Review

Effectiveness of communication interventions in obstetrics – a systematic review

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Abstract: (1) Background: Obstetric work requires good communication, which can be trained in interventions targeting health care providers and pregnant women/ patients. This systematic review aims to aggregate the current state of research on communication interventions in obstetrics. (2) Methods: Using the PICOS scheme, studies published in peer-reviewed journals in English or German between 2000 and 2020 were searched. Out of 7,018 results, 71 studies were included in this synthesis and evaluated using the Oxford Level of Evidence Scale. (3) Results: 63 studies, including a communication component, revealed a positive effect on different proximal outcomes (i.e., communication skills). Three studies evaluating the effect of communication training on distal performance indicators (i.e., patient safety) proved to be beneficial to some extent. Most studies included different groups at the same time; those addressing health care providers were more common than those with students (61 vs. 12). Expectant mothers were targeted only in 9 studies. Overall, the evidence level of studies was low (only 11 RCTs), with 24 studies evidence level of I-II, 35 of III, and 10 of IV. (4) Conclusions: Communication training should be applied more often to improve communication of staff, students, and pregnant women, and thereby improve patient safety.

Keywords: communication, patient safety, obstetrics, midwifery, intervention, training, interprofessional, learning

1. Introduction

In obstetrics and gynecology, *medical errors and liabilities* cause high healthcare costs and negative outcomes for women and their new-born babies [1]. In 72% of all perinatal deaths, communication errors are identified as the main cause [2]. A key component to reduce errors in general and thus ensure patient safety is good *patient-provider communication* as well as effective *communication between healthcare professionals* [3,4]. However, communication needs to be improved, especially in obstetric care, which is reflected in public debates about obstetric violence, especially in the face of emergency [5]. Preventing such traumatic experiences and/ or debriefing is required and possible even in an emergency by means of efficient and effective communication [6]. In a systematic review published in the year 2002, dissatisfaction around birth was found to be negatively related to the amount of support from caregivers, the quality of the caregiver-patient relationship, and their involvement in decision making [7].

All of these aspects can be trained by different interventions including *simulation trainings*. A number of single studies have identified communication as the key determinant of patient safety in obstetrics. Interventions seem to buffer the effects of social inequality, lack in childbirth preparation, pain, and medical interventions [6,7]. However, there is no systematic review summarizing the single

findings with a focus on the *effectiveness of communication interventions*. The purpose of this review is thus to provide an overview of the current state of research and identify how communication can be improved and what conclusions for further research can be drawn. Since patient safety is the overarching goal in all research on communication in obstetrics, we will consider this more distal outcome along with the more proximal outcome of safe communication.

1.1 Patient safety

Patient safety is commonly defined as the absence of preventable adverse events (PAE) or incidents [4]. Patient safety incidents are near misses or PAEs that are a consequence of healthcare processes and healthcare interventions, rather than of the patients' condition itself. Ineffective communication between healthcare professionals (HCP) and HCP and patients plays a large role in causing such incidents and events.

Patient safety is a *key performance indicator* in healthcare, including obstetrics that requires a variety of different behaviors [8,9]. Besides medical and technical skills, teamwork [10], communication has been shown to be an integral component of safe patient care [4]. For this reason, teaching communication skills have been implemented in medical curricula, and communication training takes place regularly in continued education [9]. Overall, there is evidence that communication training might reduce PAE [11,12]. However, the obstetric setting, and particularly the birthing process, requires more detailed attention for several reasons.

Usually, the *role of the expectant mother* is different from the role of a patient who has an illness that needs to be cured. The hospital situation and the participation of the expectant mother and her partner are connected to the anticipation of becoming parents, and many expectant mothers expect that their anticipation will be met by HCP. While nervousness and pain are considered a part of this process to a certain degree, the overall idea of the hospital stay is excitement and joy. However, although pregnancy and giving birth are not usually pathological processes requiring medical interventions, potential (severe) complications require effective interprofessional (medical) intervention and collaboration [13]. Maintaining good interpersonal patient-provider communication despite the stressful situation is crucial, e.g., to reduce the risk of psychological trauma by keeping the patient informed and to enable the pregnant woman/ mother to express concerns [1].

For these reasons, communication training from other medical fields might not be transferable to this setting [14]. Tools and techniques need to be adapted to the specific context to ease the transfer of learned skills and pre-existing knowledge into practice. Consequently, in recent years, *communication training for HCP has been adapted to the obstetric setting*. Additionally, medical and nursing students are often required to practice communication skills in obstetric settings during their education. However, despite the integral part of the expectant mother in this setting, the efforts to actively engage her in communication processes have been scarce [15].

1.2 Safe communication in obstetrics

A multitude of *models of safe communication* exists in healthcare that might be transferred to obstetric care. Accurate, clear communication is central to all of them. For instance, communication is one of four central aspects in the TeamStepps framework of teamwork in healthcare, which has been validated in many clinical settings, including obstetrics [16]. The communication dimension of this framework utilizes different tools to facilitate safe communication between healthcare providers, particularly to ensure the recipient has understood the sender's information correctly (e.g., closed-loop communication), to convey critical information to a larger group of people efficiently (e.g., callout), and to request help in emergencies in which information needs to be conveyed quickly (e.g., the Situation Background Assessment Recommendation, SBAR, technique or checklists) [17].

Focusing on transporting factual information is necessary for safe communication but not sufficient, especially in obstetrics. Interpersonal and relational communication has been identified as one of four dimensions in midwifery models of care [18]. These models consider that – unlike most other reasons to visit a hospital – birth is a natural process in most cases and a joyful moment for the parents, but it can also cause uncertainty or fear. Thus, consideration of interpersonal or relational

aspects of communication with the expectant mother – such as being respectful and taking her emotions into account – is essential to convey important information to the expectant parents. Moreover, focusing on interpersonal communication with other team members is likely to improve team functioning and increase team members' motivation to engage in more technical communication [19].

When evaluating communication competencies in healthcare, *teamwork* needs to be regarded, too: In a previous meta-analysis, teamwork was revealed as positively related to performance with r=0.28 [10]. While both are important training outcomes and determinants for patient safety, communication is crucial for team functioning. Suppose technical and emotional communication competencies are exhibited appropriately in the team setting. In that case, the processes of encoding, decoding, and transactional sense-making are performed adequately, thus increasing the likelihood of safe communication [4]. As a consequence, the risk of PAEs may be reduced. Thus, we focus on communication as a part of teamwork and consider teamwork training if they have a specific communication aspect (including digital interventions and simulation training) [20].

1.3 Research aims

Based on a rather broad definition of communication, the goal of this review was to summarize and evaluate the current state of research on communication interventions in obstetrics. Communication interventions include training of different modes for HCP, interdisciplinary teams, expectant mothers, and their accompanying persons. Thus, our general research question was formulated as follows: *Do interventions including a communication component have an effect on proximal (i.e., communication skills) or distal (i.e., patient safety) performance indicators in obstetrics?* According to the PICOS scheme (PICOS stands for *P*opulation, *I*ntervention, *C*omparison, *O*utcomes, and *S*tudy design [21]), we aim to evaluate the following research questions in detail:

1. Participants: 1a) Are communication trainings more frequent during education or on the job? 1b) Are expectant mothers (and their accompanying persons) also targeted?
2. Interventions: 2a) Are the interventions grounded in theory or organizational initiatives? 2b) Are communication trainings usually standalone interventions, or are they part of larger training programs?
3. Comparisons: 3a) What conclusions regarding the strength of effects can be drawn from the comparisons analyzed in the single studies? 3b) Are single or interactive effects investigated?
4. Outcomes: 4a) What types of outcomes are examined? 4b) Are distal outcomes such as patient safety considered?
5. Study design: Based on the study design, how robust are the results?

2. Materials and Methods

2.1 Definition of central concepts

Communication was defined as broadly as possible in order to avoid missing important publications in the field. Therefore, all interventions targeting the exchange of information in verbal, written, or using form were included if the manuscripts matched other inclusion criteria (see below). Publications were included when either the intervention was focusing only on communication or a teamwork intervention contained an explicit communication component were described. We regarded both relational (such as acknowledging the patients' perspective) and technical (such as completeness of clinical information) communication interventions. As communication in healthcare is transmitted via various channels, we considered both oral and written as well as analog and digital communication.

