Coordination and communication in healthcare action teams: The role of expertise

Michael J. Burtscher

Zurich University of Applied Sciences & University of Zurich

Fridtjof W. Nussbeck

University of Konstanz

Nick Sevdalis

King's College London

Stefan Gisin

University Hospital Basel

Tanja Manser

University of Applied Sciences and Arts Northwestern Switzerland

Published version: Burtscher, M. J., Nussbeck, F. W., Sevdalis, N., Gisin, S., & Manser, T. (2020). Coordination and Communication in Healthcare Action Teams. *Swiss Journal of Psychology, 79(3-4)*, 123-135. https://doi.org/10.1024/1421-0185/a000239

Correspondence concerning this article should be addressed to Michael J. Burtscher, ZHAW, Department of Applied Psychology, Pfingstweidstrasse 96, CH-8037 Zürich, Switzerland, E-mail: burf@zhaw.ch , Phone: +41 58 934 80 15

Abstract

Communication and coordination are central team processes in healthcare action teams. However, we have a limited understanding of how expertise affects these processes and to what extent these effects are shaped by interprofessional differences. The current study addresses these questions by jointly investigating the influence of different aspects of expertise – individual expertise, team familiarity, and expertise asymmetry – on coordination quality and communication openness. We tested our propositions in two hospitals: one in Switzerland (CH, Sample 1) and one in the United Kingdom (UK, Sample 2). Both samples included two-person anesthesia action teams consisting of a physician and a nurse ($N_{CH} = 47$ teams, $N_{UK} = 48$ teams). We used a correlational design with two measurement points (i.e., pre- and post-operation). To consider potential interprofessional differences, we analyzed our data with actor-partner interdependence models. Moreover, we explored differences in the effects of expertise between both hospitals. Our findings suggest that nurses' expertise is the most important predictor of coordination quality and communication openness. Overall, differences between the two hospitals were more prevalent than interprofessional differences between physicians and nurses. The current study provides a nuanced picture of the effects of expertise, and thereby extends our understanding of interprofessional teamwork.

Keywords: action team, expertise, coordination, communication, interprofessional

Word count (excl. abstract, references, figures, and tables): 5973

Introduction

Teamwork is a major contributor to safe and efficient patient care (Dinh et al., 2020; Schmutz et al., 2019), particularly in dynamic settings such as operating rooms and intensive care units (e.g., Manser, 2009; Reader et al., 2009; Wilson et al., 2005). Most teams in these settings can be classified as action teams (Edmondson, 2003; Farh & Chen, 2018; Klein et al., 2006; Kolbe et al., 2014; Vashdi et al., 2013) – teams of highly skilled specialists cooperating for brief performance episodes in a challenging environment (Sundstrom et al., 2000). Due to the interdependence and urgency of tasks, effective coordination and open communication of information are considered central determinants of team performance (Edmondson, 2003; Fernandez et al., 2008; Reader et al., 2009).

Consequently, research has sought to identify factors that positively affect coordination quality and communication openness. Expertise represents a likely candidate: research has emphasized the impact of both individual members' expertise (e.g., Patel et al., 2000) as well as team familiarity – the expertise of having worked together before – (e.g., Kurmann et al., 2014) on teamwork in healthcare. In addition, it has been suggested that other aspects of expertise also play an important role. Transactive memory systems (i.e., knowledge about 'who knows what') were positively related to perceived team effectiveness in anesthesia (Michinov et al., 2008). Moreover, differences in team members' perceptions of each other's expertise have been shown to affect coordination and performance (Gardner & Kwan, 2012). As healthcare teams are characterized by their interprofessional composition (Hughes et al., 2016; Kvarnström, 2008) whereby individual members possess distinctive sets of knowledge and skills, we regard the perception of differences in expertise as particularly relevant predictor of teamwork. To conceptualize these differences, we introduce the construct of 'expertise asymmetry' – the degree to which team members perceive their own task-related expertise to differ from the expertise of their teammates.

The current study simultaneously investigates three aspects of expertise – individual expertise, team familiarity, and expertise asymmetry – in two-person anesthesia action teams. Importantly, we quantify interprofessional differences in the effects of expertise by analyzing our data using actor-partner interdependence models (APIM; Kenny et al., 2006), a statistical technique that allows for modeling specific effects for physicians and nurses. Finally, we collected data in two different hospitals - one in Switzerland and one in the United Kingdom – which allowed for exploring inter-organizational differences in the effects of expertise. The current research aims to improve our understanding of healthcare action teams by investigating how different aspects of expertise affect major team processes and whether the effects of expertise are shaped by interprofessional and inter-organizational differences. Given the vital role of teamwork in healthcare, we regard this as an important contribution to the literature that also has practical implications.

