





# Collaboration Between Physicians from Different Medical Specialties in Hospital Settings: A Systematic Review

Anoek Braam , Martina Buljac-Samardzic , Carina GJM Hilders , Jeroen DH van Wijngaarden 

Health Services Management & Organisation, Erasmus School of Health Policy & Management, Erasmus University Rotterdam, Rotterdam, the Netherlands

Correspondence: Anoek Braam, Health Services Management & Organisation, Erasmus School of Health Policy & Management, Erasmus University Rotterdam, Bayle Building, P.O. Box 1738, Rotterdam, DR 3000, the Netherlands, Email braam@eshpm.eur.nl

**Abstract:** Health care today is characterized by an increasing number of patients with comorbidities for whom interphysician collaboration seems very important. We reviewed the literature to understand what factors affect interphysician collaboration, determine how interphysician collaboration is measured, and determine its effects. We systematically searched six major databases. Based on 63 articles, we identified five categories that influence interphysician collaboration: personal factors, professional factors, preconditions and tools, organizational elements, and contextual characteristics. We identified a diverse set of mostly unvalidated tools for measuring interphysician collaboration that focus on information being transferred and understood, frequency of interaction and tone of the relationship, and value judgements about quality or satisfaction. We found that interphysician collaboration increased clinical outcomes as well as patient and staff satisfaction, while error rates and length of stay were reduced. The results should, however, be interpreted with caution, as most of the studies provide a low level of evidence.

**Keywords:** systematic review, interphysician, collaboration, Physician, medical specialist, hospital

## Interphysician Collaboration in Hospitals: A Systematic Review of the Literature

Health care today is characterized by an increasing number of patients with comorbidities, rapidly growing medical knowledge and technological innovations.<sup>1,2</sup> Where medical knowledge and technological innovations create a movement towards increased specialization in different fields of medicine, comorbidities require a more integrated approach.<sup>3</sup> The long history of hospital structures based on medical disciplines contributes to a highly specific view of patients' problems.<sup>3-5</sup> Therefore, to provide diagnoses and treatment for complex multimorbid patients, collaboration, communication, and coordination between doctors from different specialties is considered essential.<sup>6-8</sup> In short, to cope with the rising demands of today's health care, interphysician collaboration in hospitals is inevitable.

The present literature on collaboration in hospitals often focuses on interprofessional teams defined as the collaboration between disciplines such as doctors and nurses, pharmacologists, and/or allied health professionals.<sup>3,9,10</sup> This interest in interprofessional collaboration in the literature is also evident from the recently published reviews focusing on diverse aspects of interprofessional collaboration. For example, Pomare et al<sup>11</sup> published a systematic review of key findings of interprofessional collaboration in hospitals demonstrating that interprofessional collaboration has a range of benefits for hospitals across the patient, staff, and organizational levels. These benefits include improved clinical outcomes, increased staff satisfaction, lower readmission rates, and reduced length of stay.<sup>11</sup> Additionally, Peltonen et al<sup>10</sup> published a systematic review that demonstrated that a large number of instruments have been developed to measure interprofessional collaboration, aiming to measure similar but distinct topics, such as professionals, teamwork, communication, supportive factors, collaboration and conflicts. Schot et al<sup>12</sup> showed with their systematic review that professionals actively contribute to interprofessional

collaboration by bridging multiple types of gaps, negotiating overlaps in roles and tasks, and creating spaces to do so. An earlier published review already indicated that collaboration is essentially an interpersonal process that requires the presence of a series of elements in the relationships between professionals on a team together, which include the willingness to collaborate, trust in one another, mutual respect, and communication.<sup>8</sup> However, in literature on interprofessional collaboration physicians are either represented as a single unified group or a specific group of physicians is studied. Interphysician collaboration and communication are addressed much less frequently in the literature and are not addressed in existing reviews. We define interphysician collaboration as any form of interaction for the purpose of patient care between physicians from different medical specialties. In which we take into consideration that collaboration may range from hand-off to formal consultation, to coprovision of care.<sup>13</sup>

Physicians all start out as medical students in the same program, but when they specialize, their professional identity is shaped by the behaviours of their peers and supervisors, the tasks and roles they are expected to fulfil and the specific context of their specialty.<sup>14</sup> The literature also shows that personality traits are related to choice of specialty.<sup>15,16</sup> As a result, different specialties exhibit different types of behaviour; for example, some are more likely to engage in nonconstructive behaviour or have different conflict styles for resolving issues.<sup>17,18</sup> The unique cultures of specialties and characteristics of medical specialists can cause miscommunication and tension that inhibits interphysician collaboration.<sup>19</sup> Physicians should therefore not be treated as a homogeneous group but as a diverse one that faces their own obstacles and challenges in collaboration. These challenges deserve attention, especially as interphysician collaboration becomes more important in the complex setting of hospital care.

## New Contributions

Despite attention to interprofessional collaboration in health care, the literature on health care is often focused on collaboration between physicians and nurses or allied health professionals. With more multimorbid patients, collaboration between physicians is inevitable. To the authors' knowledge, no systematic evaluation of current evidence on interphysician collaboration has been conducted yet. We therefore conducted a systematic review of interphysician collaboration in hospitals. Our aim is to provide an overview of the literature on interphysician collaboration by answering the following three questions:

What factors affect interphysician collaboration in hospitals?

How is interphysician collaboration measured?

What are the effects of interphysician collaboration on patient and hospital outcomes?

## Method

We searched for and reviewed articles that examined interphysician collaboration in hospitals. Studies were identified by systematically searching six electronic databases (Embase, Medline, Web of Science, Cochrane, PsycINFO, Google Scholar). The search strategy was designed in collaboration with a professional research librarian. The search combined terms from three categories: physicians AND collaboration OR communication (see [Appendix](#) for an example of the full electronic search strategy for all databases). The final search was performed on 12 June 2020.

## Criteria

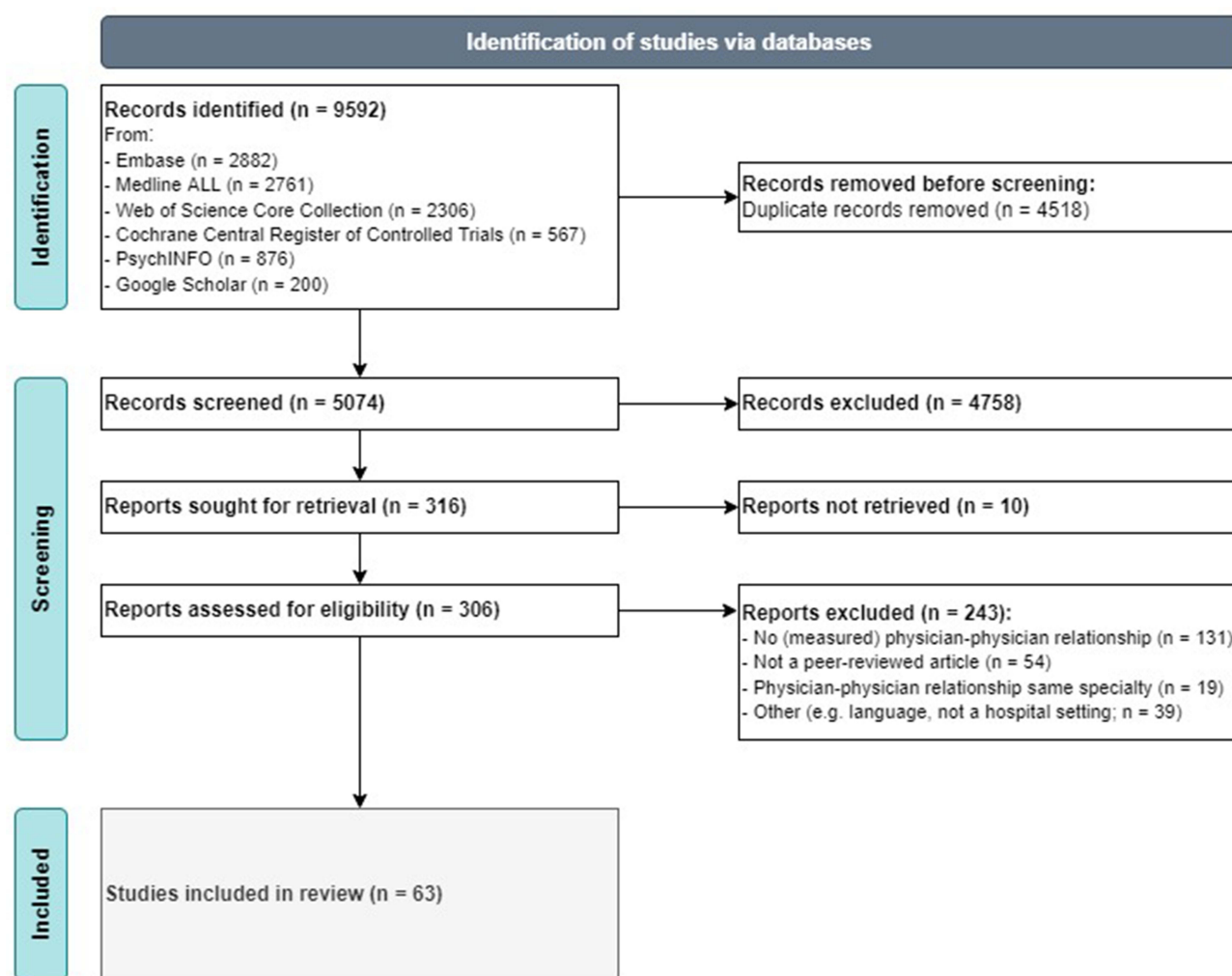
Studies were included if they met the following inclusion criteria:

