a patient at a site remote from the patient or primary physician”(2). A closer look at published articles in this field shows that authors use the “teleconsultation” for 3 reasons:

- Both sides are health providers [e.g., who may need a second expert opinion]

- Physician–physician consultation (3-5)
- Physician–primary care provider (PCP) communication, like nurses (6)
- One side is health provider and another side is the patients [e.g., for tele-monitoring or tele-visiting]
- Physician – patient relationship (7)
- PCP–patient relationship (8, 9)
- Tripartite communication among physician – PCP – patient (10).

In this review, we are going to distinguish between these types of teleconsultations and focus only on the remote consultation between two or more physicians. The goals of these teleconsultations are different and include second expert opinions, tele-management, referrals, and so on.

If teleconsultation is established cor-

rectly, good outcomes like timely access to correct medical information, quality improvement of the diagnosis and treatment process, increased physician trust, and significant improvement in the total quality of health care will result. Similar to every other type of consultation, the requesting physician, who is present at the patient's location, must collect sufficient and correct information for the remote consultant physician (11). Good and optimum communication between these physicians consists of exchanging related clinical information as well as patient preferences and values (12). This is of great importance especially in resident – supervising physician communication and is considered a critical factor of patient safety (13, 14). Due to the lack of the physical presence of the consulted expert, his/her final diagnostic or treatment decision is based only upon information received from the consulting physician. Hence, the quality of the decision depends directly on the quantity and quality of information received. Some researchers have suggested solutions such as sending medical documents like photographs and video images (15) or improving the quality of images (16) to increase the definiteness of timely diagnosis.

Review studies in the field of teleconsultation have been done. Verhoeven (2007) assessed benefits and deficiencies of teleconsultation and video conference regarding clinical, behavioral, and care coordination outcomes of diabetes care for inpatient-caregiver interaction (17). Brebner (2006) also has reviewed studies for technical feasibility, clinical effectiveness, cost effectiveness, and level of local management in accident and emergency teleconsultation (18). The effect of telemedicine on diagnostic and therapeutic decisions (19, 20), e-mail based telemedicine articles (21) and evidence on electronic communications between health care providers (22) were reviewed as well. According to authors' knowledge, there is no systematic review on physician-physician teleconsultations with a focus on the decision making process. So the purpose of present study is to review these types of teleconsultation and to cover the following topics: type of technologies that have been used, specialty level of physicians, time and geographical distribution, medical field, and teleconsultation outcomes and structure.

2. METHOD

Database: The PubMed electronic database was searched. As Bahaadinbeigy (2010) mentioned, this database covers a considerable amount of published articles in the field of telemedicine. Three top specialized journals of the telemedicine field: "The Journal of Telemedicine and Telecare", "E-Health and Telemedicine Journal", and "International Journal of Telemedicine", as well as IEEE journals are indexed in MEDLINE (23).

The primary search was done on January 2015 and was updated on December 2015. Furthermore, review articles that were primarily about teleconsultation had their reference lists searched for additional relevant articles. A hand search of the table of contents of "The Journal of Telemedicine and Telecare", "E-Health and Telemedicine Journal", and "International Journal of Telemedicine" was also done to identify relevant papers, concurrently. An attempt was made to contact a particular expert in the telemedicine field if any other related paper was available. Concepts and keywords that were used

to perform the search tasks are listed in Table 1.

Target concepts	Matching keywords
Teleconsultation	Teleconsultation, Teleconsultation, Remote consultation Electronic consultation, Econsultation, E-consultation, Email consultation Real time consultation, Real-time consultation
Telemedicine	Telemedicine, Telehealth, Tele health, Telecare, Tele care

Table 1: Concepts and keywords

Search script is described in Table 2.