Theoretical background

Teamwork in healthcare

Teamwork is particularly important in dynamic healthcare settings such as operating rooms and intensive care units (e.g., Manser, 2009; Reader et al., 2009; Wilson et al., 2005). Most teams in these settings can be classified as action teams (Edmondson, 2003; Farh & Chen, 2018; Klein et al., 2006; Kolbe et al., 2014; Vashdi et al., 2013). As an example, consider a trauma team of anesthesiologists, surgeons, and nurses who treat the victims of a car accident. Such teams typically have to “respond to unexpected events in a coordinated way, often requiring a free and open transfer of information to enable real-time, reciprocal coordination of action” (Edmondson, 2003, p. 1421). Action teams perform tasks where poor teamwork can have serious consequences including the loss of human life (e.g., Burtscher et al., 2018; Klein et al., 2006; Kolbe et al., 2014). Moreover, these teams are unstable: they are brought together for a single performance episode (e.g., surgical procedure), may change team composition depending on emergent task requirements and disband upon completion (Ishak & Ballard, 2012; Tschan et al., 2006; Vashdi et al., 2013).

Another key characteristic of healthcare teams is that they are professionally diverse and often multidisciplinary (Edmondson, 2003; Hughes et al., 2016). They can include anesthesiologists, surgeons, emergency physicians, nurses, and paramedics. Thus, members of healthcare teams differ in their training, their professional cultures, and their perceptions regarding team members' roles and responsibilities (Sexton et al., 2000; Thomas et al., 2003). A number of studies suggest that these interprofessional differences affect key team processes such as communication and coordination (e.g., Kvarnström, 2008; Lingard et al., 2002; Powell & Davies, 2012).

Coordination quality and communication openness

Effective coordination is a critical process in healthcare action teams because their tasks are highly interdependent: In the operating room, actions of one team member may require an immediate reaction from another team member (Helmreich & Schaefer, 1994). The importance of coordination is amplified in interprofessional teams where activities must be coordinated among individual experts because certain tasks have to be completed by a specific member (e.g., Cannon-Bowers & Bowers, 2011; Hughes et al., 2016). Empirical research confirms the importance of coordination quality. A series of studies has emphasized the importance of coordination to the performance of anesthesia teams (e.g., Burtscher, Manser, et al., 2011; Burtscher et al., 2010; Manser et al., 2009), and a review highlights the importance of effective coordination for teams performing cardiopulmonary resuscitation (Fernandez Castelao et al., 2013).

Communication openness represents another central determinant of action team performance in healthcare (Manser, 2009; Reader et al., 2009; Tschan et al., 2015). Given the interdependence, urgency, and unpredictability of their tasks, free and open transfer of information is considered vitally important (Edmondson, 2003). In support of this proposition, less intra-team information sharing during surgery was found to increase the likelihood of patient death or major complications (Mazzocco et al., 2009), and communication failures have frequently been linked to adverse events in the operating room (Greenberg et al., 2007; Lingard et al., 2004; Williams et al., 2010). In this context, interprofessional barriers can impede open communication and, thus, compromise patient safety and quality of care (Nagpal et al., 2010).

The role of expertise

In general, expertise can be described as possessing expert skill or knowledge in a specific area. In the team context, expertise includes multiple aspects. For one, individual members' expertise – the specialized skills and knowledge that an individual brings to the team's task – is one of the most important team resources (Bunderson, 2003; Faraj & Sproull, 2000). Research has demonstrated that members' task-related expertise is positively related to team processes and outcomes (e.g., Bonner et al., 2002; Littlepage et al., 1997). In healthcare, the role of expertise for teamwork has also been emphasized (e.g., Oborn et al., 2019; Patel et al., 2000). However, the role of expertise in interprofessional healthcare teams has received limited attention in literature. Although their roles and responsibilities overlap to a certain degree (e.g., anesthesiologist and anesthesia nurse), team members have received different training (i.e., medical school vs. nursing school) and thus, their expertise in a specific area can vary considerably.

Besides individual expertise, the expertise of having worked together before is likely to affect coordination quality and communication openness in healthcare action teams. This expertise is referred to as team familiarity (cf. Huckman et al., 2009). Higher team familiarity has been proposed to have positive effects on team performance because it is beneficial for coordination, particularly during early stages of a team's existence (Guzzo & Dickson, 1996). In line with this notion, team familiarity has been related to team performance and patient outcomes in surgical teams (Kurmann et al., 2014; Xu et al., 2013).