The term *intervention* was defined widely, too. We included all structured actions intended to improve communication in obstetric settings. Thus, interventions in the strict sense (team or communication training for a scientific or practical purpose) but also large-scale quality improvement initiatives, examinations in medical/ nursing education, or implementation of technology also fell under our definition of intervention if they focused on the obstetric field.

2.2 Search strategy

We searched seven databases (CINAHL, ERIC, Pubmed, PsycInfo, ScienceDirect, Web of Knowledge, and Cochrane Systematic Reviews) to identify relevant literature (Figure 1). The Cochrane Systematic Reviews database was searched to identify previous relevant systematic reviews and scan them for additional relevant studies. The basic search term was *((Communication OR team) AND (training OR intervention OR skills)) AND obstetric**. The full search strategy can be found in appendix 1.

We searched for titles, abstracts, keywords, and journal titles since publications in obstetric journals might not mention the word 'obstetric' in titles, abstracts, or keywords, which could have lead to the exclusion of relevant publications. In addition, we also searched for the appropriate MeSH (Medical Subject Headings) and Thesaurus terms. In this first stage, we included studies published in peer-reviewed journals in English or German between January 2000 and December 2019 extensively and performed an update until the end of November 2020. We also hand-searched reference lists of identified systematic reviews in our initial search to identify additional eligible studies that were included as separate references in the review at hand.

2.3 Screening and selection procedure

After excluding duplicates, non-peer-reviewed publications, and publications in languages other than German or English, two raters (AW and either NH, NL or NS or SL) screened all references independently. At the title and abstract screening stage, we included empirical (i.e., qualitative and quantitative) studies referred to communication or team interventions in an obstetric setting. 'Obstetric settings' includes studies centered around pregnant women and women trying to get pregnant (and their partners), the birthing, and the woman's postpartum stage. Simulations of the situations as mentioned earlier were included. Studies that focused on newborns were included if the situation described in the study was part of the birthing process (i.e., resuscitation of a newborn immediately after birth). Otherwise, these studies were considered as pediatric settings.

In terms of study participants, pregnant women, women trying to become pregnant, and their partners, obstetric health care professionals (i.e., midwives), healthcare professionals working in an obstetric setting (such as anesthetists), and students working in an obstetric setting were included. We decided to include educational settings with students to account for the fact that non-technical skills (NTS) training has been integrated into medical and nursing curricula in recent years. In doubtful cases, i.e., if relevant information was missing, studies were included for full-text screening.

At the full-text screening stage, we included studies that (1) explicitly implemented a communication intervention and measured change in relevant outcome variables. In this case, relevant outcome variables could focus on communication or other constructs, such as clinical parameters thought to be changed by communication training (e.g., EmONC-simulation curriculum by Afulani et al., 2020 [22] or VitalTalk by methodology by Chung et al., 2020 [23]). We also included studies that (2) described communication as part of a team training intervention and measured change in a communication-related outcome variable (the effect cannot be attributed to communication only). Outcome variables could be measured via a pre-post comparison or subjectively reported improvements of relevant variables – thus, all levels of evidence from Randomized Control Trials (RCTs) to qualitative interviews were included. Even though the evidence for an interventions-induced change in descriptive or qualitative studies cannot be compared to RCTs, these studies nevertheless provide a more in-depth understanding of current research questions and gaps. Studies that did not provide descriptions that were detailed enough to judge whether a study belonged to case (1) or case (2) were excluded (Figure 1).

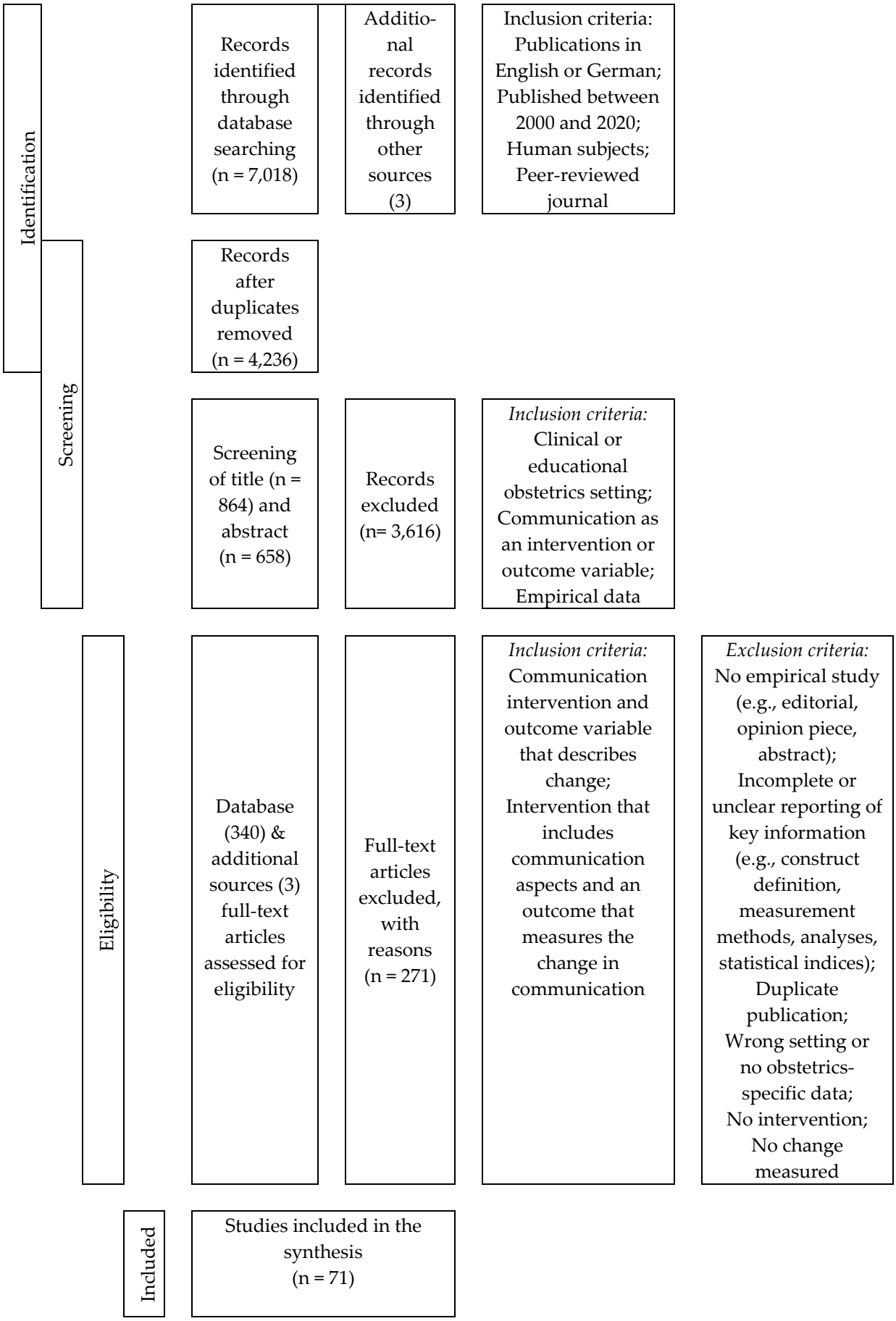

Figure 1. Systematic search method and inclusion/ exclusion criteria

At the title and abstract screening stage, all articles selected by either rater were included. At the full-text screening stage, disagreements were solved by reaching a consensus through discussion. An overview of the screening and selection procedure can be found in Figure 1.

2.5 Quality rating

The quality rating consisted of two steps. In the first step, we rated studies based on an adapted version of the levels of evidence defined by the Oxford Centre for Evidence (OLE) Based Medicine to determine the robustness of a study's findings (see Figure 2, and section 3.2) [24]. However, this instrument provides a global overview and is generally not suitable to rate qualitative studies, which we included to gain a more in-depth understanding of healthcare professionals' perception and acceptance of interventions. Thus, in order to systematically evaluate all included studies, we combined and adapted previous scales [24], which assessed dimensions such as transparency of reporting or the appropriate use of the methodology chosen. Each study was rated by two independent raters (AW and NH, NS or SL). Not all items were applicable to all studies. Disagreements were resolved through discussion.

2.6 Data extraction

We extracted information on the study setting and population, variables of interest to this review and their measurement, type of intervention and analysis, main results, and whether the communication was the focus or one part of the intervention from the reviewed studies. Only data relevant to this review was extracted if the variables of interest were part of a larger intervention (i.e., quality improvement initiative).

3. Results

After completing the screening procedure, 71 studies were included (Table 1 for details).