("Remote consultation"[MeSH Terms]) AND (teleconsultation OR teleconsultation OR econsultation OR e consultation OR email consultation OR electronic consultation OR real time consultation OR telemedicine OR telehealth OR tele health OR telecare OR tele care) Filters: published in the last 10 years; Humans; English

Table 2: Search script

Study selection criteria: Studies were included in this review if they: (1) focused on physicians, both as the consultation requester (solely or with other health care providers) and consultant, (2) reported a real-not simulated-medical consultation for real patients that occurred between two or more physicians, (3) published within the recent 10 years, (4) were in English, and (5) had an available abstract. Retrieved studies were excluded if they were: (1) review studies, expert opinions, editorials, or repeated articles from the same authors, or interventions (only the most updated or final version was included), (2) only a telephone-consultation, and (3) published only as an abstract (as for a conference proceeding).

Paper Selection: A fetch and tag plan was designed by the researchers to manage the screening process. According to this plan, an online Zotero library was created and shared among the researcher. Then, the result from the search script injection into PubMed was inserted into the library. The scan and select process was conducted by two independent investigators (K.B. and K.D.) and was based on titles and abstracts of articles. If there was a conflict about inclusion and exclusion in this process, the full text document was assessed. All retrieved records were tagged with pre-planned keywords (for example: tag "Ti_Rej" used as equal to reject by title). Then, the full text version of all possibly-relevant records were analyzed. The inclusion and exclusion criteria described above were applied more strictly in this level again, and disagreements were resolved by the third researcher's decision (M.T.). Using the Zotero library again, all the accepted records were tagged for geographical location, medical fields, type of technology, specialty level of physicians, type of consultation effect, and the presence of a structured template for consultation.

Data extraction strategy: The concept and data extraction process was conducted using a Microsoft Excel-based form listing all the required information, including first author, year, geographical location, medical domain, consulting person/group, consultant person/group, and specialty level of physicians, type of consultation effect, and the presence of a structured template for consultation. The first author (K.D.) extracted the required information from the included articles into this form using Zotero tags. Other authors reviewed the completed form and made corrections when required.

3. RESULTS

A bibliometric review process was performed to analyze the articles. The primary search was done using MeSH terms and a list of suggested keywords. But the primary results indicated lack of sufficient specificity. The researchers iteratively improved the script and assessed the new results until the status in which everybody was satisfied. Total number of retrieved records was 1544 at the beginning and 1702 after the search update. Finally, 174 full-text articles were selected and analyzed. The selection process is shown in Figure 1 and titles of selected articles are listed in Appendix 1.

Time:

The most retrieved records belong to the years 2011 and 2013, but the most accepted articles belong to the years 2012 and 2013. Number of accepted articles in 2015 is less than others; it may be due to the time consuming process of article indexing in PubMed (Figure 2). In overall, although the ten year trend shows a slight eventual rise in both numbers of publication types, we did not find any specific pattern, justifying some rises and falls.