Importantly, research indicates that not only the absolute amount of expertise within a team but also other aspects of members' expertise play a critical role. Before a team can benefit from having expert members, their expertise has to be recognized: teams perform better when their members know 'who is good at what' (e.g., Ellwart et al., 2014; Faraj & Sproull, 2000; Littlepage et al., 1995). Knowledge about 'who knows what' represents a component of transactive memory systems, which have been related to perceived team effectiveness in anesthesia (Michinov et al., 2008) and interprofessional team experience in geriatrics (Tan et al., 2014). Moreover, research suggests that differences in team members' perceptions of each other's expertise affect coordination (Gardner & Kwan, 2012).

As interprofessional healthcare teams are characterized by individual differences in knowledge, skills, and attitudes, we propose that perceptions of these differences play an important role. In particular, we suggest that perceptions of one's own knowledge and skills in comparison to the perception of one's teammates' knowledge and skills affect team processes. We conceptualize this difference as expertise asymmetry – the degree to which team members perceive their own task-related expertise to differ from the expertise of their teammates. Importantly, expertise asymmetry is different from status or power (cf. Galinsky et al., 2015). Whereas the latter focuses on overall hierarchical differences (i.e., higher vs. lower status), expertise asymmetry captures qualitative differences in knowledge and skills between team members. Higher levels of asymmetry indicate that members perceive their own task-related expertise to be qualitatively different, but not necessarily higher or lower, from that of their teammates.

As an example, consider a two-person team performing a task which requires two types of expertise. One team member may feel very experienced with respect to the first type of expertise ('100%') but less experienced with respect to the second type of expertise ('50%'). At the same time, this team member perceives the teammate to be less experienced in the first ('50%') and highly experienced in the second type of expertise ('100%'). Hence, overall, the team member perceives him/herself as equally experienced as his/her teammate but he/she thinks that they differ *qualitatively* from each other in the distribution of their expertise.

The present research

We simultaneously investigate the influence of three aspects of expertise (i.e., individual expertise, team familiarity, expertise asymmetry) on two key team processes – coordination quality and communication openness. We propose that expertise asymmetry explains differences in these processes above and beyond individual expertise and team familiarity. We expect, however, that expertise asymmetry exerts differential effects on both outcomes. We hypothesize that expertise asymmetry will positively affect coordination quality (Hypothesis 1). This is because in asymmetric teams, it is easier to determine which team members have the most expertise in specific areas ('who is good at what'), which in turn facilitates task allocation (e.g., Austin, 2003; Ellwart et al., 2014; Faraj & Sproull, 2000). For example, if Member A is very skilled in one area, while Member B is not skilled, it is self-evident that Member A should perform tasks in this area. However, if Member A and B are both equally skilled, task coordination becomes more challenging as it has to be made explicit and potentially negotiated.

By contrast, for communication openness, we hypothesize that expertise asymmetry will have a negative effect (Hypothesis 2). This is because perceiving differences in expertise indicates an interprofessional gap, which constitutes an impediment of open communication

(Hughes et al., 2016; Lingard et al., 2002). For example, one team member may feel that the other member does not have sufficient task-specific expertise to make a contribution, and therefore sees no need to openly share information.

To explicitly address interprofessionalism, we investigated how the effects of expertise differ between physicians and nurses (Research question 1). Moreover, we collected data from two hospitals: one in Switzerland and one in the United Kingdom. We were interested in whether inter-organizational differences between the two hospitals would influence the effects of expertise (Research question 2). In the British sample, we also explored differences between teams that included a resident physician or an attending physician (Research question 3). Thus, the present study included three different sets of teams: 1) teams with a resident physician from a Swiss hospital, 2) teams with a resident physician from a British hospital, and 3) teams with an attending physician from a British hospital.

General Method

Design and procedure

We tested our predictions in anesthesia teams because they represent a prototypical example of healthcare action teams (Kolbe et al., 2014), and include members from different professions who possess specialized skills (i.e., physicians and nurses). We used an observational design with two measurement points: Individual expertise, team familiarity, and expertise asymmetry were measured before the start of the operation; coordination quality and communication openness were measured after the operation was completed. To ensure comparability between cases, we only considered elective operations.

The study as such and the data collection in Switzerland were approved by the "Ethikkommission beider Basel" (now: "EK Nordwest- und Zentralschweiz"), reference number: 21/12. Participants provided written informed consent prior to the data collection. The UK study was part of a wider research program on observational assessment of clinical teams and approved as such through the Imperial Centre for Patient Safety and Service Quality (‘Teams, skills and safety’ program, led by NS at the time of the study: www.imperial.ac.uk/patient-safety-translational-research-centre/our-work/prior-to-august-2017/theme-4-teams-skills-and-safety/). As the study was part of a larger study program and involved minimal-risk for participants, participants were provided with information about the study and gave explicit oral consent before they were handed the questionnaire. Moreover, the questionnaire itself included a description of the study (e.g., aim of the study, guarantee of anonymity, voluntary participation). Thus, filling in the questionnaire was considered as written consent.