- Focus of study: Studies that deal with interphysician collaboration, indicating what factors affect interphysician collaboration, measuring interphysician collaboration, introducing a form of collaboration, and articles pointing out the effect on health care of collaboration between physicians from different specialties. Studies in which "team" collaboration was researched and nurses or other health care personnel were included in the team were excluded when they did not specify the doctor–doctor collaboration.
- Field of study: Studies conducted within hospitals. We excluded studies that focused on interphysician collaboration between hospitals or between a hospital and another health care setting (eg, primary care).
- Study design: We included only empirical studies, with all empirical research designs. For example, theoretical papers or editorials were excluded.

- Publication status: To safeguard research quality, only studies published in peer-reviewed journals were included. Book chapters were excluded.
- Language: For transparency reasons, only studies written in English were included.
- Year of publication: We did not make any restrictions.

## Record Selection

The search resulted in 9592 articles. After excluding the duplicate studies, 5074 articles remained for screening. [Figure 1](#) summarizes the search and screening process according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.<sup>20</sup> The screening process consisted of two steps, for which we used Microsoft Excel. First, two researchers (AB and JW or MB) independently screened all records by scanning the titles and abstracts. Records were excluded if they did not meet the inclusion criteria. If the information provided in either the title and/or the abstract was not clear enough for a justified decision, the articles were included in the full-text screening phase. When the first and second readers disagreed, the third researcher also reviewed the article and decided whether to in- or exclude the article. This process resulted in 316 full-text articles being reviewed. Second, these 316 full-text articles were independently reviewed by two researchers (AB and JW or MB). Disagreements were discussed with all three researchers until consensus was reached. This process resulted in the inclusion of 63 full text articles.



**Figure 1** PRISMA 2020 Flow Diagram.<sup>20</sup>

## Data Extraction Process

We developed a data extraction sheet using Microsoft Excel, pilot tested it on ten articles and refined it accordingly. The first author extracted the data from the included articles. Data extraction included information on the study aim, methods used, an indication of which research question was answered, information about the type of interphysician relationship (eg, with a supporting specialty, a consultation or handover), the results of the study, and discussion of the results.

In the next step, these data were converted into result tables that answer the three research questions. As a first step, the first author used an inductive coding strategy for each research question separately. Emerging categories were discussed among three authors (AB, MB, JW). For the effects of interphysician collaboration, the example from interprofessional literature in health care was followed using the categories of patient, staff, and hospital, which was immediately agreed upon. After a few discussions, a satisfactory categorization emerged for the factors that affected interphysician collaboration, although one of the categories changed names multiple times from procedures and guidelines in the beginning to preconditions and tools in the end. The category on measurement was discussed on a number of occasions in which the first four categories, namely, climate and atmosphere, cooperative state of mind, connections, and cooperative behaviours, were developed. After testing this categorization, some extracted data did not seem to fit the descriptions given, and there was overlap between categories. An iterative process of modifying and rearranging categories was performed until a satisfactory categorization emerged that suited all extracted data.

For the effects of interphysician collaboration, we assessed the quality of evidence based on the Grading of Recommendations Assessment Development, and Evaluation (GRADE) scale. GRADE distinguishes four levels of quality of evidence (high, moderate, low, very low) based on study design. Studies can be upgraded or downgraded based on additional criteria, such as a high probability of reporting bias (downgrading) or strong evidence of association (upgrading).<sup>21</sup>

## Results

The search produced 9592 hits. After duplicates were removed, a total of 5074 hits were evaluated. First, the titles and abstracts were evaluated, resulting in the exclusion of 4758 articles. Second, the full texts ( $n = 316$ ) were reviewed, of which 253 articles were excluded because the focus of the study was not physician–physician relationships ( $n = 131$ ) or investigating relationships between physicians of the same specialty ( $n = 19$ ); the publication status ( $n = 54$ ); and other reasons (eg, language, field of study). Finally, 63 articles were selected for the analysis.

## Characteristics of the Included Studies

The included studies ( $n = 63$ ) were published between 1980 and 2020, but the majority were published in the last decade ( $n = 49$ ; 78%). Almost all studies were conducted in Western countries ( $n = 58$ ; 92%), and more than half of these were conducted in the United States ( $n = 37$ ). Approximately half of the articles ( $n = 34$ ; 53%) were published in a journal in the research domain of a specific specialty (eg, radiology, internal medicine, emergency medicine), highlighting the specificity of the conducted research. The other half included mostly journals within the field of health care services ( $n = 17$ ). Different configurations of collaboration were investigated within the studies, namely, consultation ( $n = 26$ ), handovers ( $n = 7$ ), and approaching a patient together ( $n = 19$ ). The remaining ten articles discussed collaboration in more general terms, not a specific configuration. Other distinctions found in the included articles are the specialties investigated, namely, generalists ( $n = 10$ ; eg, emergency department physicians, geriatricians), supporting specialists ( $n = 15$ ; eg, radiology, pathology), specific specialists ( $n = 17$ ; eg, cardiology, urology) or physicians in more general terms ( $n = 21$ ). Almost all studies made use of a quantitative research design ( $n = 58$ ), and most of these used survey data or medical records. Only five studies used either qualitative methods (case study, focus groups) or a mixed method design.

At the start of our review, we aimed to answer three questions. Only six of the included studies (implicitly) gave answers to all three. Twenty-one of the 63 studies only (implicitly) answered one of the questions. Thirty-six of the 63 studies (implicitly) answered two of the questions; in most of these cases ( $n = 22$ ), these studies indicated factors influencing interphysician collaboration and measured interphysician collaboration. The effect of interphysician collaboration for the patient or hospital was not addressed in these studies. Overall, the included studies not only showed a