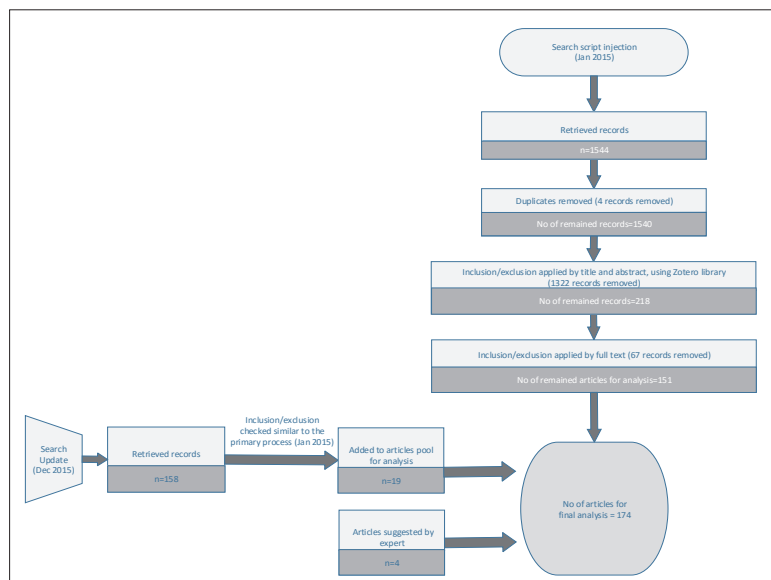


Figure 1 – Selection process of articles

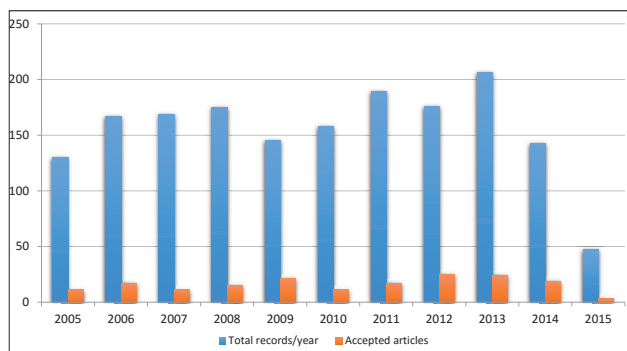


Figure 2 – Time distribution of total retrieved records and accepted articles per year

Medical fields:

Teleconsultation for adult and pediatric patients accounts for 85.63 and 14.36 percent of accepted articles, respectively. Surgery, general medicine, mixed consultations, and stroke were the most prevalent medical fields in the adult group, and general medicine as well as cardiology was the most prevalent

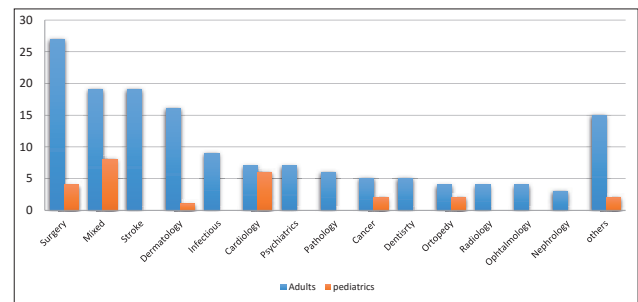


Figure 3 – Medical fields in adult and pediatric group

in pediatrics (Figure 3).

Geographical aspects

Transboundary teleconsultations

Some teleconsultations were not limited within a specific country's borders; rather they took place as consultations between two or more countries. These account for 22.5 percent (no = 39) of accepted articles. About half of the articles in this class (no=21), belonged to teleconsultations between physicians of a specific country as the requesting consultees and physicians of the responding country as the respondent consultants. Requesting consultants belonged to a wide range of countries; from developing to developed. Teleconsultations that occurred between European or European-American countries were mainly second opinions between experts like tumor boards (5), remote neuro-monitoring during aortic surgery (24), and to identify anatomic landmarks (25). All of them were of real time (RT) teleconsultation type. In one case, the consultation was performed as a multicenter cooperation to obtain second opinions about cancer (26).

Another class in this group was teleconsultations that were established between physicians of developing countries and experts from developed countries. Requesting countries in one third of the articles in this class were from Africa varying in medical fields like pediatrics (27, 28), orthopedics (4), surgery (29), and infectious disease (30). In addition, experiences of teleconsultation between Antarctic stations with their supporting countries (31-33) or geographically remote islands with other countries were reported (34-37).

Sometimes the requesting countries were more than one. For example, Italian hospitals located in 22 different countries were connected to a network of health centers in Italy (38) or physicians working in resource-limited settings who submitted their diagnostic or management queries form to ITM (–Institute of Tropical Medicine) experts by email or in a discussion forum (39). About one third of articles in this class were related to teleconsultations that occurred to support deployed health care providers who were located in austere combat environments and served as military or non-military personal in different countries (e.g., Iraq and Afghanistan) (40-46)

In some teleconsultations, more than one country acted as responders. In one case, several surgery, oncology, and pathology experts from one African country sent their queries and experts of the same or related medical fields from around