Measures

Individual expertise and expertise asymmetry. With guidance from subject matter experts from both organizations, we identified nine relevant areas of expertise for anesthesia. These include infection control, drug administration, and dealing with ventilation problems (see Appendix A). Participants were asked to indicate a) their personal level of expertise in each of these areas, and b) the level of expertise of their teammate on a 7-point Likert-scale (1 = very inexperienced to 7 = very experienced). The scale for individual expertise had excellent reliability in both samples ($\alpha_{Sample1} = .95$, $\alpha_{Sample2} = .96$). Thus, items were averaged to obtain single scores for individual expertise.

Expertise asymmetry was calculated as squared Euclidean distance between participants’ ratings of their own expertise and their ratings of their teammate’s expertise for each of the nine items separately. Again, these scores were averaged to obtain a single measure of expertise asymmetry. Expertise asymmetry ranges from zero to a potential maximum value of 36, with higher values indicating higher levels of asymmetry.

Team familiarity. We measured team familiarity with the item "How often have you worked with your teammate before?" (1 = never to 5 = very often). Physicians' and nurses' familiarity scores were highly correlated. We averaged them to form a single team-level rating in order to increase parsimony of the statistical analyses.

Coordination quality. We used the five-item scale developed by Lewis (2003) to operationalize the quality of team coordination. A sample items is "We worked together in a well-coordinated fashion". Participants indicated their agreement using a 7-point Likert-scale (1 = strongly disagree to 7 = strongly agree; $\alpha_{Sample1} = .81$, $\alpha_{Sample2} = .71$).

Communication openness. We used O'Reilly and Roberts' (1977) five-item scale to measure communication openness. The wording was slightly adapted to the setting of the current study. A sample item is "It was easy to talk openly to my teammate." Participants indicated their agreement using a 7-point Likert-scale ($\alpha_{Sample1} = .90$, $\alpha_{Sample2} = .92$).

Analytic strategy: Actor-partner interdependence models

We used actor-partner interdependence models (APIM, see Figure 1) to model the psychological and statistical non-independence of the two team members' variables (Kenny et al., 2006). Due to the interactive character of the common task for physicians and nurses, which is likely to influence individuals' task-related cognitions and behaviors, but also due to the nested data structure (i.e., two persons form a team), APIM were deemed as most appropriate analytical strategy. In addition, the APIM allows for analyzing actor and partner effects: actor effects are effects within an individual (e.g., effect of nurse's expertise asymmetry on nurse's coordination quality), whereas partner effects are effects of one team member on the other (e.g., nurse's expertise asymmetry on physician's coordination quality).In our model, there are two actor effects (i.e., one within nurses and one within physicians) and two partner effects (i.e., one running from nurse to physician and one the opposite way). These effects adequately reflect the interdependence of the two team members' views about coordination quality and communication openness. Please note that the definition of actor and partner effects is solely determined by the dependent variable (of nurses or physicians); it is not the role of an individual. APIM were calculated using Mplus 7.4 (Muthén & Muthén, 1998-2015).

----- *insert Figure 1 about here* -----

Importantly, we only included nurses' expertise scores, that is, their averaged self-ratings regarding the nine areas of expertise (see above), as a predictor. Physicians' expertise was not entered as predictor variable because it is confounded with the physician's level of seniority (i.e., resident vs. attending). In the first sample, all teams included a resident physician, whereas, in the second study, about half of the teams included a resident and half the teams an attending physician. Consequently, we analyzed these three sets of teams separately: teams consisting of a resident physician and a nurse from sample 1 (CH), 2) teams consisting of a resident physician and a nurse from sample 2 (UK), and 3) teams consisting of an attending physician and a nurse from sample 2 (UK).

Sample 1

Participants and setting

Data collection was conducted at a teaching hospital in Switzerland. Our sample included 47 two-person anesthesia teams consisting of a resident physician and a nurse who worked together over the course of one operation. Reflecting the reality of changing team composition within a restricted set of potential team members, a number of participants included in this study were working in more than one team. However, we made sure that each team included in our sample had a unique composition, meaning that if a person was part of multiple teams, it was always with a different teammate. In total, 23 physicians and 25 nurses participated in the study. Physicians were on average 33.78 years old (*SD* = 4.06) and had work experience of 5.38 years (*SD* = 3.80); nurses were on average 37.16 years old (*SD* = 8.96) and had work experience of 6.44 years (*SD* = 7.04). For reasons of confidentiality, we did not collect data on participants' gender in either of the two samples.