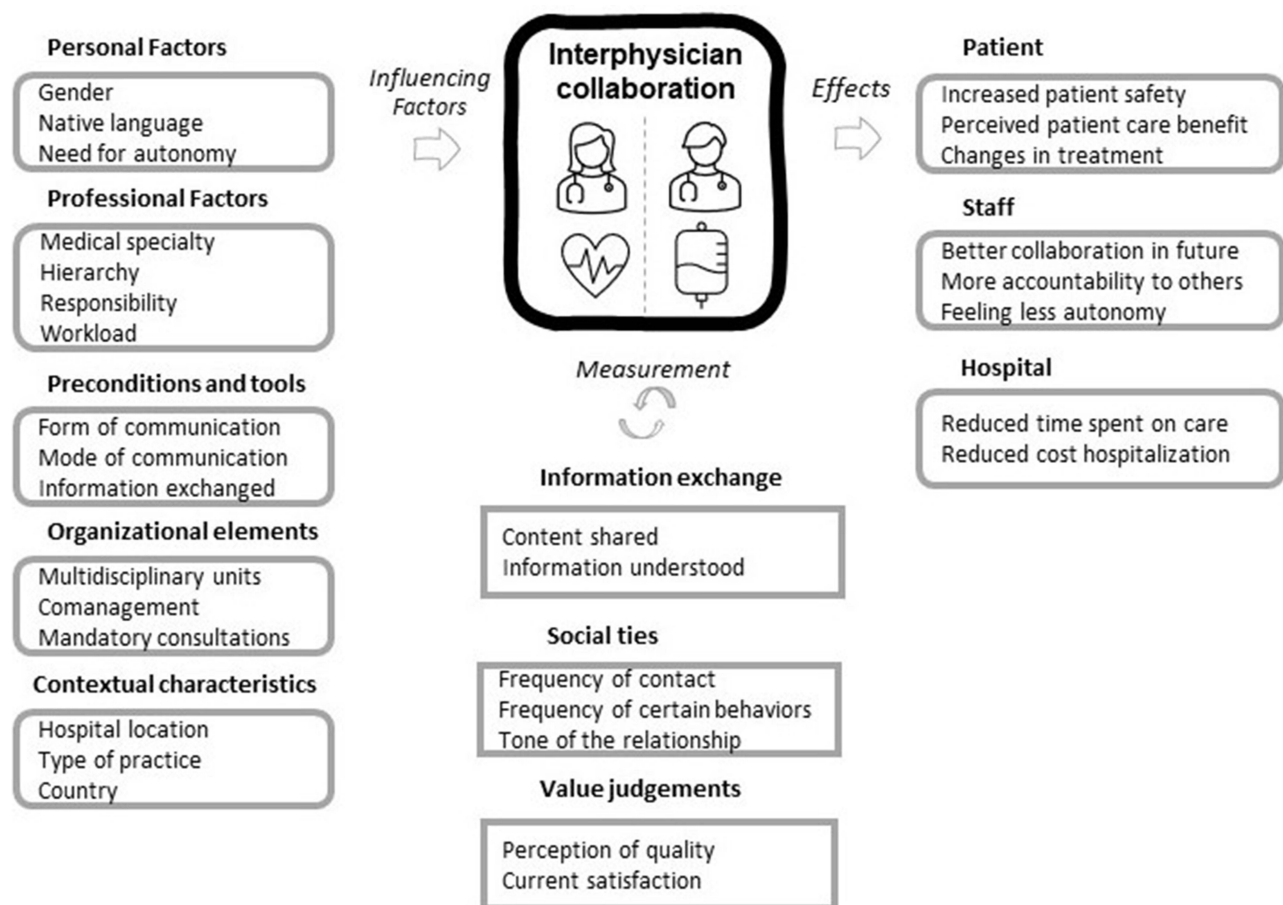
wide variety of focus but also discussed diverse topics. To better understand the differences and commonalities between these studies, we inductively coded their findings separately for each question. This resulted in a categorization of what factors affect interphysician collaboration based on 42 studies, of how interphysician collaboration is measured based on 47 studies, and of what the effects of interphysician collaboration are based on 22 studies (Figure 2; Table 1).

## Factors That Affect Interphysician Collaboration

The elements that influence collaboration can be categorized into five aspects: personal factors, professional factors, preconditions and tools, organizational elements, and contextual characteristics.

### Personal Factors

The characteristics of an individual linked with interphysician collaboration are gender, age, native language, need for autonomy, and one's own conflict style. Regarding gender, a female physician is more likely to be rated more positively than a male physician in terms of collaboration.<sup>31</sup> Additionally, a female physician is more likely to perceive incivility during a medical consultation.<sup>61</sup> However, being female is not found to affect how the communication atmosphere is perceived.<sup>26</sup> Physicians with higher levels of autonomy are more likely to describe the communication atmosphere as open and supportive,<sup>26</sup> but at the same time, a lower preference for the autonomy of physicians seems to be beneficial for interphysician collaboration.<sup>36</sup> Overarching conclusions on gender and autonomy are not possible due to the different contexts in which these are measured. A clearer picture can be presented for language, age, and image, although that picture is largely based on one or two studies. Not having the same mother tongue, or in other words being language discordant, makes interaction harder.<sup>23,34</sup> Age is not a predictor for interphysician collaboration.<sup>26,31</sup> Being concerned



**Figure 2** A visualization of influencing factors, measurement, and effects of interphysician collaboration.

**Table I** General Information on Categorization for Answering Questions on Inter-Physician Collaboration of the Included Studies (n = 63, in Chronological Order Based on Publication Year)

Reference	Study Characteristics					What we Learned About Inter-Physician Collaboration		
	Country	Study Design	Terminology	Specialties	Study Purpose	Influencing Factors	Measurements	Outcomes
Luke & Thomson (1980) <sup>22</sup>	USA	Chart Review (n = 183)	Consultation	Not specified	Exploratory examination of informal relationships among physicians	Groups having same reimbursement mechanisms are more likely to consult one another	Consultation frequency	-
Nakao & Axelrod (1983) <sup>23</sup>	USA	Survey (n = 100)	Communication	Not specified	Explore consensus as to meaning of adjectives and adverbs used to express frequency in the medical literature	Greater commonality of meaning among native (English) speakers	Communication interpretation	-
Ferguson & Rubinstien (1987) <sup>24</sup>	USA	Chart Review / Interviews (n = 85)	Consultation	Surgery/ Internal Medicine	Examine the practice of preoperative medical consultations in community hospital setting	-	Consultation quality	Changes in patient management (medication, laboratory test, procedure, anesthesia)
Leonard, Babbs, and Creed (1990) <sup>25</sup>	UK	Survey (n = 110)	Communication	Psychiatry	Examine written communication between psychiatrists and other hospital doctors	Preference for clear referral letters of about one page long with highlighted main points. Many physicians would like a personal discussion	-	-
Akre, Falkum, Hoftvedt, and Aasland (1997) <sup>26</sup>	Norway	Survey (n = 2628)	Communication	Not specified	Explore perceived communication atmosphere between physician colleagues in various arenas of Norwegian health care	Low degree of autonomy and high degree of stress are associated with interpersonal relationships not conducive to learning and coping	Communication atmosphere	-
Katz et al (1998) <sup>27</sup>	USA	Survey (n = 396)	Consultation	Cardiology/ Surgery/ Anesthesiology	Ascertain what surgeons, anesthesiologists and cardiologists is important to obtain from a cardiology consultation and the effect of cardiologists' recommendations on perioperative management	-	Consultation quality	Changes based on recommendations in preoperative and postoperative management, not in intraoperative management
Madjar et al (2001) <sup>3</sup>	USA	Survey (n = 229)	Collaboration	Urologists / Gynecologists	Examine differences among urologists and gynecologists' treatments and to characterize the collaboration between them	Statistically significant correlation between extent of collaboration and specialty and between degree of collaboration and country of practice	Collaboration (frequency, when, reasons not)	-
Dukerich, Golden, and Shortell (2002) <sup>28</sup>	USA	Focus Groups/ Survey (n = 1504)	Cooperation	Not specified	Examine relationships among physicians' organizational identification and cooperative behaviors	Organizational identification is positively related to engaging in cooperative behaviors.	Cooperative behaviors	-



Aminzadeh et al (2003) <sup>6</sup>	Iran	Chart Review (n = 110)	Consultation	Infectious disease specialist	Analyze current referral letters which request infectious disease consultation to improve consultation based on medical records	-	Referral letter content	Reduction of unnecessary and inadequate antibiotic use
Stoller & Striet (2003) <sup>29</sup>	USA	Survey (n = 181)	Consultation	Medicine / Surgery / Pediatrics	Assess clinicians' views on the determinants of effective inpatient consultation and the existing process of inpatient consultation	Direct physician-to-physician communication is valued when requesting and responding to an inpatient consult	Consultation value; Consultation satisfaction	-
Conley, Jordan, and Ghali, (2009) <sup>30</sup>	Canada	Chart Review (n = 188)	Consultation	Internal medicine	Determine percentage of consultation requests from general internal medicine that pose a clear clinical question to medical subspecialists, assess frequency of direct communication and describe differences in consultation process by subspecialty	Differences between subspecialties were seen (frequency consulted, urgency, direct contact) although not statistically significant	Consultation content	-
Hess, Lynn, Holmboe, and Lipner (2009) <sup>31</sup>	USA	Survey (n = 803)	Consultation Communication	Not specified	Evaluate a tool called the 'communication with referring physicians practice improvement module' which assesses and encourages improved communication among physician consultants and referring physicians	Consultants' communication were modestly associated with their gender and type of medicine subspecialty.	Communication quality	-
Apker et al (2010) <sup>32</sup>	USA	Tool development based on discourse analysis	Handoff Communication	Emergency / General Medicine	Develop and evaluate a handoff communication assessment tool.	-	Handoff content and language	-
Boulware, Dekarske, and Filice (2010) <sup>33</sup>	USA	Survey (n = 323)	Consultation	Not specified	Learn physicians' preferences for elements of an ideal inpatient medical consultation	Recommendations for effective consultation, first priority clearly state a question	-	-
Molleman et al (2010) <sup>9</sup>	Netherlands	Survey (n = 1827)	Multidisciplinary Team Meeting	Not specified	Examine consequences for medical specialists of participating in multidisciplinary medical team meetings in terms of perceived clinical autonomy, domain distinctiveness, and professional accountability	-	Involvement in multidisciplinary medical teams	Physicians more involved in multidisciplinary team meetings feel less clinical autonomy and more accountable to other specialties

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Table 1 (Continued).