Medical Fields	Adult				Pediatrics			
	RT	SF	Both (RT and SF)	NS	RT	SF	Both (RT and SF)	NS
Burn	--	--	1	--	--	--	--	--
Cancer	3	2	--	--	2	--	--	--
Cardiology	4	1	2	--	5	--	1	--
Chronic	1	--	--	--	--	--	--	--
Dentistry	4	1	--	--	--	--	--	--
Dermatology	2	12	2	--	--	1	--	--
EMS	--	--	1	--	1	--	--	--
Endoscopy	1	--	--	--	--	--	--	--
ethics	1	--	--	--	--	--	--	--
gynecology	1	--	--	--	--	--	--	--
Infectious	6	3	--	--	--	--	--	--
metabolic	--	1	--	--	--	--	--	--
microbiology	1	--	--	--	--	--	--	--
Mixed	5	6	7	2	4	2	2	--
N/s	1	--	--	--	--	--	--	--
Nephrology	--	2	1	--	--	--	--	--
Occupational medicine	--	--	1	--	--	--	--	--
Ophtalmology	--	4	--	--	--	--	--	--
Ortopedy	2	2	--	--	--	1	1	--
pathology	3	2	1	--	--	--	--	--
psychiatrist	5	--	2	--	--	--	--	--
Pulmonology	1	1	--	--	--	--	--	--
Radiology	1	1	1	1	--	--	--	--
Speech pathology	1	--	--	--	--	--	--	--
Stroke	17	--	1	--	--	--	--	--
Surgery	11	10	4	1	3	--	1	--
toxicology	--	1	--	--	--	--	--	--
Transplantation	--	1	--	--	--	--	--	--
ENT	--	--	--	--	1	--	--	--
Total	71	50	24	4	16	4	5	0

Table 3: Frequency and technology method used for teleconsultations based on medical fields in adult and pediatrics

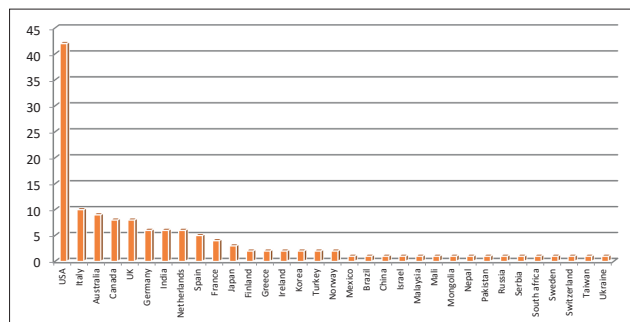


Figure 4: Geographical distribution of Inland TCs

the world responded to them (47). In another case, teleconsultation was performed to identify the anatomic landmarks during surgery (25).

Some of the experiences were international teleconsultations, in which several countries participated as requesting or as responding countries. More often, the queries were from physicians of resource-limited origins and were responded to by a network of international experts. All of such cases were asynchronous and web-based teleconsultations (48-51).

Inland TCs

A considerable amount of teleconsultations were inland experiences (77.5%, no=135), and the USA, Italy and Australia were the three top countries in this group (Figure 4).

Specialty level of requesting physicians

Non-specialists (GPs, medical residents, PCPs, deployed health care providers, and general dentists) or general hospitals were the dominant group who requested teleconsultation (74.7%, no=130). Specialist-specialist consultations account for 25.3% of teleconsultations cases we found across the literature.

Technology

Real time, store and forward, and hybrid technologies were used in 50, 31, and 16.7 percent of articles, respectively. Stroke (in adults) and cardiology (in pediatrics) were the medical fields with the most use of RT technology. On the other hand, dermatology (in adults) and mixed consultations (in pediatrics) mostly used SF technology (Table 3).