3.1. Study characteristics according to the PICOS scheme

Investigating *research question 1a*, the majority of interventions addressed study participants as professional (in terms of HCP, etc.) with overall 65 publications (91,5%). In detail, 35 studies aimed to improve communication in interdisciplinary teams, 12 in residents, nine in midwives, four in nurses, three in anesthetists, and two in different health care providers. Twelve communication interventions targeted students (16,9%), with five addressing medical students, four nursing students, two midwifery students, and one addressing a general student group. Nine studies included mothers, pregnant women, or patients (*research question 1b)*.

Testing *research question 2a* whether the interventions are grounded in theory or organizational initiatives, we found that in all studies, the authors reported theory-based approaches (using implicit or explicit theories concerning simulation, communication, shared decision making, skills training, and error disclosure). This approach was much more frequent than organizational initiatives (patient safety culture, safety interventions/ training, and organizational targets) with just six studies.

Answering *research question 2b*, 40 studies (56,3%) focused on communication *interventions* alone, whereas in 31 studies (43,6%), communication was part of a team training or other type of intervention such as addressing organizational aspects. Addressing *research question 3* regarding the *comparison*, the majority of studies (40 publications, 56,3%) employed a pre-post design. 14 studies (19,7%) used a retrospective post-intervention evaluation. Twelve studies (16,9%) managed an RCT design. One study employed a control group but failed at randomization [25]. One publication was a systematic review of aggregating studies from simulation training [6]. Regarding *research question 3a,* 63 studies revealed a positive effect on different proximal outcomes (i.e., communication skills). Three studies evaluating the effect of communication training on distal performance indicators (i.e., patient safety) proved to be beneficial to some extent. Relate to *research question 3b*, all included studies evaluated single effects, and additionally, only four studies' interactive effects were evaluated explicitly [26-29]. Detailed results are reported in Table and below in sections 3.2.1-3.2.4.

Table 1. Overview of all intervention studies on communication in obstetrics included in the current systematic review.

	Author	Focus [1]	Study population[2]	Metho-dology	Intervention[3]	Description of Communication[4]	Outcome measure	OLE [5]	Effects	Aggregated[6]
1.	Afulani et al., 2019 [15]	Other	M, HCP	Pre-post	TT emergency simulation	HCP's Comm quality rated by M	Quant. survey	IIIb	Comm ↑	++
2.	Afulani et al., 2020 [22]	*Comm*	N, M, R	Pre-post	RMC-focused simulation	emphasizing respect for feelings, and preferences	Mixed method	IIIb	Knowledge ↑ self-efficacy ↑	++
3.	Ahmed et al., 2019 [30]	Other	R	RCT	TT (NTS)	Cesarean section, Comm	Observer rating	Ib	Comm ↑	++
4.	Alder et al., 2007 [31]	*Comm*	R, M	RCT	Comm, simulation	MAAS-R, Patient satisfaction with comm	Observer, survey	Ib	M satisfaction ↑	+
5.	Amoakoh et al., 2019 [32]	*Comm*	M, HCP	Pre-post	Comm	Completeness of written Comm	Record review	IIb	Comm ↑	+
6.	Baijens et al., 2018 [33]	*Comm*	M	Pre-post	Shared decision making	Preferences in 1. decision making and 2. information	Mixed Method	IIIa	-	-
7.	Bambini et al, 2009 [34]	Other	S	Pre-post	Simulation of obstetric	Quality of Comm	Qualitative survey	IV	Self-reported skills ↑	+
8.	Bashour, 2013 [35]	*Comm*	M, R	RCT	Comm	Comm, Satisfaction	Observer, survey	Ib	-	-
9.	Black, 2018 [36]	Other	T	Retro-spective	T training, simulation	Subjective Comm skills	Quant. survey	IIIb	Comm ↑	+
10	Bloomfield et al., 2020 [37]	*Comm*	R, N, T	Pre-post 14m	Simulation	Comm skills, knowledge	Mixed method	IIIb	Comm ↑, knowledge ↑	+
11	Bonnema et al., 2009 [38]	*Comm*	R	Retro-spective	Comm	Comm regarding error disclosure	Quant. survey	IIIa	Comm ↑	+
12	Cavicchiolo et al., 2019 [39]	Other	M	Pre-post	Clinical skills (neonatal resuscitation)	Comm per ANTS	Observer rating	IIb	-	-
13	Chung et al., 2020 [23]	*Comm*	R	Pre-post 3m	VitalTalk simulation	on-the-spot encouragement, suggestions Comm	Quant. survey	IIIb	Comm ↑	+
14	Crofts et al., 2008 [40]	Other	T, patient actors	RCT	T training simulation	Comm (more information not available)	Quant. survey	Ib	Comm ↑	++

	Author	Focus [1]	Study population[2]	Metho-dology	Intervention[3]	Description of Communication[4]	Outcome measure	OLE [5]	Effects	Aggregated[6]
15	Dadiz et al., 2013 [41]	*Comm*	HCP	Pre-post 3 years	T training simulation	Comm, information exchange	Quantitative, observ.	IIb	Comm ↑ info exchange ↑	+
16	Deane et al., 2015 [42]	Other	S, M	Retro-spective	Clinical skills training	Comm	Mixed method	IIIb	Comm ↑	+
17	Fransen et al., 2012 [43]	Other	T	RCT	T training, simulation	Comm incl. SBAR, closed-loop, CTS	Observer rating	Ib	Comm ↑	++
18	Franzon et al., 2019 [20]	*Comm*	M	RCT	E-health intervention	Information transmission	Quanti-tative, Record	Ib	Feeling better pre-pared, knowledge ↑	+
19	Freeth et al., 2009 [44]	Other	T	Retro-spective	T training, simulation	Effective Comm, information sharing	Qualitative interviews	IV	Awareness ↑	+
20	Gardner, 2008 [45]	Other	T	Retro-spective	T training, simulation	Comm (closed-loop, speaking-up, error dis)	Quant. survey	IIIa	Comm ↑	+
21	Guimond et al., 2019 [17]	*Comm*	S	Pre-post	T training, simulation	SBAR	Observer rating	IIb	SBAR performance ↑	++
22	Haller et al., 2008 [46]	Other	T	Pre-post	T training (CRM)	Comm (speaking-up, asking, closed-loop)	Quant. survey	IIIa	Comm ↑	+
23	Hughes et al., 2017 [47]	*Comm*	T	Pre-post	3 interventions (phone, 2 digital texting)	Communicating critical delivery information (e.g., location of delivery room)	Record review	IIIb	Comm ↑	+
24	Hughes et al., 2014 [48]	Other	S	Retro-spective	T training, simu. PROMPT	Not described	Qualitative interviews	IV	Comm ↑	+
25	Hullfish et al., 2014 [26]	*Comm*	T	Pre-post	Timeout checklist	Speaking-up, voice	Quant. survey	IIIb	Own opinions respected by others ↑	+
26	Kahwati et al., 2019 [49]	Other	T	Pre-post	T work and Comm	Comm; modified adverse outcomes index	Mixed-meth	III	Comm ↑	+
27	Karkowsky et al., 2016 [50]	*Comm*	S	RCT	Comm, simulation	Verbal, nonverbal and patient-centred Comm	Quant. survey, Observat.	Ib	Comm ↑	+