Reference	Study Characteristics					What we Learned About Inter-Physician Collaboration		
	Country	Study Design	Terminology	Specialties	Study Purpose	Influencing Factors	Measurements	Outcomes
Gasiorek & van de Poel (2012) <sup>34</sup>	Sweden, Denmark, Germany, Italy, Belgium	Survey (n = 188)	Communication	Not specified	Explore language-discordant mobile medical professionals' interactions with other doctors across contexts.	A mobile medical professional have issues with communication including difficulty with small talk, pronunciation, nonverbal communication and related cultural norms. They are less confident speaking to superiors than speaking to peers	-	-
Kessler et al (2012) <sup>35</sup>	USA	Prospective randomized study (n = 43)	Consultation	Emergency / General Medicine	Evaluate whether a standardized consultation model in the emergency department would improve physicians' ability to relay appropriate information and communicate successfully during consultation	Residents trained in using a standardized model for clinical consultation received higher ratings for their effectiveness. No natural progression in consulting skills with increased experience was shown	Consultation effectiveness rating	-
Kirschbaum (2012) <sup>36</sup>	USA	Survey (n = 58)	Communication	Surgery / Anesthesiology	Examine communication variables that are associated with face-negotiation theory in a sample of operating-room physicians	Differences between the two groups of operating room-physicians which may result in different communication patterns. Both groups recognize the importance of collaboration as surgical team members	Factors underlying to communication (independence, interdependence, self-concern, awareness of others, conflict style)	-
Kirschbaum, Rask, Brennan, Phelan, and Fortner (2012) <sup>37</sup>	USA	Pre- and posttest survey (n = 44)	Communication	Obstetrics / Anesthesiology	Determine effectiveness of multidisciplinary team training on organizational culture and team communication	Nonsignificant variance between obstetricians and anesthesiologists. Significant variance from pretest and posttest suggesting the training used in the study can improve communication for more effective collaboration	Factors underlying to communication (independence, interdependence, self-concern, awareness of others, conflict style)	-
Orchard, King, Khalili, and Bezzina (2012) <sup>38</sup>	Canada	Tool development based on literature review	Collaboration	Not specified	Develop, test, and refine the assessment of interprofessional team collaboration scale	-	Discrete elements of interprofessional care (partnership, shared decision making, cooperation, coordination)	-



Carr et al (2013) <sup>7</sup>	USA	Rotation evaluation / Program leadership meetings / Survey (n =26)	Co-management	Pediatrics / Surgery	Describe a 5-year experience with a co-management model in a pediatric residency program	The dyadic model of transition led to positive changes in self-assessed preparedness to provide transition care and engage colleagues around the care of shared patients	-	Increased knowledge and trust between pediatric residents and surgeons
Nayak, Beaulieu, Rubin, Jafi, & Lipson (2013) <sup>39</sup>	USA	Survey (n = 160)	Communication	Radiology	Identify referring physicians' preferences about radiology reports and quantify perceived value of multimedia reports compared with narrative text reports	Radiology reports with embedded images are viewed favorably with potential for beneficial outcomes	-	-
Pimmer, Mateescu, Zahn, and Genewein (2013) <sup>40</sup>	Switzerland	Experiment (n =42)	Communication	Medical students	Determine the effects of different synchronous smartphone-based modes of communication	Simple integration of images did not lead to improved knowledge gains, whereas images with guided noticing did. Integrating images was significantly more positive evaluated for support than only speech.	-	-
Uddin, Hamra, and Hossain (2012) <sup>41</sup>	Australia	Data analysis (n = 85)	Collaboration	Not specified	Determine the effect of collaboration networks among healthcare professionals on patients' medical condition	-	Social network analysis	In hospitals where physicians are on average less strongly connected there are higher readmission rates and higher costs than in hospitals where physicians have a strong connection.
Uddin, Hossain, Hamra, and Alam (2013) <sup>42</sup>	Australia	Data analysis (n = 85)	Collaboration	Not specified	Explore physician collaborations using measures of social network analysis and exponential random graph model	-	Social network analysis	Increased links among physicians, more relationships to maintain is positively correlated with hospitalisation cost and readmission rate. In network with small number of actors with a major collaboration and communication role is correlated with lower hospitalisation cost and readmission rate
Anthoine, Delmas, Couterut, and Moret (2014) <sup>43</sup>	France	Tool development based on literature review / professional panel	Communication	Not specified	Develop and test psychometric properties of the communication and sharing information scale which assesses specifically interprofessional communication	-	Sharing of medical information, effectiveness communication	-

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Table 1 (Continued).

Reference	Study Characteristics					What we Learned About Inter-Physician Collaboration		
	Country	Study Design	Terminology	Specialties	Study Purpose	Influencing Factors	Measurements	Outcomes
Bruckel et al (2014) <sup>44</sup>	USA	Survey (n = 43)	Collaboration	Cardiology / Cardiac Surgery	Assess the prevalence of Heart Teams and their association with collaboration in routine practice	Improved subjective collaboration between surgeons and cardiologists at institutions with case conferences and heart teams	Collaboration (existence, satisfaction)	-
Gupta (2014) <sup>45</sup>	UK	Pre- and posttest data analysis (n = 494)	Multidisciplinary Team Work	Geriatrics / Orthopedic Surgery	Assess impact of a geriatrician-led comprehensive and collaborative hip fracture care on hip fracture outcomes	Care model improves multidisciplinary teamwork between geriatrician and orthopaedic surgeon	-	Significant reduction in time to surgery and in hospital length of stay
Kessler et al (2014) <sup>46</sup>	USA	Survey (n = 760)	Handoff	Emergency / General Medicine	Describe current status of inpatient handoff, describe training of resident on inpatient handoff, assess opinion about best practices for inpatient handoff	Handoff factors identified as important include identifying high-risk patients, designating interrupted time to perform the handoff, and standardizing information provided during handoffs	-	-
Rosenkrantz, Kiritsy, and Kim (2014) <sup>47</sup>	USA	Survey (n = 49)	Communication	Several	Evaluate the degree of variability in clinicians' interpretation of expressions used by radiologists to communicate their level of diagnostic confidence within radiological reports	-	Communication interpretation	-
Hewett, Watson, and Gallois (2014) <sup>48</sup>	Australia	Survey (n = 147) / Interviews (n = 10)	Communication	Not specified	Explore medical records through the lens of communication accommodation theory	Specialists asked to contribute to the care of patients under the care of another specialty underaccommodate when communicating with treating specialists	Communication understanding	-
Bradley et al (2015) <sup>15</sup>	UK	Survey (n = 606) / Focus group	Communication	Not specified	Explore experience with rude, dismissive and aggressive communication in hospitals	Seniority is relatively protective against rudeness. A subset of predictable specialties are more likely to be rude, dismissive, or aggressive in their communication. Happens because of workload, lack of support, culture	Frequency and effects of rude communication	When exposed to rude, dismissive, aggressive behavior mistakes are made endangering patient safety and making staff feel sad, angry and demotivated
Fatahi, Krupic, and Hellström (2015) <sup>49</sup>	Sweden	Focus groups	Consultation	Radiology	Study radiologists' experiences of written and oral communication with referring clinicians and its potential implications for decision making and patient care	Radiologists emphasize sufficient use of a communication tool. And a preference for oral instead of written communication	-	-