Results

Table 1 provides an overview of descriptive statistics. The relatively high mean scores indicate that physicians and nurses were equally positive in their assessment of their teams' communication and coordination. Zero-order correlations indicate that both team members agreed about expertise asymmetry in their team (r = .49). Interestingly, in those teams with more experienced nurses, both team members perceived less asymmetry (r = -.30 and r = -.61). Not surprisingly, considering the action team's task, communication openness and coordination quality were correlated in one team member's view. These correlations exceeded the correlations of the team members when rating the same outcome (coordination or communication, see Table 1, shaded area).

----- *insert Table 1 about here* -----

The APIM (see Table 2, upper part) revealed that for physicians***, coordination quality*** could be predicted by team familiarity (β = .29), whereas for nurses, coordination quality could be predicted by their own self-rated expertise (β = .44). Importantly, we found the expected positive effect of expertise asymmetry for both physicians (β = .27; one-tailed p < .05; two-tailed p = .09) as well as for nurses (β = .40). In support of Hypothesis 1, the more asymmetric physicians and nurses perceived their team, the better they judged the coordination quality during the operation. Taken together the independent variables explained

15% of the variance of physicians' coordination quality ratings and 13% of the nurses' ratings.

----- *insert Table 2 about here* -----

With respect to ***communication openness***, no predictor in the APIM turned significant. Thus, our second hypothesis was not supported in this sample. The proportions of explained variance were very low with 5% for physicians and 3% for nurses.

Sample 2

Participants and setting

We collected data at a teaching hospital in the United Kingdom. Our sample included 48 two-person anesthesia teams consisting of a physician and a nurse (In the UK, instead of a nurse, anesthesia teams often include an operating department practitioner. As both have the same roles and responsibilities, we did not distinguish between them). Compared to sample 1, teams tended worked together for multiple performance episodes (i.e., surgical procedures) and only a few participants were part of more than one team. Again, we made sure that each team had a unique composition. In total, 42 physicians and 45 nurses participated in the study. Physicians were on average 38.10 years old (*SD* = 9.00) and had a work experience of 10.70 years (*SD* = 8.66); nurses were on average 39.56 years old (*SD* = 8.64) and had a work experience of 11.31 years (*SD* = 9.86).

The second sample provided the opportunity to explicitly consider the level of seniority of the physician because teams in the second sample included either a resident (N = 25) or an attending physician (N = 23). We were interested in potential differences regarding the effects of expertise between teams with a resident and teams with an attending physician. As expected, there was a significant difference regarding individual expertise between residents (*M* = 5.43, *SD* = 1.01) and attending physicians (*M* = 6.79, *SD* = 0.29), $t(23.28) = -5.92$, $p < .001$. As we only had a few missing data points in our dependent variables and we could presume "missing at random", we used the FIML (i..e, full information maximum likelihood) estimator implemented in Mplus 7.4 (Muthén & Muthén, 1998-2015). This allowed us to make full use of the data at the team-level.

Results

Descriptive statistics are depicted in Table 3. With regard to mean scores, we found a similar pattern as in sample 1 in that physicians and nurses were both positive in their assessment of coordination quality and communication openness. Exceptions are resident physicians who seemed to have on average lower ratings of communication openness, as compared to both nurses as well as attending physicians. Notably, in teams with resident physicians, nurses' ratings of coordination quality and communication openness were strongly associated, whereas these ratings were uncorrelated in teams with attending physicians.

----- *insert Table 3 about here* -----

Coordination quality

With respect to the APIM (Table 4), we found that in ***teams with resident physicians***, the most important factor was nurses' self-rated expertise (β = .49), which predicted physicians' ratings of coordination quality. No other predictor turned significant. Thus, hypothesis 1 was not supported. The model explained 34% percent of the variance in physicians' coordination quality ratings, but only 10% of the variance in nurses' ratings.

----- insert Table 4 about here -----

For ***teams with attending physicians***, physicians' coordination quality ratings could again be predicted by nurses' expertise (β = .50). As expected, physicians' expertise asymmetry (β = -.42) predicted variance coordination quality as rated by physicians above and beyond the other aspects of expertise. Contrary to our expectations, the effect was negative, indicating that higher ratings of expertise asymmetry were related to lower coordination quality. No predictor for nurses' ratings of coordination quality turned significant. In total, the model explained 48% of the variance in attending physicians' coordination quality, and 18% of nurses' coordination quality.

Communication openness

Concerning communication openness, we found that for ***teams with resident physicians***, nurses' ratings of communication openness could be predicted by their own expertise (β = -.64). In support of Hypothesis 2, higher levels expertise asymmetry perceived by nurses were related to less communication openness as perceived by nurses (β = -.65). The model explained 18% of the variance in resident physicians' communication openness ratings and 38% of the nurses' variance.