	Author	Focus [1]	Study population[2]	Metho-dology	Intervention[3]	Description of Communication[4]	Outcome measure	OLE [5]	Effects	Aggregated[6]
28	Kim et al., 2012 [51]	*Comm*	S	Pre-post	Comm, simulation	Comm skill	Quant. survey	IIIa	Comm ↑	++
29	Kirschbaum et al., 2012 [52]	*Comm*	R	Pre-post	Comm, simulation	Comm culture as per PRIOR	Quant. survey	IIIa	Independence ↓, dominance ↓, inter-depend. ↑ integrat. ↑	+
30	Kumar et al., 2016 [53]	Other	M	Retro-spective	Clinical simulation	Increase in learning related to Comm	Qualitative survey	IV	Comm ↑	+
31	Kumar et al., 2019 [54]	Other	M	Retro-spective	Clinical simulation	Increase in learning related to Comm	Qualitative survey	IV	Comm ↑	+
32	Lavelle et al., 2018 [55]	Other	T	Retro-spective	T training, simulation	Described implicitly (NTS)	Qualitative survey	IV	Knowledge ↑, awareness ↑	+
33	Le Lous et al., 2020 [6]	Other	M, S, R	Systematic review	Simulation Training	Good/efficient Comm incl. providing sufficient items	self-report, objective	Ia	Non-technical skills ↑	+
34	Lean et al., 2017 [56]	*Comm*	T	Pre-post	Comm training	Compliance with standardized handover	Record review	IIb	Compliance ↑	++
35	Lee et al., 2018 [57]	*Comm*	T	Pre-post	Comm intervention	Closed-loop Comm, adherence stand. handover	Organizational data	IIIb	Compliance ↑ Durat. admission ↓	++
36	Lefebvre et al., 2020 [58]	Other	T	Pre-post	Quality improvement	speaking-up, conflict management, SCORE	Quant. survey	IIIb	Comm ↑	++
37	Letchworth et al., 2017 [59]	Other	T	RT	T training, simulation	with T and M as per GAOTP + direct and closed-loop	Observer rating	IIb	Comm ↑	++
38	Lindhardt, 2014 [60]	*Comm*	T	Pre-post	Comm training	Motivational interviewing, support behavior change	Observer rating	IIIb	Comm ↑	+
39	Lori et al., 2016 [61]	*Comm*	M	Pre-post	Comm training	Health literacy-aware Comm	Mixed method	IIIa	Comm ↑	+
40	Lupi et al., 2012 [62]	*Comm*	S	RCT	Comm training, simulation	General + specific (e.g., completeness of info)	Survey + Observater rating	Ib	Comm ↑	+
41	Mancuso et al., 2016 [63]	*Comm*	T	Pre-post	Comm training	quantity + quality (e.g., closed-loop Comm)	Observer rating	IIb	Comm ↑	+

	Author	Focus [1]	Study population[2]	Metho-dology	Intervention[3]	Description of Communication[4]	Outcome measure	OLE [5]	Effects	Aggregated[6]
42	Marzano et al., 2016 [64]	Other	T	Retro-spective	T training, simulation	Standardization of comm; satisfaction with Comm	Quant. survey	IIIb	Comm ↑	+
43	McArdle et al., 2018 [16]	Other	T	Pre-post	T training (TStepps) & clinical skills	SBAR, huddles, callout, checkback, closed-loop-; compliance with strategies	Quant. survey	IIIb	Comm ↑	+
44	Michelet et al., 2019 [65]	Other	M	RCT	T training, simulation	Outcome measure: verbal exchanges	Observer rating	IIb	Verbal exchanges of T members ↑	+
45	Moore et al., 2020 [66]	Other	R	Pre-post 11 m	SAFE-OB	Assist each other, T work, better T spirit	mixed methods	IIIb	Twork + Comm ↑	+
46	Morony et al., 2018 [67]	*Comm*	N/ telehealth staff	RCT	Comm training	quality of information received (e.g., sufficiency, usefulness, support of N)	Quant. surv (staff/ caller)	IIa	Self-perceived Comm ↑	+
47	O'Rourke, 2018 [68]	*Comm*	T	Pre-post	Patient safety interventions	Quality of hand-offs and Comm with M	Quant. survey	IIIb	Comm ↑	+
48	Phipps et al., 2012 [69]	Other	T	Pre-post	T training, simulation	Safety-related Comm, adverse outcomes index	Quant. survey	IIIa	Comm ↑ Adverse outcomes ↓	+
49	Posner, 2011 [70]	*Comm*	R	Pre-post	Workshop on error disclosure	Patient-centered (non-) verbal Comm	Observer rating	IIIb	Comm ↑	+
50	Raney et al., 2019 [71]	Other	N	Retro-spective	Simulation (PRONTO)	Structured clinical discus-sions and speaking-up	Semi-struct. int.	IV	Satisfaction with training ↑	+
51	Régo et al., 2011 [27]	Other	T	Pre-post	T training based on CRM	General Comm skills; calling for help	Mixed method	IV	Assertiveness ↑, help seeking ↑, Comm ↑ -	+
52	Reszel et al., 2019 [72]	Other	T	Retro-spective	Patient safety culture	Emergency Comm strategies (e.g., SBAR)	Semi-struct. int.	IV	Comm ↑	+
53	Riley-Baker et al., 2020 [73]	*Comm*	S	Pre-post	ACE.V in three simulated environments	Caring for M overall well-being; Comm appropriately with physician T members	Checklist	IV	Comm ↑	+
54	Romijn et al., 2019 [74]	Other	T	RCT	T training	Intervention: SBARR Outcome measure: AOI	AOI	Ib	-	-

	Author	Focus [1]	Study population[2]	Metho-dology	Intervention[3]	Description of Communication[4]	Outcome measure	OLE [5]	Effects	Aggregated[6]
55	Ronsmans et al., 2001 [75]	Other	M	Retro-spective	Comm + clinical skills	Comm behaviors (collecting, distributing info)	Structured interviews	IIIa	Information transferal ↑	+
56	Roter et al., 2015 [28]	*Comm*	M with low literacy, R	RT	Comm trainings	Patient and physician Comm behaviors	Observer ratings	IIb	M: online > face-to-face; R: opposite	+
57	Santos et al., 2015 [11]	Other	T	Pre-post	Safety interventions	Standardized emergency comm + error reporting	Organizational data	IIIa	Staff report errors ↑, occurrence errors ↓	+
58	Sawyer et al, 2014 [76]	Other	R	Pre-post	T training, simulation	Comm among T members, calling for help	Observer rating	IIIa	Comm ↑	++
59	Shea-Lewis et al., 2009 [12]	*Comm*	T	Pre-post	T training (CRM)	Intervention: SBAR; Outcome: Adverse events	Organizational data	IIIb	Adverse outcomes ↓	++
60	Siassakos et al., 2009 [77]	*Comm*	T	Pre-post, control group	T training, simulation	Comm behavior (command, enquiry, response, interruption etc.)	Observer rating qualitative	IIIb	Comm ↑	+
61	Siassakos et al., 2010 [78]	Other	S	RCT	T training, (comm+simulation) vs. lecture	within outcome: quality of Comm	Observer rating	Ib	Simulation > lecture: Comm ↑	++
62	Sonesh et al. 2015 [79]	Other	T	Pre-post	T training (TStepps)	Comm clarity and accuracy	Quant. survey	IIb	-	-
63	Staines et al, 2019 [80]	Other	T	Pre-post	T training (TStepps)	Comm openness, feedback + Comm errors	Quant. survey	IIb	-	-
64	Thomas et al., 2010 [81]	Other	S	RT	T training, simulation	Comm (e.g., sharing info, inquiry, assertion); SBAR	Observer rating	IIIb	Comm ↑	+
65	Truijens et al., 2015 [29]	Other	T, M	Pre-post	CRM T training	Comm effectiveness (e.g., SBAR)	Quant. survey	IIb	Comm ↑ @pregnancy only	+
66	Walker et al., 2014 [82]	Other	T	Pre-post	simulation (PRONTO	Thinking out loud and clear, direct Comm	Observer rating	IIIb	Comm ↑	+
67	Walton et al., 2015 [25]	Other	T	CT	simulation (PRONTO)	Patient-centered Comm; effective Comm within T	Observer rating	IIb	Comm ↑	+
68	Warland et al., 2014 [83]	*Comm*	S	Pre-post	Assertiveness training	Assertiveness (i.e., speaking-up)	Quant. survey	IIIb	Assertiveness ↑	+

	Author	Focus [1]	Study population[2]	Metho-dology	Intervention[3]	Description of Communication[4]	Outcome measure	OLE [5]	Effects	Aggregated[6]
69	Weiner et al., 2016 [84]	Other	T	Pre-post	emergency (PROMPT)	Satisfaction with physician interaction rated by N	Quant. survey	IIIb	Satisfaction with physician interact. ↑	+
70	White et al., 2016 [85]	Other	R, M	Pre-post	Safety training	Part of the training but not defined	Semi-struct. int.	IV	Comm ↑ [prior to the intervention]	+
71	Zech et al., 2017 [86]	Other	T	Pre-post	T training, simulation	Lack of Comm; openness of Comm	Quant. survey	IIIb	No overall change in openness of Comm	-

[1] Study focus: Comm=Communication;

[2] Study population: M = Mothers/patients, HCP = health care professionals, N = nurses, R = residents/medical doctors, S = students, T = Teams;

[3] TT = Team Training, [4] within the intervention and/or as the outcome;

[5] OLE = Oxford Level of Evidence: IIIa: evidence from non-experimental studies / inferential statistics, IIIb: evidence from non-experimental studies / descriptive statistics, IV: qualitative studies, cf. Oxford Centre for Evidence-Based Medicine: Levels of Evidence (March 2009) — Centre for Evidence-Based Medicine (CEBM), University of Oxford;

[6] Aggregated effects: ++ = Effects as hypothesized, + = some effects, - = no effect.