Kirschbaum et al (2015) <sup>16</sup>	USA	Pre- and posttest survey (n = 85)	Communication	Anesthesiology / Surgery / Obstetrics / Gynecology	Measure the effect of multidisciplinary communication training on latent variables of communication	Significant increase and decrease in scores supporting more participatory communication and teamwork after training, especially among surgical physicians. Variance in pre training scores of conflict style for each physician group. After training all physicians integrating style approximately same and higher than pre-training	Factors underlying to communication (independence, interdependence, self-concern, awareness of others, conflict style)	-
Mazurenko & Hearld (2015) <sup>50</sup>	USA	Survey (n = 4720)	Communication	Not specified	Examine the relationship between a medical practice's external environment and physician engagement in communication activities	Higher income levels and an urban location are associated with higher odds of communication with other physicians	Time spent on communication	-
Sadigh et al (2015) <sup>51</sup>	USA	Survey (n = 200)	Consultation	Radiology	Evaluate referring physicians' perceptions of multimedia-enhanced radiology reporting as an alternative to traditional text-only radiology reporting	Favorable opinions of added value of multimedia-enhanced reporting	Satisfaction	-
Smith et al (2015) <sup>52</sup>	USA	Survey (n = 126)	Handoff	Emergency / General Medicine	Assess physicians' perceptions of the ED admission handoff process and identified potential barriers to safe patient care	-	Communication quality	Ineffective handoffs harm patients
Aripoli, Fishback, Morgan, Hill, and Robinson (2016) <sup>53</sup>	USA	Pre- and posttest survey (n = 115)	Collaboration	Radiology / Internal Medicine	Determine if incorporating radiology residents into clinical rounds would strengthen relationship between radiology residents and referring clinicians	Introduction of the "radiology rounds" increased face-to-face communication and clinical collaboration	Collaboration (relationship initiation, trustworthiness)	Perceived patient care benefits. Increased trust of referring clinicians in radiologists and increased credibility of radiological interpretations
Dickerson et al (2016) <sup>54</sup>	USA	Patient review (n = 100)	Communication	Radiology / Surgery	Determine if direct in-person communication between acute care surgical team and radiologists alters surgical decision making	-	-	After multidisciplinary meeting discussing patients substantial changes in patient management, not due to different interpretation of imaging
Golab et al (2016) <sup>55</sup>	Poland	Case study	Communication	Surgery	Determine whether a 3D model helps to plan and perform a complicated surgery	The 3D model helped draft a surgical plan that was accepted by all surgical teams involved with urology and cardiac surgery teams	-	Using the 3D model increased patient safety, facilitated communication between surgical teams and reduced surgery duration
Gulacti, Lok, Hatipoglu, and Polat (2016) <sup>56</sup>	Turkey	Consultation observation (n = 519)	Consultation	Emergency medicine	Evaluate WhatsApp messenger usage for communication between consulting and emergency physicians	-	Consultation content	-

(Continued)

Table I (Continued).

Reference	Study Characteristics					What we Learned About Inter-Physician Collaboration		
	Country	Study Design	Terminology	Specialties	Study Purpose	Influencing Factors	Measurements	Outcomes
Heidemann et al (2016) <sup>57</sup>	USA	Pre- and posttest survey (n = 110)	Consultation	Not specified	Characterize the scope, identify root causes and implement a data-derived solution for the problems related to difficulty identifying correct consulting physicians	Introduction of a unified university hospital paging system	Satisfaction	Physicians concluded that the opportunity to contact the right physicians decreased adverse outcomes, increased satisfaction, improved the process, and decreased delays in patient care
Hollingsworth et al (2016) <sup>58</sup>	USA	Data analysis (n = 251630)	Teamwork	Not specified	Test whether teamwork among physicians is a determinant of surgical outcomes	-	Social network analysis	Higher levels of teamwork are associated with significantly improved clinical outcomes, lower readmission rates, less emergency department visits, and lower mortality
Junker et al (2016) <sup>59</sup>	Germany	Experiment (n = 7)	Consultation	Radiology / Urology	Evaluate the accuracy of PIC-MABP for locating suspicious prostate lesions when applied to mpMRI datasets	The PIC-MABP is a reliable system to enhance interdisciplinary communication of mpMRI findings between radiologist and urologist	Communication understanding	-
Landgren, Alawadi, Douma, Thomas, and Etchegaray (2016) <sup>60</sup>	USA	Survey (n = 88)	Communication Speaking up	Pediatrics	Examine reasons reported by pediatric residents for not speaking up about safety events when they are observed in practice	Most common barrier to speaking up was a lack of interpersonal skills. Second most frequently reported reason for silence were related to safety of speaking up, including intimidation, fear of consequences and hierarchy concerns	Safety and team work culture	-
Shetty, Vaghasiya, Boddy, Byth, and Unwin (2016) <sup>61</sup>	Australia	Survey (n = 40)	Consultation	Emergency medicine	Determine frequency and factors influencing perceived incivility during emergency department phone calls	Women were more likely to report perceived incivility. Consultation made to surgical specialties carried increased risk for incivility compared to medical specialties though not reaching statistical significance. Consultation with radiology for imaging requests were associated with the highest risk for incivility.	Grading consultation (positive, neutral, negative)	-
Chung, Jasien, and Maslow (2017) <sup>62</sup>	USA	Pre- and posttest survey (n = 71)	Collaboration	Pediatrics / Internal medicine	Educational innovation to improve pediatrics and adult medicine residents' interdisciplinary communication and collaboration	Dyadic model with pediatrics and internal medicine for transition of patients with chronic medical illnesses, neurodevelopmental disorders and mental health conditions is well received	-	Dyadic model resulted in increased comfort in communicating with colleagues from other disciplines

Kapoor et al (2017) <sup>63</sup>	USA	Pre- and post data analysis (n = 363)	Collaboration	Intensivists	Report the impact of collaboration between cardiologists and noncardiac intensivists on CICU outcomes	The implementation of a collaborative cardiologist-intensivist management model increases communication between cardiologists and noncardiac intensivists	-	Implementation of a mandatory medical intensivist consultation resulted in decreased mortality, increased 28-day ventilator free days, significant reduced length of stay and reduction of hospitalization charge
Matta, Nunez-Atahualpa, and West (2017) <sup>64</sup>	USA	Call observation	Consultation	Radiology	Install a communication software that was customizable, to solve problems that radiologists encounter contacting other physicians	Implementing the software tool increased physicians satisfaction with radiologists; communication and availability	Satisfaction	-
Real, Fields-Elswick, and Bernard (2017) <sup>65</sup>	USA	Survey / Assessment (n = 51)	Communication	Several	Explore whether mindful residents perform better than their peers as members of the health care team	Communication had overall robust relationships with mindfulness	Communication (openness, voice, feedback)	-
Afifi, Person, & Haddad (2018) <sup>66</sup>	Israel	Pre- and post data analysis (n = 212)	Communication	Pathology / Surgery	Evaluate the impact of dialogue between surgeons and pathologists in lymph node evaluation	Initiation of a structured oncology service enhanced dialogue between surgeons and pathologists	-	The dialogue resulted in significant improved examination of lymph nodes, significantly improving the percentage of patients receiving adequate staging of their cancer
Bhatti, Brown, Kazerooni, & Davenport (2018) <sup>67</sup>	USA	Survey (n = 188)	Communication	Radiology	Explore sentiments of radiology and referring provider residents with respect to the delivery and receipt of directly communicated radiology test results	Referring residents prefer direct communication of radiology results even for non-urgent unexpected findings, whereas radiology residents prefer less direct communication		
Gonzalez et al (2018) <sup>68</sup>	USA	Chart review (n = 1234)	Communication Handoff	Emergency / General Medicine	Develop and test a handoff communication tool and a standardized process for transitioning patients from emergency department to hospital inpatient service	Implementation of the developed handoff tool improved communication between specialties	Satisfaction with communication tool	Nonsignificant decrease in transfers to intensive care unit and number of rapid response team calls. Significant decrease in time to inpatient order. Satisfaction with the process improved confidence regarding accuracy and timeliness of information provided
Korbl, Wood, and Harvey (2018) <sup>69</sup>	Australia	Survey (n = 262)	Consultation	Pathology	Assess the attitudes of pathologists, dermatologists, surgeons and general practitioners as to what circumstances warrant telephone contact in addition to standard written report	-	Communication frequency Communication preferences	-

(Continued)

Table 1 (Continued).