Teleconsultation effect on the decision of requesting physician

The effect of teleconsultation on the decision of the requesting physician was mentioned clearly only in 45 percent of articles. The teleconsultation were reported to result in change in treatment plan, referral or evacuation rate, change in diagnosis, and educational effects (Figure 5). High quality and rapid decision making (16), shortening diagnosis time, faster and better patient management (52, 53), diminishing the length of hospitalization and intensive care stay (53), improving the accuracy of triage (54), anxiety reduction, educational value (55), increasing the confidence (56-58), and reducing the amount of unnecessary procedures (59) were some of the effects of teleconsultation on the requesting physician side.

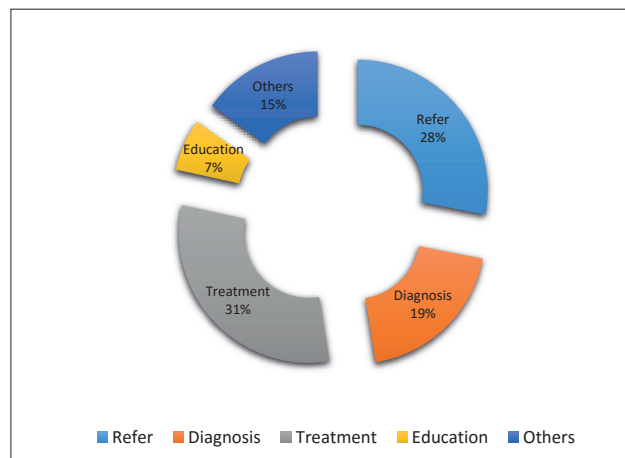


Figure 5: Reported effects of teleconsultation on requesting physician

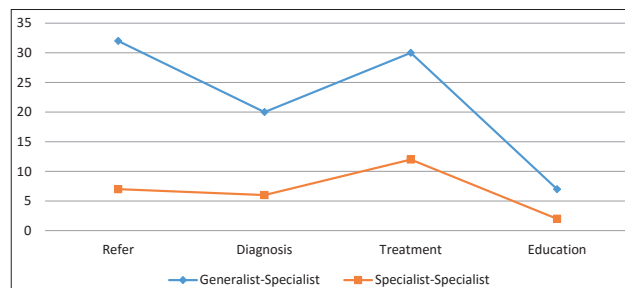


Figure 6: Reported effects based on specialty level of teleconsultation parties

As seen in Figure 6, teleconsultation between two levels of centers/experts (general physician or hospital with a specialist center/physician) was more effective for referrals (mostly reducing referrals) and treatment decisions, respectively. How-

ever, when specialist-specialist teleconsultation occurred, teleconsultation affected and changed the treatment and then referral decisions.

Teleconsultation structure

Use of structured template for teleconsultation had been noticed only in five articles. Of them, two were in the teledermatology areas that used a semi-structured form (60) and an online structured pre-consultation questionnaire (mostly to educate medical trainees) (61). In another case, a web-based structured format to upload patient-related information was established to determine the effect of teleconsultation in cases of strabismus (48). In two other cases, a structured interview was performed in acute stroke care by telephone consultation (62) and a standardized query form (including all relevant clinical information) were designed for teledermatology consultation (52).

4. DISCUSSION

In this review, 174 physician-physician teleconsultation articles were analyzed. The results showed that there was widespread distribution in the time, location, and medical field of the selected articles.

We expected to find an upward trend in the number of published telemedicine and teleconsultation articles during the recent 10 years; however, no such trend was found.

Although teleconsultations were performed for patients of different age groups, less than 15 percent of them were for pediatrics. Surgery, general medicine, and mixed fields were the most frequent topics in adult teleconsultations. This was valid for general medicine and pediatric cardiology. Surgery teleconsultations were performed mainly by sending the radiology images, videos, or clinical pictures in order to reduce unnecessary patient transfer or travel and other related costs, and also aid rapid decision making in some cases. In the stroke field, the goals of teleconsultations were often reduction in the pre/in-hospital time interval to start treatment interventions and prevention adverse outcomes. Positive results of teledermatology teleconsultations were cost-effectiveness, good decision triage, and high diagnostic accuracy.