For ***teams with attending physicians***, our analysis revealed a different pattern. Physicians perceived communication to be open, when the team is familiar (β = .35), and the nurse is experienced (β = .37). In support of Hypothesis 2, higher levels of expertise asymmetry perceived by physicians were related to less communication openness as perceived by physician (β = -.64). However, no predictor for nurses' communication openness ratings turned significant. In teams with attending physicians, the model explained 73% of the physicians' communication openness ratings and 23% of the of nurses' ratings.

Overview of main findings

Table 5 provides an overview of the main findings from the six APIMs. The table indicates the presence of a positive or negative effect for each combination of predictors and outcomes for the three types of team in our study. For ease of illustration, we do not distinguish between actor and partner effects.

----- *insert Table 5 about here* -----

Discussion

The goal of the current study was to specify the effects of expertise on coordination quality and communication openness in healthcare action teams. All three aspects of expertise (individual expertise, expertise asymmetry, and team familiarity) contributed to explaining the team processes we evaluated: up to 48% of the variance in coordination quality and up to 73% in communication openness. The significance of each aspect, however, varied between professions (i.e., physicians and nurses) and across the three types of teams found in the two participating organizations.

Overall, nurses' expertise seems to be the most important predictor of coordination quality and communication openness: Five of the six APIMs revealed significant effects (Table 5). In particular with regard to coordination quality, we found positive effects for all three team types: Having a nurse with a high task-related expertise facilitates team coordination. In partial support of our hypotheses, expertise asymmetry did explain variance above and beyond individual expertise and team familiarity in four models. Team familiarity seems to have the least explanatory power: Only two models revealed significant effects.

Research implications

The current research suggests that perceptions of differences in expertise (i.e., expertise asymmetry) explains variance above and beyond the known effects of individual expertise and team familiarity. This finding is in line with previous research showing that not only the absolute amount of expertise within a team but also other aspects of members' expertise affect team processes and outcomes (e.g., Burtscher & Oostlander, 2019; Ellwart et al., 2014; Faraj & Sproull, 2000). Specifically, findings from sample 2 suggest that perceptions of differences in expertise impede open communication under some conditions. This finding has potential implications for research on speaking up (e.g., openly voicing concerns to senior team members), which represents an important factor for performance and safety in both healthcare (Edmondson, 2003; Noort et al., 2019) as well as in other action team settings (Krenz & Burtscher, 2020). Given that team members are reluctant to speak up (e.g., Raemer et al., 2016; Weiss et al., 2017), focusing on expertise perceptions could represent a fruitful avenue for future research.

Regarding potential interprofessional differences, physicians and nurses were similarly positive in their assessment of coordination quality and communication openness. Moreover, the APIMs predict similar effects for physicians and nurses in sample 1. In this sample, we found positive effects of expertise asymmetry on coordination quality for both physicians and nurses. Regarding communication openness, findings for physicians and nurses were identical in that no aspect of expertise had a significant effect. In sample 2, however, we find some evidence for interprofessional differences. For physicians, working with an experienced nurse was positively associated with coordination quality and communication openness. In addition, team familiarity seems to be beneficial in teams with attending physicians. For nurses, by contrast, these factors did not have any positive effect on either team process. In fact, for nurses that worked with a resident physician, having high expertise was negatively related to perceptions of communication openness. This finding is in line with recent research showing that junior physicians and nurses significantly differ in their assessment of the causes of poor teamwork (O'Connor et al., 2016). Importantly, we would like to emphasize that although expertise seems to have worked differently for physicians versus nurses in sample 2, we did not find any opposite effects: In each of the four models (Table 4), if a predictor had a positive effect for physicians, it never had a negative effect for nurses and vice versa. In sum, although we found some interprofessional differences in sample 2, we believe that these differences should not be overrated given the general similarities between physicians' and nurses' ratings.

Finally, our findings suggest inter-organizational differences between the two hospitals: In sample 1, expertise asymmetry was positively related to coordination quality and unrelated to communication openness. By contrast, in sample 2, we find negative effects of expertise asymmetry, not only on communication openness, but also on coordination quality. How might this pattern be explained? Although task and team composition are equal in both samples, teams differ with regard to their stability (e.g., Hollenbeck et al., 2012): Whereas in the Swiss hospital teams often disband upon completion of one operation and new teams are formed ad-hoc, teams in the British hospital tend to work together over the course of an operating list, which includes several operations. More fluid action teams, such as in the first sample, must often coordinate tasks and solve problems immediately upon formation, even though they have limited experience working together (Klein et al., 2006; Vashdi et al., 2013; Wildman et al., 2012). Having hardly any time for team building, members of these teams have to rely on their initial assessment of their teammate's expertise. Consequently, expertise asymmetry becomes an important factor for coordinating tasks: higher asymmetry indicates a clear differentiation of knowledge and skills within the team, and thus, facilitates coordination. By contrast, in action teams that work together over the course of multiple performance episodes, coordination does not have to be based on initial perceptions. Instead, team members might have developed routines for coordinating tasks, clarified roles, and established a shared mental model, which represents an important factor for teamwork in healthcare (Burtscher, Kolbe, et al., 2011; Burtscher & Manser, 2012). It should be noted that our conclusion that team stability is the underlying factor explaining the inter-organizational differences is at this point speculative. Consequently, future research should address this issue by comparing a larger set of organizations.