Reference	Study Characteristics					What we Learned About Inter-Physician Collaboration		
	Country	Study Design	Terminology	Specialties	Study Purpose	Influencing Factors	Measurements	Outcomes
Macaluso et al (2018) <sup>70</sup>	Italy	Survey (n = 79)	Consultation	Pathology	Explore the interplay between clinicians and pathologists for the diagnosis and management of inflammatory bowel diseases in clinical practice in Italy	The presence of a specified pathologists was higher in high-volume centers compared to low-volume centers. Clinical trials are also more frequent in high-volume centers.	General interplay	-
Smith et al (2018) <sup>71</sup>	USA	Pre- and post scoring (n = 110)	Handoff	Emergency / General Medicine	Evaluate impact of a structured communication strategy on the quality of admission handoffs	Introduction of standardized handoff process resulted in improvements in verbal handoff quality	Handoff content	Physicians perceive that higher quality handoffs will benefit patient care
Wetterauer et al (2019) <sup>72</sup>	Switzerland	Experiment (n = 200)	Communication Consultation	Radiology	Investigate whether newly developed structured reports of prostate magnetic resonance imaging can improve interdisciplinary communication as compared to non-structured reports	Potential of improved communication between radiologist and urologist by the use of structured reports	Communication understanding	Communication with structured reports leads to fewer mistakes and lower re-consultation rate
Bowen et al (2020) <sup>73</sup>	USA	Interview (n = 94)	Communication Handoff	Not specified	Clarify in what situations and for what reasons current physicians do or do not communicate with transferring physicians about transitioned patients for whom transferring physicians are no longer responsible	Barriers to communication were structures such as opposite work schedules and competing patient care priorities, relationship factors such as hierarchy and previous challenging experiences, lack of communication culture. Changing clinical decision or uncertainty are opportunities for learning, but only uncertainty was significantly associated with communication	Communication frequency	-
Lama, Hogg, and Olson (2020) <sup>74</sup>	USA	Survey (n = 240)	Communication	Radiology	Compare and contrast the perceptions, experiences and other factors that influence communication behaviors about diagnostic errors between clinicians and radiologists	-	Communication frequency (diagnostic errors, feedback)	-
Noh et al (2020) <sup>75</sup>	Korea	Chart review (n = 152)	Collaboration	Surgery	Compare postoperative sinonasal quality of life and olfactory function in patients who underwent endoscopic pituitary surgery by a neurosurgeon or by a collaborative team of surgeons	-	-	Postoperative subjective and objective olfactory function was better for patients where operation was performed by collaborative team of surgeons. Quality of life was not significantly different for both groups

Shaarani et al (2020) <sup>76</sup>	Lebanon	Survey (n = 429)	Consultation	Not specified	Investigate the prevalence of WhatsApp use as an interprofessional communication tool among Lebanese physicians and explore the dimensions of its use	-	Frequency of using WhatsApp	-
Sheikh et al (2020) <sup>77</sup>	USA	Survey (n = 64)	Communication	Pathology	Survey dermatologists on how well pathologists communicate with them to assess which aspects of pathologists' communication skills are deemed most significant stratified by practice type	University affiliated dermatologists used electronic medical records more often to communicate with pathologists. Satisfaction with mode of communication was not different at a statistically significant level between different practice types	Satisfaction (communication, quality, completeness)	-
Mascia, Rinninella, Pennacchio, Cerrito, and Gasbarrini (2021) <sup>78</sup>	Italy	Survey (n = 20) / Clinical data (n = 222)	Multidisciplinary team	Not specified	Describe patterns of face-to-face versus electronic-based communication networks and performance, measured as promptness of treatment implementation	Electronic communication tools, which are generally viewed as an efficient way to support knowledge exchange, can instead be detrimental, especially when tacit knowledge must be transferred in multidisciplinary teams	Frequency clustering	-



about others' image in a conflict situation makes you more likely to be collaborative.<sup>36</sup> Feelings of incompetence hold people back from speaking up.<sup>60</sup>

## Professional Factors

Factors associated with interphysician collaboration relating to the profession are the medical specialty, hierarchy, responsibility, and workload/stress. Hierarchy and a large workload seem to be inhibiting factors for collaboration between physicians. A high workload or perceived stress makes people more likely to exhibit rude behaviours,<sup>15</sup> creates time constraints for communication,<sup>49</sup> and makes the communication atmosphere more negative.<sup>26</sup>

Physicians with a higher position in the medical hierarchy are more likely to express negative behaviours, and for those lower in the hierarchy, it is harder to speak up to someone at a higher level.<sup>15,34,60,61,73</sup> For a physician to communicate with other physicians, he should feel responsible and see the added value of sharing information, for example, because it improves patient safety or it has a learning effect.<sup>15,49,73</sup> In eight studies, a difference between medical specialties was found, with some being more prone to collaborate or rated higher for collaboration and others more likely to express negative behaviours.<sup>3,15,16,26,31,36,37,61</sup> A clear overview of which medical speciality is more likely to be collaborative cannot be provided, as most studies only focus on some specific specialties. Remarkably, specialties that are more likely to engage in negative behaviours (radiology, surgery, cardiology) are more often the targeted specialties in studies.

## Preconditions and Tools

Research shows preconditions for successful interaction between physicians, mostly related to consultations or handoffs. The first step is often trying to find and reach the proper physicians.<sup>29</sup> The literature showed unified paging systems and software to be helpful.<sup>29,57,64</sup> In physician-to-physician communication, the form of communication, mode of communication, and information communicated are important. When consultation takes place, information that needs to be communicated is relevant clinical patient information,<sup>25,49,68,71,77</sup> a clear question to the consulting physician,<sup>25,29,33,49,68</sup> and the urgency of the request.<sup>33,46,68</sup> Different tools seem successful in supporting this, including the DE-PASS handoff tool,<sup>68</sup> the SBAR-DR strategy,<sup>71</sup> and a structured report with standardized content and understandable language.<sup>25,29,35,46,49,59,72,77</sup> It is also important that other professionals are informed when consultations or handovers are completed, so it is clear who is now primarily responsible for the patient.<sup>33,68,71</sup> The predominant mode of communication is written reports (integrated in the electronic medical record), embedding available imaging in these reports seems of added value.<sup>39,40,51</sup> However, physicians agree that additional oral communication is of added value,<sup>25,33,49,77</sup> as well as direct physician-to-physician communication.<sup>29</sup> A case study on complex surgery indicated that working together on a personalized 3D model that provides a realistic picture of the condition and anatomy helps physicians to mutually draft a surgical plan.<sup>55</sup>

## Organizational Elements

The included studies showed positive effects of several organizational structures and procedures that stimulate physicians (sometimes mandatorily) to work together,<sup>7,44,45,53,62,63,66</sup> such as multispecialty units/teams, comanagement, and mandatory consultations. In addition to these more structured changes, a study also indicated that more face-to-face communication occurs when people work in the same team or building, indicating that physical proximity plays a role in collaboration.<sup>78</sup>

## Contextual Characteristics

Another group of studies focused on more general characteristics of the hospital and its environment. The environment of the hospital has been mapped based on, for instance, levels of income per capita, population rates, poverty rates, and states dealing with malpractice crises. Physicians are less likely to refer patients to physicians who deliver care based on a reimbursement method differing from their own reimbursement method.<sup>22</sup> A strong identification with the organization likely results in more collaborative behaviours.<sup>4,28</sup> Type of practice (eg, university affiliated) and practice size seem to have no influence on collaboration,<sup>4,31</sup> but only in higher volume hospitals does collaboration in research trials and other multispecialty activities exist.<sup>70</sup> Practising in urban locations is related to higher odds of spending time on emailing and

calling other physicians, and for the treatment of urinary incontinence and pelvic floor prolapse,<sup>50</sup> American urologists and gynaecologists are more likely to collaborate than European urologists and gynaecologists.<sup>4</sup>

## Measurement of Interphysician Collaboration

We categorized the included studies into three different groups of how interphysician collaboration is measured: information exchange, social ties, and quality/satisfaction. It is remarkable that each author uses his or her own unique measure for interphysician collaboration.