Further abbreviations in the table: ANTS = Anesthetists Non-Technical Skills; AOI = Adverse Outcome Index; CRM = Crew Resource Management; CTS = Clinical Teamwork Scale; EmONC = emergency obstetric and neonatal care; GAOTP = Global Assessment of Obstetric Team Performance; HSOPS(C) = Hospital Survey on Patient Safety (Culture); OSCE = objective structured clinical examination; MAAS-R (revised Maastricht history-taking and advice checklist); NOTSS (non-technical skill for surgeons); NTS = non-technical skills; PRIOR = practices in the operating room; covers in(ter)dependence, concern for self and others, dominance, conflict avoidance, integrating; PRONTO = Programa de Rescate Obstétrico y Neonatal: Tratamiento Óptimo y Oportuno; PROMPT = PRactical Obstetric Multi-Professional Training; RT = randomized trial; RCT = randomized controlled trial; RMC = Respectful Maternity Care; SAFE-OB = SAFE Obstetric Anesthesia course = 3-day refresher to address essential obstetric anesthesia and the most common causes of maternal death; SCORE (Safe & Reliable Healthcare's safety, communication, operational reliability, and engagement; SBAR(R) = Situation Background Assessment Recommendation Read-Back; TStepps = TeamStepps/

Investigating *research question 4a,* we found 37 publications (52,1%) that used questionnaire data. Twenty-three studies employed observations as the primary outcome measure (32,4%). Some studies (18; 25,3%) used qualitative approaches to gain an in-depth understanding of participants' experiences with the intervention and perceived learning. Four studies (5,6%) measured outcomes with recorded reviews in pre-post designs or RCTs [20,32,47,56].

Regarding the measured *outcomes*, most studies (58; 81,7%) investigated 'technical' communication, i.e., structured or standardized communication during medical procedures or processes, such as information seeking or decision making. Additionally, four studies focused on interpersonal aspects of communication with patients or colleagues explicitly, such as establishing a relationship. A more frequent outcome measure included 16 clinical aspects of communication, for instance, neonatal resuscitation, emergency simulation, complete and accurate transmission of medical information.

The 37 studies employing questionnaires explored preferences, self-rated skills, and assertiveness, with no predominant survey instrument—the 23 studies reporting observations focused mainly on communication and adherence to standardized procedures. The observational studies examined 'technical' communication as the primary outcome, adapting one of the validated non-technical skills (NTS) observational tools to the obstetric setting. The four studies using retrospective record reviews evaluated the completeness of written communication/ information (e.g., location of delivery), information transmission to better prepare women for childbirth, and compliance with standardized handover protocols. Qualitative studies focused mainly on 'soft' communication aspects such as empathy and non-verbal communication, reducing hierarchies as well as encouraging open discussion of cases. Only three studies investigated *adverse effects or errors* by capturing the number and reporting of adverse events in organizational data [11,12] or using the Adverse Outcome Index (AOI) [74]. Summarizing this regarding *research question 4b*, distal outcomes such as patient safety are considered but rather rarely.

3.2 Intervention effects

Most studies revealed some positive effects with a majority of moderate effect sizes (40 publications; 56,3%). Only 14 investigations (19,7%) revealed effects as hypothesized. Just nine studies (12,7%) presented positive effects but used only qualitative approaches so that an effect size could not be reported. Only ten studies did not find any positive effect (14,1%). In the following, we are describing representative study designs grouped into highly effective interventions (section 3.3.1), those with moderate effects (3.3.2), qualitative research design (3.3.3), and studies not finding any effects (3.3.4).

3.2.1 Highly effective interventions

Highly effective interventions could be found in all target groups and mainly comprised of well-planned, standardized simulation training tested in controlled trials, sometimes with observer ratings. Effective interventions were published between 2008 and 2020. In the following, some representative publications are described in more detail.

One example is the recently published study by Afulani et al. in which nurses, midwives, and residents were trained with regard to "Respectful Maternity Care" (RMC) emergency obstetric and neonatal care protocol. They emphasized respect for every woman's feelings and preferences and found improvements in knowledge and self-efficacy in the pre-post comparison [22]. Fransen et al., 2012 aimed to improve team skills in a multidisciplinary obstetric team, using an RCT design. The team and communication training addressed aspects reflected in the Clinical Teamwork Scale (CTS). In the observer rating, the experimental group scored higher on all communication dimensions compared to the control group [43].

Lee et al., 2018 trained multidisciplinary obstetric (OB) teams with a communication intervention containing closed-loop communication and adherence to standardized handover procedures. Outcomes were evaluated regarding organizational data after the intervention. Adherence to the handover procedure increased from 48 to 84%, and the duration from patient

admission to initiation of care decreased by 50% [57]. Finally, Siassakos et al., 2010 trained medical students in an RCT design. The team training consisted of intervention with communication and simulation, which was compared to a lecture only. The quality of communication was evaluated in terms of observer ratings. Students who attended the simulation received better communication scores compared to those who attended the lecture [78].

Thus, highly effective interventions are characterized by standardized communication training and are evaluated by experimental designs, i.e., in RCTs. Thus, investing more time into developing the training in this standardized form and preparing an RCT seems to increase effectiveness.

3.2.2 Moderately effective interventions

Overall, the 40 intervention studies demonstrating moderate effectiveness of the training by employing quantitative methods all clearly focus their interventions on communication. The studies were performed with all target groups in interdisciplinary teams and mostly emphasized multidisciplinary team components in controlled but less frequently randomized trials.

In a comprehensive intervention study, Walton et al., 2015 addressed multidisciplinary obstetric teams with technical and non-technical skills training and compared the effects to a control-intervention. The skills, as well as simulation for non-emergency deliveries (PRONTO), were taught to improve patient-centered communication, e.g., acknowledging patient requests along with effective communication practices within the team, e.g., check-backs and SBAR. Observer ratings revealed that 3 out of 5 patient-centered communication dimensions scored higher in the intervention group. Moreover, 6 out of 11 effective communication practices within the team scored higher in the intervention group [25].

Chung et al., 2020 trained OB/GYN residents in an observational, prospective cohort pilot study over 3 months. The intervention consisted of a 4-hour interactive curriculum using VitalTalk methodology delivered by certified facilitators and involving simulated patients. Positive psychology techniques with on-the-spot encouragement and suggestions from observers before replaying the conversation enabled an active practice of communication skills. The quantitative survey revealed improvements from pre to post, which were maintained over 3 months [23]. Thomas et al., 2010 aimed exclusively at medical students who were randomized to two different team training consisting of simulation and didactic. The goal was to improve standardized communication behaviors, e.g., sharing information, inquiry, assertion, teaching, and advising, as well as the SBAR technique. Observer ratings revealed that overall, more communication behaviors occurred in the intervention groups in terms of sharing information, inquiry, and assertion. However, teaching/ advising and evaluation of plans were rarely observed in all groups [81].

Concerning more distal outcomes, two of the three publications that focused on patient safety and PAE found moderate effects. The amount of missing information decreased post-intervention and at 6-month follow-up. Phipps et al., 2012 reported simulation team training (CRM). Safety-related communication in terms of openness, feedback/ communication about errors, responses to error were targeted and effectiveness evaluated by means of the adverse outcomes index assessed in a quantitative survey. The communication openness and responses to errors improved post-intervention, whereas feedback and communication about errors did not. Adverse outcomes dropped post-intervention [69]. Santos et al., 2015 trained multidisciplinary OB teams by means of safety and communication interventions with included standardized emergency communication and error reporting protocols, error disclosure, team NTS and clinical skills training. The outcome measures were adverse events and their reporting. While staff reporting of adverse events increased, the occurrence of adverse events decreased [11].

Summarizing the studies' moderately effective interventions, they targeted diverse target groups and different aspects of communication. While the quality of the studies seemed not as high as with the studies revealing stronger effects, outcomes measures included stronger targets such as objective and subjective measures of adverse events. To find effects with these outcomes might be more difficult than on outcomes like communication skills, thus relating to only moderate effects.