Practical implications

Our findings indicate that the presence of nurses with high expertise facilitates coordination quality and communication openness. This suggest that healthcare teams should indeed be interprofessional and the role of nurses further recognized. Consequently, we state a need to plan interprofessional job roles and to allow for the necessary interprofessional training. Ideally, training interprofessional teamwork should start from medical and nursing schools: We cannot simply throw people into a team and expect them to work well together (e.g. Paige et al., 2017).

The need for early interprofessional training is further emphasized by our finding that nurses' expertise had fewer positive effects in teams with resident physicians. In the absence of respective training, physicians are forced to learn working interprofessionally on the job. Apparently, senior physicians were able to acquire interprofessional teamwork skills over the course of their career, whereas junior physicians were not. Thus, specific training measures for developing interprofessional skills such as cross-training (e.g., Wilson et al., 2005) might be particularly beneficial for junior physicians.

Finally, our findings indicate that differences between the two hospitals – rather than differences between physicians and nurses – affect teamwork in healthcare. This should be considered in designing training and interventions: What works well in one hospital, might not have a positive effect in another, depending on the way in which teams are organized.

Limitations and future research

The statistical analyses were conducted relying on APIM. Yet, as several physicians and nurses were part of different teams, although each team had a unique composition, our analyses do not respect the nested data structure completely (e.g., teams nested in nurses or physicians). We were not able to respect this data structure completely due to the relatively small number of physicians and nurses. This limitation reflects the reality of conducting field studies in hospitals with a restricted pool of potential participants. Still, in future studies, sample sizes should be enlarged to consider every individual only once or to respect the cross-nesting adequately.

Besides, all our measures were self-report, which introduces the possibility of common-method bias (Podsakoff et al., 2012). We tried to decrease potential confounding effects by collecting predictor and outcomes variables at two different points in time. Moreover, the APIM takes into account correlations between predictors. Nonetheless, future research should aim to use alternative methods such as behavioral observation to assess the effects of expertise in healthcare action teams.

Our study was also limited in that it focused on anesthesiologists and nurse anesthetists. As they work within the same discipline, differences in expertise are relativity modest within these teams, at least compared to multi-disciplinary teams. Future research therefore should try to consider the wider operating room team, which also comprises surgeons and perioperative nurses, and commonly includes both senior members and trainees. Analyzing expertise asymmetry and its effects in such a complex dynamic team was beyond the scope of the current study, but we believe our study offers a foundation for such larger studies to be undertaken.

Moreover, future research should investigate additional aspects of expertise. While we think individual expertise, team familiarity, and expertise asymmetry represent key aspects of expertise in healthcare teams, other aspects of expertise likely play a role. For example, research has highlighted the importance of leadership in healthcare teams (Hu et al., 2016; Künzle et al., 2010; Tschan et al., 2006). Thus, leadership expertise would be another aspect worth considering.

Conclusion

Our study showed that individual expertise, expertise asymmetry, and team familiarity contribute to the prediction of both communication openness and coordination quality in healthcare action teams. Importantly, differences in the effects of expertise between the two hospitals in our study were more prevalent than interprofessional differences between physicians and nurses. In addition, the current research suggest that that expertise asymmetry explains variance above and beyond the other the variables. Overall, our findings provide a nuanced picture of the effects of expertise and thereby extend our understanding of interprofessional healthcare action teams, with potential implications for other action team settings.

Conflict of Interest

NS is the Director of London Safety & Training Solutions Ltd, which provides teamworking, patient safety and improvement skills training and advice on a consultancy basis to hospitals and training programs in the UK and internationally. The other authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

MJB designed this study, prepared the study protocol, contributed to the data analyses, and drafted the manuscript. FWN analysed the data, interpreted the findings, and helped writing the manuscript. NS was involved in the design of the study, helped with the data collection, and revised the manuscript. SG helped with the study protocol and the data collection, and contributed to the manuscript. TM was involved in the design of the study and helped writing the manuscript.

Funding

This research was partly funded by an IDEA league research grant to MJB.