Within the category of information exchange, we distinguish between studies that measure the content shared between physicians and studies that measure whether shared information is understood. Measuring shared information gives insight into whether information that is deemed necessary for collaboration is shared during conversations and in reports (eg, charts, electronic medical records). This is mostly measured by reviewing charts. The information that should always be included according to these measures is the patient presentation, including patient history and current assessment of the patient's illness.<sup>6,24,27,30,32,35,56,71</sup> Additionally, a clearly stated consultation question and detailed recommendations on patient care are required.<sup>6,24,27,30,35,71</sup> In two studies, these requirements are captured through a global rating scale.<sup>35,71</sup> Studies using these measurement scales also show that information is often incomplete or unclear; for example, one of the studies shows that in a quarter of the cases, no clear clinical question was presented.<sup>6,24,27,30</sup> Although in many cases information is given, it is often not verified.<sup>32</sup>

Multiple studies check whether information shared (eg, vocabulary, reporting schemes) is understood by other physicians, also mostly by using chart reviews. Two studies checked whether expressions conveying likelihood (rare, atypical, occasionally, etc.) are interpreted by physicians in the same way; these show inconsistencies in the use of these expressions and differences in understanding.<sup>23,47</sup> Three other studies checked the level of agreement about a patient's medical condition, of which two were specific about the location of lesions.<sup>48,59,72</sup> For the locations of lesions, a reporting scheme (Prostate Interdisciplinary Communication and Mapping Algorithm for Biopsy and Pathology [PIC-MABP]) and structured versus nonstructured reports are compared. It seems that a more structured report results in better understanding between physicians.<sup>59,72</sup> Another study shows that physician groups use specialty-specific language and do not accommodate enough for others to understand them.<sup>48</sup>

Related to social ties are the studies that focus on the frequency of contact between physicians, the frequency of certain behaviours expressed (eg, rude, criticist) and more abstract measured concepts related to the tone of the relationships (eg, conflict style, trustworthiness, organizational commitment, openness). Frequency of contact between physicians is measured by how often an interaction between physicians takes place or the time spent on interacting. Most of these data are based on surveys; others use claim data. Different studies use social network analysis to map and model physician care networks. From these frequency measures, we learn that engagement in interaction is diverse. As an example, one study shows that the majority of specialists are not yet involved in an integrated collaboration on complex coronary diseases,<sup>44</sup> while another study shows that specialists spend approximately five-and-a-half hours per month on multidisciplinary team meetings.<sup>9</sup> Other studies measure the frequency of behaviours perceived as negative and the frequency of communication about diagnostic errors, outing criticism.<sup>15,61,74</sup> From these studies, we learn that incivility occurs in approximately 10% of consultations and that rude behaviours are experienced by more than half of the physicians (59%) at least a few times per month. The relational part of these social ties is often measured by the concept of culture/atmosphere and/or teamwork/collaboration. We distinguish six features in the conceptualization of culture/atmosphere: openness, dialogue, generosity, competition, voice, and organizational commitment.<sup>16,26,28,36,37,60,65</sup> In the conceptualization of teamwork/collaboration, the strength of the relationship seems to be important, based on partnership, coordination, and trustworthiness.<sup>38,43,53,60</sup> A wide variety of scales are used to address the relational concepts of social ties. The scales vary, but the outcomes show that approximately 85% of the specialists participating in these studies agree that there is a supportive atmosphere,<sup>26</sup> over 50% are positive about the effectiveness of communication,<sup>43</sup> and 72% experience a positive safety culture.<sup>60</sup> Despite these more positive insights, studies also indicate that interventions help improve the teamwork climate.<sup>16,37,53</sup> Despite the diversity, the studies in general seem to capture how comfortable physicians feel about sharing their professional position with others.

Value judgements of quality and satisfaction focus on the perception of medical specialists about the quality of or satisfaction with current practice, such as the consultation process, received reports, and paging system.<sup>29,31,43,46,51,52,57,60</sup> Satisfaction with interphysician collaboration is also measured before and after implementing new communication tools.<sup>64,68</sup> These value judgements of quality and satisfaction are all based on survey data. Multiple studies generally show high satisfaction rates with collaboration, communication, and written reports.<sup>31,51,52,60,64,77</sup> As an example, in one of the studies, 88% of physicians rated the perceived quality of collaboration as positive.<sup>60</sup> A few other studies show only moderate satisfaction levels with the consultation process, even after an intervention to improve these satisfaction levels.<sup>29,68</sup>

## Effects of Interphysician Collaboration

From the included studies, we learned that the effects of interphysician collaboration are measured on three different levels, namely, the patient, staff, and hospital level. On the patient level, changes in the medical care or treatment plan for the individual awaiting or under medical care are measured. At the staff level, measurements focus on how medical professionals are affected by working together. Hospital measurements relate to how interphysician collaboration impacts the processes or outputs of the hospital system.

We identified 15 studies that mentioned the effects of interphysician collaboration at the patient level. We distinguish four different factors that were studied as outcomes of interphysician collaboration: patient management (n= 6), patient safety (n= 7), mortality (n= 3), and clinical outcomes (n= 1). The changes in patient management were changes in the medical treatment plan,<sup>6,24,27,54</sup> e.g., changes in antibiotic use and changed preoperative management. Furthermore, changes in treatment decisions based on better insights into the condition of the patient resulted in a higher percentage of patients receiving adequate staging.<sup>55,66</sup> Interestingly, one study shows that interphysician counselling did not always result in different interpretations of diagnostics, even when changes in patient management followed.<sup>54</sup> Patient safety is especially influenced by negative experiences of physicians resulting in mistakes, which could harm patients.<sup>15,52,57,72</sup> On the other hand, physicians believe that interphysician collaboration will benefit patient care, improve safety and reduce adverse events.<sup>53,68,71</sup> In difficult situations, working with multiple specialties results in lower mortality rates, although not always significantly.<sup>55,58,63</sup> The studied clinical outcomes (sinonasal functioning) show improved subjective and objective results for patients treated by a group of multiple physicians compared to only one physician, but quality of life does not significantly differ between groups.<sup>74</sup> Most of the studies only provide low to very low levels of evidence according to the GRADE, as they use cross-sectional surveys or quasi-experimental designs. Studies that have a stronger research design using pre- and postsurveys and provide moderate quality of evidence show that physicians felt or perceived patient care benefits.

On the staff level, we identified five studies, four of which investigated positive experiences. In these studies, the respondents were asked after an intervention that made interphysician collaboration inevitable (eg, comanagement, multidisciplinary team meetings, integrating radiology service in rounds) about the effects. Three of these studies indicated that working together makes them better prepared for collaboration in the future. This is based on increased trust, increased comfort in working together and increased knowledge about each other's area of expertise.<sup>7,53,62</sup> Another study shows that interphysician collaboration makes physicians feel less clinical autonomy and more accountability to other specialties but does not change the extent to which physicians feel their specialty is different from other specialties.<sup>9</sup> One out of five studies investigated negative experiences, namely, the effect of rude, dismissive, and aggressive behaviour. This kind of interphysician behaviour results in feelings of sadness, anger, and decreased motivation.<sup>15</sup> Although there are limited studies on the effects for staff, the preparedness for future collaboration is based on at least two prepost survey studies with the number of participants reflective of the departments. GRADE provides moderate quality of evidence.

Effects that impact the process or outcomes of the hospital system are displayed in nine studies, related to either reduced time spent on treatment or reduced costs of hospitalization. Reduced time spent on the treatment of the patient within the hospital is expressed as a decrease in length of stay,<sup>45,57,63</sup> lower re-evaluation rates,<sup>41,42,58,72</sup> and reduced surgery duration.<sup>55</sup> The costs of hospitalization consequently decrease with interphysician collaboration.<sup>41,42,63</sup> These outcomes are based on quasi-experimental studies, such as observational studies with a retrospective control or a comparison between the highest- and lowest-scoring hospitals on, for example, readmission rate. According to the GRADE, these studies only provide a low level of evidence, which should be considered when interpreting the results.

## Discussion

In contrast with previous reviews on interprofessional collaboration in health care, we targeted our review on a group that is underrepresented in the literature, as they are mostly studied as one homogeneous group: medical specialists. Our review confirmed that there are important differences between medical specialties, for example, differences in using words to express diagnostic confidence. These and other specialty-bound characteristics, such as the use of specialty-specific language, can be causes of misunderstanding and difficulties in collaboration between medical specialties. The aim of this review was threefold: to identify factors influencing collaboration between medical specialties, identify instruments used for measuring interphysician collaboration, and summarize and categorize the effects.