3.2.3 Interventions demonstrating effectiveness in *qualitative* research designs

Overall, the nine intervention studies demonstrating the effectiveness of the training by employing qualitative methods have in common that they used a simulation component for their communication training and evaluated the effectiveness retrospectively. The studies were performed with mainly interdisciplinary teams but also focusing on midwives and students.

For example, Freeth et al., 2009 aimed at multidisciplinary teams. In their retrospective post-intervention study, the team training with emergency simulation was intended to improve effective communication in terms of information sharing. This was evaluated by means of qualitative interviews. Participants stated after the training that they realized the importance of communicating clearly and proactively supporting patient safety [44]. Raney et al., 2019 studied obstetric nurses in a retrospective post-intervention study with the pre-post comparison. The OB emergency simulation (PRONTO) intervention included training components that focused on structured clinical discussions and speaking-up. In the semi-structured interviews, nurses reported that the training helped reduce hierarchies, encourage open discussion of cases, and speaking-up [71].

Another study investigating multidisciplinary teams with a retrospective post-intervention study and pre-post comparison was conducted by Régo et al., 2011. The team training included OB emergencies was based on CRM. The aim was to improve general communication skills and calling for help. Quantitative and qualitative surveys were performed in which physicians reported higher assertiveness and willingness to call for help post-intervention, but no differences were found for midwives. Overall, 94% of participants mentioned improvements in communication skills and realized their importance in post-intervention interviews [27]. Reszel et al., 2019 trained multidisciplinary OB teams and evaluated the effects in a retrospective post-intervention study with pre-post comparisons employing mixed methods. The intervention consisted of patient safety, culture interventions, and emergency communication strategies, e.g., SBAR. The outcome measures were communication quality, which was measured by semi-structured interviews. Participants reported improved interprofessional communication [72].

3.2.4 Interventions with *no* effect

The eight intervention studies demonstrating no effect of the training are characterized by rather simple intervention techniques such as providing a patient checklist to aid the gathering of information and improve shared-decision making. Half of them (4) were addressing interdisciplinary teams, with the other ones aiming at expectant mothers only (1), expectant mothers and OB/GYN residents (1), midwives only (1), or anesthetists and midwives (1). Additionally, some studies were not able to test the effectiveness of their interventions due to methodological shortcomings.

Cavicchiolo et al., 2019, for example, trained midwives and evaluated the clinical skills training in terms of neonatal resuscitation by pre-post comparisons. Communication dimensions in terms of coordinating, exchanging information, and gathering information were assessed with ANTS (Anesthetists' Non-Technical Skills). In addition, observer ratings of videotaped neonatal resuscitations were conducted. Results were that coordination and exchanging information could not be observed, and no differences in gathering information occurred, indicating shortcomings of the chosen evaluation instrument [39]. Zech et al., 2016 trained multidisciplinary obstetric teams with training containing emergency simulation, trying to target openness of communication. In the quantitative survey (HSOPS), no overall change in openness of communication could be found over time; however, the evaluation revealed large differences between hospitals [86].

With regard to the distal outcome of adverse events and patient safety, Romijn et al., 2019 aimed at multidisciplinary teams with team training based on CRM communication principles for intrapartum referrals and SBAR-intervention. Outcome measures were organizational data (AOI), but no changes in the AOI pre-and post-intervention measured could be found [74].

Taken together, studies revealing interventions with no effect were characterized by rather lowly elaborated training, addressing expectant mothers (besides professionals) and relatively weak methodology.

3.3 Study quality according to the Oxford Level of Evidence

In order to give an overview of how robust the results are (PICOS scheme question 5 on study design) and to examine *research question 5*, the Oxford Level of Evidence scale was applied. Overall, only one study was rated as level Ia (1,4%). Ten studies were categorized as Ib (14,1%), one as IIa (1,4%), and 13 as IIb (18,3%). Twelve studies ranged with IIIa (16,9%), and the majority (23 publications) could be classified as IIIb (32,4%). Additional 10 were rated as IV (14,1%).

Study designs with a higher level of evidence (Ia, Ib, IIa and IIb) all demonstrated positive effects of their communication interventions, but study designs with a low evidence level and thus lower quality (IV) were more likely to not demonstrate any effects (8 out of 10 studies failed to reveal positive effects, Figure 2). One out of all studies with a medium level of evidence (IIIa + IIIb) was similarly not able to show a positive effect. Interestingly, not only more but also stronger effects were found in the Ia and Ib evidence level studies than in the IIa and IIb evidence level studies when examining effect sizes (Figure 2). Summarizing the findings on *research question 5*, the study designs revealed partially robust results (strong effect meaning effect as hypothesized, some effects with some effects as hypothesized, some hypotheses not confirmed).

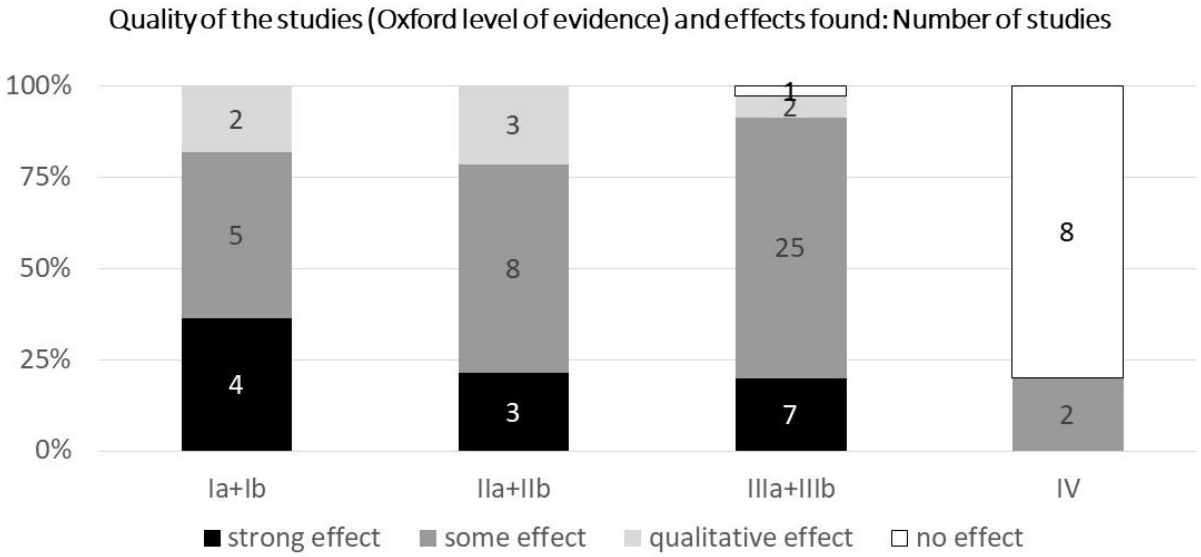

Figure 2. The number of studies rated regarding their level of evidence as an indicator for the robustness of a study's findings.

Methodological limitations that affected the robustness of evidence occurred in all studies that did not feature a control group, randomization, or assessment of control variables. Small sample sizes and large dropout rates prevented the calculation of statistics in some studies. Other limitations included the lack of pre-post comparisons (i.e., missing baseline measures) or observer follow-ups. In one study, pre-and post-samples were actually different: one group of patients assessed before HCP were trained and a different group after the training, so effects could have been caused by differences in groups.

Small sample sizes might be a reason for the lack of reporting concerning interaction effects in training evaluation. Only 6 publications reported interaction effects (8,5%), with only one study reporting a long-term follow-up. In this study, OB/GYN residents were assessed in a prospective cohort pilot study. After three months, it was evident that intervention effects were maintained at the post-intervention level over 3 months, but a further increase could not be reached [23].

Moreover, there was no clear description of how communication was trained or operationalized in the intervention in many original studies, which seemed especially problematic in qualitative studies. Most qualitative interviews, observations, or objective data lacked accurate and comprehensive reporting. Most studies, however, used subjective data, which would require

validation or additional evaluation of organizational or objective data. A possible bias in subjective data relates to social desirability, which was rarely controlled due to convenience sampling methods.

4. Discussion

Patient safety is one of the key aims in healthcare since multiple severe problems were reported. However, during the course of the research, *safe communication* has been identified as a crucial determinant of patient safety (culture) [4], which is also true for the obstetric setting. Consequently, communication training is a promising intervention when targeting patient safety incidents or PAEs in obstetrics.