More than two thirds of teleconsultation studies were in-land experiences, but there was no meaningful relationship between the number of final articles and geographical distribution of the linked countries. Transboundary teleconsultations were classified into consultations between two specific countries (about half of them), one country with several other countries, or several countries with several other countries.

In some articles, both the requesting and responding physicians were on the same specialty level (specialist-specialist consultations); however, more frequently this was a generalist-specialist relationship (GPs/medical residents/general hospitals with specialist physician/third level hospitals). This finding was expected because access to expert opinions is one of the most important purposes of teleconsultations. Some of the specialist-specialist teleconsultations were done as group discussions and teleconferences.

Stroke (in adults) and cardiology (in pediatrics) teleconsultations used only RT technologies and this may be due to the urgent nature of diagnosis and treatment in these medical fields. Hersh (2006) believed that using videoconferencing and RT technologies are more effective in medical fields

that need verbal interactions (20). Our findings indicate that adult teledermatology consultations were done using store and forward methods mostly due to the non-urgent nature of this field and simplicity of the store and forward method. This finding is in accordance with Hersh's study (2006) that showed store and forward methods have been used in several specialties; the most common being dermatology and wound care (20). A systematic review by Caffery et al. (2010) also showed that e-mail based telemedicine has been commonly used in many medical fields that needed low-bandwidth Internet and were image-based for tele-diagnosis as dermatology, pathology, wound care, and so on (21). Validity of diagnosis and improvement of patient management are some of the outcomes of image-based telemedicine systems for injury emergency care, too (63).

Less than half of the studies (45%) reported explicit effects of teleconsultation on the decision of the requesting physician. The most common effects included changes in the treatment/management plan, referral/evacuation rate, and in primary diagnosis, respectively. A few studies have indicated the educational effects of teleconsultations on requesting physicians. The mentioned effects were more obvious when there was a training-learning relationship between teleconsultation parties (4, 61, 64) such as medical residents and the supervising expert. Confidence improvement of the requesting physician (in diagnosis or caring) was one of the most important reported effects. Confidence rate was reported up to 90 percent in telephone consultations (58) and 96 percent for video conferences (56). Quality of exchanged data like images had a notable impact on achieved confidence (57). High quality and rapid decision making was another effect that referring experts reported in the teleconference experience (16). Reducing the length of hospitalization and intensive care stay were some of the other impacts of teleconsultations, which were mentioned in a prospective, multicenter cohort study (53). Shortened diagnosis time, faster and better patient management (52, 53), improving accuracy of triage (54), reduces anxiety, educational value (55), Increased confidence (56-58), reduced amount of unnecessary procedures and improved level of patient management (59) were some of other effects of teleconsultation on requesting physician.

It is important to consider that in this section, we only assessed the studies that particularly noted the clear effects of teleconsultations on physicians. There were several studies that did not report a specific effect or were focused on topics such as user/patient satisfaction (38, 60, 64-69) or cost (34, 70-73). As such papers were mostly based on subjective judgments, authors decided not to represent them in this paper.

And finally, while both requesting and responding physicians demonstrated their dissatisfaction from the current consultation/referral process and unstructured, low-quality of exchanged data (74-76), there were few studies that mentioned the structured format for teleconsultations (77-79). In addition, inadequacy of information is one of the main problems that was highlighted by specialists to provide an opinion. So using a more structured clinical template might improve this process (51).

5. CONCLUSION

The present study focused on the recent ten years of published articles on physician-physician teleconsultations.

Increasing access of remote patients to specialized health care is one of the goals of using telemedicine. Hence, we assumed more teleconsultations occurred between general physicians/centers with specialized experts/centers. This assumption was confirmed according to our results.

Despite our efforts to identify a clear pattern of data and information exchange between consulting parties, only in a few articles a semi-structured or structured template was used. In addition, there were no descriptions on the fields' selection process or definition of fields' format and so on.

Our findings have shown that although there are positive impacts of teleconsultation as an educational influence, improving patient, still have gaps that need to be repaired.

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