Our review shows that good interphysician collaboration mostly has positive outcomes. Clinical outcomes for patients as well as patients' satisfaction with care improve. Staff members are more satisfied and experience the positive outcomes of working together. Some studies present reduced error rates, reduced length of stay or reduced hospitalization costs. The strongest, namely, moderate, evidence shows that physicians believe good interphysician collaboration will improve patient care, patient safety, and efficiency. Hence, there seem to be good reasons to try to stimulate and improve interphysician cooperation. However, although most studies present positive results, they should be interpreted with some caution. First, in most studies, collaboration was measured with an unvalidated instrument. Second, most of the studies had a low level of evidence. Notwithstanding these imperfections, our findings seem to be in line with studies on interprofessional collaboration, which show similar positive outcomes.<sup>11</sup>

We identified a very diverse set of tools used to measure interphysician collaboration, each often newly developed for a specific study. As we focused on how interphysician collaboration is measured, we categorized the instruments based on what they attempted to measure. The three main focus points are the information transfer between physicians, the social ties between the physicians, and value judgements about quality and satisfaction. Tools related to information transfer focus on the type of information shared and/or if shared information is understood by physicians. Tools focused on social ties measure the frequency of contact between physicians, the frequency of certain behaviours expressed (eg, rude, criticist) or the tone of the relationships (eg, conflict style, trustworthiness, organizational commitment, openness). Remarkably, none of the studies refer to relational coordination theory or use the appurtenant measurement instrument that captures both frequency and relational dynamics, while this instrument is often used in studies on interprofessional relationships.<sup>79–81</sup> Finally, tools that use value judgements focus on the perception of medical specialists about the quality of or satisfaction with current collaboration. These tools are often used to evaluate newly implemented communication guidelines. Collaboration is a comprehensive construct and, at the same time, is interchangeably used with coordination, cooperation, and communication.<sup>82</sup> This results in great diversity in operationalizations and the development and choice of measurement tools. Furthermore, only two of the included studies address the development and psychometric testing of a scale (Assessment of Interprofessional Team Collaboration Scale and Communication and Sharing Information-scale), and only in a few studies is an existing tool (eg, Inventory of Communication Atmosphere among Physicians [ICAP]) or a tool derived from an existing tool (eg, derived from the Pharmacist-Physician Collaborative Index [PPCI]) used to measure interphysician collaboration. This also seems to be in line with a review of interprofessional literature, which showed that few tools have been validated for interphysician collaboration. However, they consider the CSI scale promising for assessing interprofessional collaboration in hospital settings.<sup>10</sup>

The review identified five categories of factors influencing collaboration between physicians: personal factors, professional factors, preconditions and tools, organizational elements, and contextual characteristics. The most researched personal factors were gender, age, and need for autonomy, but these factors appeared in different contexts, which makes generalization impossible. The professional factors showed that interactions are influenced by the specialty medical professionals belong to and their position on the hierarchical ladder. Certain specialists and physicians higher on that ladder are more likely to express behaviours that negatively influence collaboration. Other, more qualitative studies seem to suggest that certain types of specialties are more prone to cooperate and that cooperation between certain specialties is easier or more difficult as a consequence of either complementary or overlapping professional domains.<sup>8</sup> Such notions are lacking in quantitative studies, making it difficult to identify patterns and generalize findings, as studies often only focus on relationships between two specific types of specialties. Preconditions and tools are designed to

support effective collaboration by demanding structured communication of relevant information. Examples are embedding available imaging in reports or using a 3D model of a tumour to discuss a surgical plan. Studies on organizational elements indicate that embedding structures that lead to collaboration and physical proximity can help medical specialists interact. Contextual characteristics seem, on the one hand, to create opportunities for interaction; for example, collaboration in research trials and multispecialty activities, which only exist in high-volume hospitals. On the other hand, contextual characteristics such as reimbursement methods can inhibit interaction, as they may influence specialists' income. Our review showed mostly similar determinants of interphysician collaboration as reported in research on collaboration between different health professionals.<sup>8</sup> The review on interprofessional collaboration, for example, distinguished organizational structures and coordination and communication mechanisms, such as standards and protocols, as determinants. Both support the overall impression that many determinants affect interprofessional collaboration.

One of the reasons to perform this review was the observation that the increasing number of complex multimorbid patients necessitates more collaboration, communication, and coordination between doctors from different specialties. However, most of the studies we found focus on collaboration between specialists with a supporting (radiologist, anaesthesiologist) or referring (emergency physician) role. Research on collaboration between specialized care physicians in the treatment of patients with complex problems and comorbidities is lacking. In addition, it is striking that the studies we found hardly address Electronic Patient Records, nor online meetings or online patient encounters, which we consider providing great opportunities for bringing multiple specialties together. During the Covid crises the use of such tools has probably increased much, which might be addressed in future studies due to publication delay. Further, most of the studies we found focus on either consultation or coprovision of care. Especially coprovision of care seems to hold benefits for patients, but downsides of these types of interphysician collaboration that might be expected such as consequences for the medical profession (eg jurisdiction) and more practical barriers (eg insurance coverage) are not addressed.<sup>13,83</sup>

At the same time, different initiatives have been used to improve care for complex, multimorbid patients. For example, there is an introduction to the medical training of new types of hospital doctors with a more general focus.<sup>84,85</sup> However, some initiatives, such as those in the Netherlands, also assign a coordinating specialist for complex patients who is responsible for continuity and coherence in care.<sup>86</sup> Currently, we also see many hospitals in Western countries trying to reorganize their structures to stimulate interphysician and interprofessional cooperation. They are changing from traditionally structured hospitals mostly built around medical specialties to more process-based organizations structured around patient needs.<sup>87</sup> As our review found that physical proximity and multidisciplinary teams have positive effects on interphysician collaboration, it seems plausible that such a redesign of hospitals might stimulate interphysician collaboration. However, empirical evidence that reorganization effectively encourages the development of collaborative relationships between professionals is still lacking (see also Morley & Cashell, 2017<sup>88</sup>).

## Limitations

This review has some limitations. First, our initial interest and therefore our search terms were focused on the measurement of interphysician collaboration. Because of this focus, descriptive studies about interphysician collaboration did not meet our inclusion criteria. For example, we excluded multiple studies that did describe factors influencing interphysician collaboration but did not measure interphysician collaboration, for example, articles around themes such as boundary spanning. Based on that, we cannot guarantee that all possible factors affecting interphysician collaboration are represented within our review. Second, we included all terms that indicate an interaction, such as collaboration, coordination, communication, and cooperation. On the one hand, this made us include a broad spectrum of articles, but on the other hand, it also made the review very diffuse. Nevertheless, even when we had chosen one of the terms beforehand, we still might have included a very broad spectrum of literature, as our review showed that all these concepts can be operationalized and measured in many ways. Third, we excluded grey literature by only focusing on articles published in peer-reviewed journals presenting empirical data and written in English. Thereby, we may have excluded relevant studies that present results that show no significant effects of (or on) interphysician collaboration. Because of publication bias, such studies are not always submitted or accepted for publication.



## Implications for Research and Practice

Our findings suggest that quantitative research on interphysician collaboration is still in a developmental stage. There is a need for further development, validations and use of standardized measurement tools. Better use could be made of tools already developed to measure interprofessional collaboration, for example to measure relational coordination. There is a need for studies with stronger designs to produce higher level evidence. Studies should also focus more on current developments related to the need for more interphysician collaboration to deal with the increasing number of (complex) patients with comorbidities, the development of new hospital designs to promote such collaboration, and the effects of digitalization. Furthermore, attention should be paid to both positive and negative sides of different types of interphysician collaboration from the perspectives of multiple stakeholders (eg doctors, patients, managers, other care professionals).

Hospital management and policy makers can find some support in our findings for stimulating interphysician collaboration by introducing digital communication support tools, multispecialty units/teams, co-management, and mandatory consultations. Also, creating physical proximity can help medical specialties to interact more. These findings seem to support the relevance of hospital redesigns towards integrated practices.

The evidence suggests that medical specialists often recognize the importance of interphysician collaboration for quality and safety. However, they are not always aware of the existing barriers to do so. There seems to be a clear understanding that working together with other types of professional like nurses, although still remaining suboptimal (see for example Filizli & Önlü, 2020<sup>89</sup>) requires extra time and effort. Somehow interphysician collaboration is seen as less problematic. Studies show that next to practical barriers (time, proximity, availability), there are also barriers related to specialty language, specialist hierarchy, and autonomy. Medical specialists should be aware of these barriers and spent time and effort to break these down.

## Conclusion

The number of studies on interphysician collaboration in hospitals has increased in the last decade, but the quality of the studies remains limited. Multiple tools have been developed to measure interphysician collaboration; however, most of these tools have not been validated in this setting and are only used for a single study. Despite limited evidence, our review showed promising results that collaborative practice between physicians increased the satisfaction of patients and staff while also reducing the length of stay, error rates, and hospitalization costs. The strongest evidence indicates that physicians believe that their collaboration will lead to better patient care. We noted that personal factors, professional factors, preconditions and tools, organizational elements and contextual characteristics can influence interphysician collaboration. Importantly, studies indicate that collaboration between physicians is influenced by the medical specialty they belong to. However, we still need to better understand the underlying patterns in collaboration between specialists and to what extent these patterns could be generalizable beyond the researched specialties, discuss the benefits and disadvantages of collaboration models in care, and address e-health possibilities for collaboration, to be able to deliver better care for the increasing number of patients with comorbidities.

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Disclosure

The authors declare that they have no competing interests.

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