Obstetrics is a specialty within healthcare, as women giving birth are usually healthy and usually need midwives' support rather than medical interventions [1]. For that reason, communication skills developed for other disciplines need to be adapted to the obstetric setting by considering the expectations and needs of the expectant mother before and during the birth process [87]. However, a physiological birth can quickly turn into a pathological birth process and thus challenge the obstetric team with a sudden, time-critical emergency situation. If a cesarean section results, this increases the negative consequences for the child as found in a meta-analysis [1].

Both the consideration of the expecting mother's needs in the normal course of birth and the professional coordination in an upcoming emergency situation is highly sensitive to communication skills and require, on the one hand, the ability to *responding to the mother's demand* and on the other hand fast and reliable *interprofessional communication skills* [88,89]. As various aspects of the field of obstetrics are of interest (from shared-decision making to emergency training), our searching strategy was based on a broad definition of communication and included different participant groups, interpersonal interactions, and communication tools. With this systematic review, we aimed to aggregate the current state of research on *communication interventions in obstetrics* by *looking at different target groups*.

4.1 Overall results

The overarching research question of this review was whether interventions including a communication component have an effect on a) proximal (i.e., communication skills) or b) distal (i.e., patient safety) performance indicators in obstetrics. Having provided an overview of interventions with high, moderate, and no effects, we can conclude that interventions, including a communication component, are effective for proximal outcomes.

Although communication was operationalized differently between studies, nearly 20% of all studies found effects as previously hypothesized regarding 'technical' or 'relational' communication skills. Another 56% found moderate effects indicating that the communication training had a positive impact on the trained study population, although different or smaller than hypothesized. In nine studies, only qualitative indicators were given so that effect sizes could not be computed/ inferred. However, these studies can provide a more in-depth understanding of the mechanism of how communication or team training improve skills or other communication outcomes, which is also valuable in understanding the effects of communication training, for instance, by demonstrating that many HCP were not aware of the importance of communication for patient safety prior to the communication training [44].

Regarding more distal – plausibly more objective and more expensive– patient safety outcomes, conclusions can only be drawn with great caution: Only three studies targeted patient safety outcomes such as adverse events with mixed results. One study provided evidence that the reporting and occurrence of PAEs could be reduced; one study did not find positive effects. Therefore, it is clear that more studies are needed aiming at reducing PAEs and thus improve patient safety. Only then, possible mechanisms can be identified and inform new and promising approaches.

Another important consideration limiting the conclusion that communication training is effective is that in nearly 44% of publications, communication was an integral part of a broader teamwork training approach. It is correspondingly unclear whether the communication intervention

alone improved communication skills or whether a team training framework is needed to achieve improvements in communication.

However, a majority of studies (56%) strongly focused on communication as a standalone intervention, thus indicating that the communication component is crucial. Nevertheless, more research in terms of dismantling studies is needed.

4.2 PICOS research questions

Following these general statements, it must be borne in mind that study designs and characteristics strongly differed between publications. Overall, our review presents studies with heterogeneous approaches regarding study participants, intervention methods, study design, outcome measures, and operationalization as well as study quality. Despite the common knowledge of the importance of communication for patient safety in obstetrics, it is yet not systematically trained in mothers.

Additionally, there are almost no studies with effects on patient safety measured directly. However, the majority evaluates proximal outcomes regarding communication skills. In the following, we provide an overview of how different study characteristics seem to impact the effectiveness of communication training according to the PICOS scheme.

4.2.1 Study population

Concerning the frequency of communication training, professionals who had finished their education were targeted more frequently. According to our results, students were explicitly addressed only in fewer studies. As communication is an essential aspect of patient safety, it should be trained at an early stage of education [57,90]. Furthermore, to reach sustainable improvement, it is recommended to be repeatedly provided on a regular schedule for all stages of career [91] for which we found no evidence in the reviewed intervention studies. Most studies implemented training that was not repeated or advanced.

As *expectant mothers* were rarely addressed and a mutual understanding of their needs is of crucial importance [4], we suggest including them more often. Expectant mothers and their partners should be targeted personally to improve communication skills and assertiveness within the birth process. A possible challenge is that expectant mothers usually only have very limited contact with the facility in which they plan to deliver their babies, thus making it difficult to address them in training prior to childbirth. This challenge is even more pronounced due to the current *COVID-19 pandemic*. Possible solutions include the adaptation of digital information or interventions. Creating digital possibilities (e.g., online training or training apps) might be beneficial in accounting for the patient perspective [20].

Furthermore, to value study population characteristics with regard to their background and culture, the health service context should be taken into account as obstetric teams in developing countries face different challenges than in developed countries and high-income regions [92,93]. In high-income countries and areas, barriers towards patient safety and communication are very different than in countries in which highly needed technological or medical equipment cannot be taken for granted [94].

4.2.2 Intervention characteristics

Our findings present that many interventions were part of a more comprehensive team training, e.g., simulation program, in which improved communication skills were one out of many more objectives. These results indicate that simple communication interventions should be integrated into broader team training, especially featuring a simulation of crucial situations. However, the current COVID-19 pandemic poses a significant barrier to the implementation of well-planned, repeated, and targeted training programs since infection prevention measures have to be met at all times. Especially in the near future, *digital interventions (telehealth, eHealth, mHealth)* open new avenues [4,20,67].

Potentials of digital modes become especially important in times of work concentration due to efficiency increasing, few experts on the labor market, and multi-tasking as a societal trend [95,96],

which are more long-term challenges in healthcare, including obstetrics. There are multiple advantages to digital training, such as adaptability to the user's needs [4], just-in-time-interventions [97], and a high number of potential users who are motivated to participate due to technological interests instead of the content, making it easier to reach rather unmotivated individuals [4,20,25,67]. Another benefit of digital interventions is that they might overcome distance rules due to the pandemic.

Concerning intervention techniques, it must be noted that few of them were described in detail. Since the availability of intervention protocols is an important aspect of Open Science, aiming to increase the *transparency and thus reproducibility* of interventions and evaluations [98], future research should aim to provide more accurate and clear descriptions of their design and interventions.

4.2.3 Comparisons and analyses

On the positive side, we can conclude that most of the pre-post comparisons indicate that trainings were effective. However, only 12 studies managed an RCT design, while the majority of intervention studies used designs with lower evidence levels. In addition, many studies lack a clear description of the respective significance of results. Furthermore, only a few interaction effects were reported.

Training outcomes were oftentimes only measured in a post-treatment time point of measurement, with only one study providing more long-term evidence [23]. These results indicate a need for more well-planned, high-quality interventions with a clear description of training topics, methods, and corresponding outcomes. What seems promising, however, was that study quality was related to the occurrence of positive effects overall publications. Out of the study designs with a higher level of evidence (Ia to IIb), zero reported no or negative effects, while studies of lower quality were more likely to demonstrate no positive effects (8 out of 10 in evidence level IV).

4.2.4 Outcomes

As mentioned above, the outcomes are mainly examined as proximal outcomes of the interventions (i.e., improved communication skills) while only a few studies tested for distal indicators such as patient safety or culture error reporting [11,12,74]. However, the variety of measured outcomes, including correct hand-over information, the support of assertiveness, openness, and interpersonal communication, mirrors the vast potential for optimization.

As different aspects of everyday clinical practice are addressed, it is difficult to draw conclusions regarding the improvement of communication and overall patient safety. However, the definition of communication applied in this systematic review already reflects the broadness of communication skills and techniques. Although the differentiation between 'technical' and 'relational' skills offer a first leverage point to frame communication, a *comprehensive model of necessary skills in obstetric care* has to our knowledge not yet been established. Defining a set of skills as well as a framework modeling the mechanisms could help to identify shortcomings and standardize communication training so that the most effective interventions could be further developed.

The same applies to the assessment and evaluation of PAE. Up to date, there is no general understanding of which events can be classified as a PAE in the obstetric setting, which makes it more difficult to identify and target determining factors. Therefore, an agreed-upon approach towards patient safety is needed, especially in obstetrics, gynecology, and women's health [92].

4.2.5 Robustness of study results

As described in section 3.3, about half of the studies (35 of 71) included were classified to level III of the Oxford Level of Evidence (OLE). While studies with a higher quality also revealed better results, we can conclude that the validity of effects drawn from most comparisons analyzed in this review is mixed due to the different designs, which also differed in quality. Furthermore, only the main effects but very few interaction effects were investigated. In this regard, we can conclude that the results of the aggregated studies appear robust in terms of general positive effects, but we expected to find stronger and higher quality in original studies. It appears that studies with a higher

quality also have a higher chance to actually detect positive effects. Thus, the recommendation clearly is to conduct well-planned studies and interventions.

All qualitative studies were assigned to level IV of the OLE as they mainly focused on additional aspects relating to communication such as empathy and non-verbal communication, reducing hierarchy as well as encouraging open discussions of cases. Although most qualitative publications reported some positive change, it should be taken into account that participants usually rate interventions favorably and perceive them as useful in terms of learning, working in a team, and communicating efficiently.

Only a few studies investigated *adverse effects or treatment errors* by capturing the number and reporting in organizational data. Especially qualitative studies lack comprehensive reporting, which is required for classification in OLE. This could be improved in the future. Thereby, qualitative designs can contribute substantially as they can be understood as the best suitable approach to gain a more in-depth understanding of the results of quantitative surveys or to exploit a research topic through subjective perspectives [3,13]. Therefore, qualitative results alone are not meant to be generalized in terms of quantification, but they contribute to a better understanding of behavior patterns and underlying mechanisms such as experiences, emotions, and cognition [99]. A systematic, qualitative review (e.g., qualitative meta-synthesis) would be beneficial to summarize according to results in the future. However, more original studies are needed for that, as for aggregating the quantitative results into a meta-analysis as well.

4.3 Limitations

Although this systematic review was able to summarize the literature regarding communication interventions in obstetrics and provide an overview of how study characteristics interrelate with effectiveness, there are some limitations that must be considered carefully. This study presents an overview of the current state of intervention studies on communication interventions in obstetrics published in English or German language. Therefore, it is likely that relevant results published in other languages were not covered. However, English is the natural language of research in which most results are published, which is why the overview should reflect most sources available to researchers in the obstetric field.

Another common limitation to nearly all systematic reviews and meta-analyses is the publication bias: Since we only searched for published articles in scientific search engines, we were not able to include studies that were never published in a peer-reviewed journal. However, it is more likely for studies without improvements or even with negative effects after interventions to be published, so our review might show a more positive and promising pattern than is actually existent.

Furthermore, as we included a broad range of studies covering several topics on communication improvement in obstetrics, we may have overlooked significant aspects detected in single studies. An example is the background and setting of the study protocols as well as the study population. Accordingly, it is very likely that obstetric teams in developing countries face different challenges and, therefore, must conduct research as well as training under different circumstances [92,93]. But even in high-income countries, birth settings are very different: A delivery in a high-level perinatal center requires a different approach from obstetric teams and the expectant mother than delivery in a birthing center or even at home. In future studies, cultural background and international or cultural diversity of the patient-provider team as well as among the healthcare professionals should be taken into account, too. Simple language difficulties may arise but not be overcome by simple digital devices such as translators. This needs to be taken into account, especially in times of high migration rates and recruitment of staff abroad.

Finally, it was especially not possible to conduct an in-depth analysis of qualitative research in the field, so that the focus of this review was to understand the effects and their moderators. Nevertheless, qualitative studies can add a deeper understanding of possible mechanisms and should thus be combined with qualitative research to more extent. Likewise, with the quantitative studies, analyzing and aggregating effect sizes with a meta-analytical procedure should be applied, which was not possible in this study due to too few appropriate studies.

5. Conclusions

Nevertheless, we conclude that our systematic review provides an overview of important aspects of obstetric communication training and thus suggestions for future research. In summary, a large majority of the intervention studies indicate a positive effect on proximal outcomes in obstetrics, such as communication skills or behavior. However, communication training seems to be more effective in combination with team training featuring a simulation of crucial, time-critical obstetric situations. The evidence regarding patient safety and thus, the reduction of PAE due to communication training is low because not many studies used clinical parameters as outcome measures. Consequently, more intervention studies, specifically targeting PAE in their interventions, are needed in order to ensure patient safety in obstetrics.

Concerning participants, the more experienced staff was trained than students, and few interventions included expecting mothers. This emphasizes the need for broader, ongoing training programs targeting all staff members in all levels of education. We recommend that communication training to be applied in an integral way of the education and professional to different target groups (students, educated staff on all professional levels, expectant mothers and their partners) to improve communication and thereby improve patient safety. Furthermore, communication and safety training should be integrated into educational curricula and provided throughout professional career and lifelong training/ continued education [9], as the effects of single training may fade away over time.

With regard to future research, we strongly recommend that studies investigating communication and patient safety in obstetrics aim for more high-quality RCT designs so that conclusions can be drawn with greater certainty. Referring to the publications described in this review, a lack of evidence still exists with regard to dismantling studies and also digital interventions [20], especially targeting mothers. This gap in the literature should be addressed by applying standards of Open Science so that interventions and designs can be reconstructed and replicated in the future.

Supplementary Materials: Appendix; see below.

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Appendix A

Initial Extensive Search Strategy *for publications published January 2000- December 2019*

Search databases: Web of Science, psycinfo, cinahl, medline (pubmed), eric, cochrane systematic reviews.

Search date: December 18, 2019 and January 17, 2020

Search phrase: (Communication training OR communication intervention OR team training OR team intervention OR communication skills OR team skills) AND obstetric*
((kommunikation OR teamwork OR team) AND (intervention OR training OR ma*nahme OR schulung) AND (geburtshilfe))

Fields searched (as applicable): Title, abstract, key concepts or key words, MeSh/Thesaurus [Note: in the second search in January 2020, 'obstetrics' was to be included in (Title, abstract, key concepts or key words, MeSh/Thesaurus) OR journal title to account for the fact that the word 'obstetrics' would not necessarily be included in a relevant study published in an obstetrics journal. However, to keep search results manageable, 'obstetrics' was included in the journal title to exclude all other medical specialties.]

Refinements: January 2000- December 2019, English or German language, peer reviewed

Inclusion criteria:
Some kind of training or intervention intended to improve communication in an obstetrics setting; empirical study (quantitative or qualitative). Two types of studies were included:
A) Intervention was focused on communication only / outcome could include communication or other variables (i.e., change in clinical process data) / outcome has to measure change in relevant variable (e.g., pre-post comparison or subjective report of skill improvement).
B) Intervention was focused on other topic (i.e., teamwork, quality improvement initiative) and INCLUDED communication. In that case, outcome variables need to explicitly measure communication (e.g., pre-post comparison or subjective report of skill improvement).

Exclusion criteria (any stage):
Communication part – intervention or outcome - not distinguishable from other training parts; no intervention; no variable measured that describes change; OB and other specializations not separated between OB and other specialties; not OB setting; wrong language, wrong year, dissertation, proceeding/Abstract/opinion piece/editorial; not enough info/ writing of insufficient quality to assess quality (i.e. Pakistani journal), not clear how communication was assessed, no data to back up claims)

Results in numbers (1st and 2nd search combined):
- Initial database entries: 6116 (plus 3 studies extracted from systematic reviews on the topic)
- Remove duplicates (automatically): 5155
- Remove duplicates manually: 4477
- Remove studies not meeting inclusion criteria (wrong language, year, type of publication): 4236
- After title screening (AW): 581 + After title screening (NL): 306 + After title screening (NH): 264
- (AW & NL & NH combined: 636)
- After abstract screening (AW): 192 + After abstract screening (NH): 171
- (AW & NH combined: 328)
- After fulltext screening (AW): 55 + After fulltext screening (NH): 75 + After fulltext screening (NS): 15
- (AW & NH combined: 102 – match 28)
- (AW & NS combined: 70 – match 6)

• Include after consensus discussion (AW & NH): 62 + Include after consensus discussion (AW & NS): 10
• FINAL STUDIES IN: 69 (3 duplicates between NS & NH)

Update Search strategy *for publications published in 2020*

Search databases: See Initial Extensive Search Strategy

Search date: 2020-11-26

Search phrase: See Initial Extensive Search Strategy

Fields searched (as applicable): See Initial Extensive Search Strategy

Refinements: January 2020- December 2020, English or German language, peer reviewed

Inclusion criteria: See Initial Extensive Search Strategy

Exclusion criteria (any stage): See Initial Extensive Search Strategy

Results in numbers (1st and 2nd search combined):

- Initial database entries: 22 (plus 0 studies extracted from systematic reviews on the topic)
- Remove duplicates (automatically): 0
- Remove duplicates manually: 0
- Remove studies not meeting inclusion criteria (wrong language, year, type of publication): 0
- After title screening: 4
- After abstract screening: 12
- After fulltext screening: 0
- Include after consensus discussion: 6
- FINAL STUDIES IN: 6 (0 duplicates)