NS' research was supported by the National Institute for Health Research (NIHR) Collaboration for Leadership in Applied Health Research and Care South London at King's College Hospital NHS Foundation Trust. NS is a member of King's Improvement Science, which is part of the NIHR CLAHRC South London and comprises a specialist team of improvement scientists and senior researchers based at King's College London. Its work is funded by King's Health Partners (Guy's and St Thomas' NHS Foundation Trust, King's College Hospital NHS Foundation Trust, King's College London and South London and Maudsley NHS Foundation Trust), Guy's and St Thomas' Charity, the Maudsley Charity and the Health Foundation. The views expressed are those of the authors and not necessarily those of the National Health Service, the NIHR, or the Department of Health and Social Care.

Acknowledgments

The authors are grateful to Surbhi Malhotra for her help in planning this research. We also thank Etna Engeli and Norlan Lau for their assistance with data collection.

References

Austin, J. R. (2003). Transactive memory in organizational groups: The effects of content, consensus, specialization, and accuracy on group performance. *Journal of Applied Psychology, 88*(5), 866-878. https://doi.org/10.1037/0021-9010.88.5.866

Bonner, B. L., Baumann, M. R., & Dalal, R. S. (2002). The effects of member expertise on group decision-making and performance. *Organizational Behavior and Human Decision Processes, 88*(2), 719-736. https://doi.org/10.1016/S0749-5978(02)00010-9

Bunderson, J. S. (2003, December 1, 2003). Recognizing and utilizing expertise in work groups: A status characteristics perspective. *Administrative Science Quarterly, 48*(4), 557-591. https://doi.org/10.2307/3556637

Burtscher, M. J., Kolbe, M., Wacker, J., & Manser, T. (2011). Interactions of team mental models and monitoring behaviors predict team performance in simulated anesthesia inductions. *Journal of Experimental Psychology: Applied, 17*(3), 257-269. https://doi.org/10.1037/a0025148

Burtscher, M. J., & Manser, T. (2012). Team mental models and their potential to improve teamwork and safety: A review and implications for future research in healthcare. *Safety Science, 50*(5), 1344-1354. https://doi.org/10.1016/j.ssci.2011.12.033

Burtscher, M. J., Manser, T., Kolbe, M., Grote, G., Grande, B., Spahn, D. R., & Wacker, J. (2011). Adaptation in anaesthesia team coordination in response to a simulated critical event and its relationship to clinical performance. *British Journal of Anaesthesia, 106*(6), 801-806. https://doi.org/10.1093/bja/aer039

Burtscher, M. J., Meyer, B., Jonas, K., Feese, S., & Tröster, G. (2018). A time to trust? The buffering effect of trust and its temporal variations in the context of high-reliability teams. *Journal of Organizational Behavior, 39*(9), 1099-1112. https://doi.org/10.1002/job.2271

Burtscher, M. J., & Oostlander, J. (2019). Perceived Mutual Understanding (PMU). *European Journal of Psychological Assessment, 35*(1), 98-108. https://doi.org/10.1027/1015-5759/a000360

Burtscher, M. J., Wacker, J., Grote, G., & Manser, T. (2010). Managing nonroutine events in anesthesia: The role of adaptive coordination. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 52*(2), 282-294. https://doi.org/10.1177/0018720809359178

Cannon-Bowers, J. A., & Bowers, C. (2011). Team development and functioning. In *APA Handbook of Industrial and Organizational Psychology* (Vol. 1, pp. 597-650). American Psychological Association. https://doi.org/10.1037/12169-019

Dinh, J. V., Traylor, A. M., Kilcullen, M. P., Perez, J. A., Schweissing, E. J., Venkatesh, A., & Salas, E. (2020). Cross-Disciplinary Care: A Systematic Review on Teamwork Processes in Health Care. *Small Group Research, 51*(1), 125-166. https://doi.org/10.1177/1046496419872002

Edmondson, A. C. (2003). Speaking up in the operating room: How team leaders promote learning in interdisciplinary action teams. *Journal of Management Studies, 40*(6), 1419-1452. https://doi.org/10.1111/1467-6486.00386

Ellwart, T., Konradt, U., & Rack, O. (2014). Team mental models of expertise location: Validation of a field survey measure. *Small Group Research, 45*(2), 119-153. https://doi.org/10.1177/1046496414521303

Faraj, S., & Sproull, L. (2000). Coordinating expertise in software development teams. *Management Science, 46*(12), 1554-1568. https://doi.org/10.1287/mnsc.46.12.1554.12072

Farh, C. I. C., & Chen, G. (2018). Leadership and member voice in action teams: Test of a dynamic phase model. *Journal of Applied Psychology, 103*(1), 97-110. https://doi.org/10.1037/apl0000256

Fernandez Castelao, E., Russo, S. G., Riethmüller, M., & Boos, M. (2013). Effects of team coordination during cardiopulmonary resuscitation: A systematic review of the literature. *Journal of Critical Care, 28*(4), 504-521. https://doi.org/10.1016/j.jcrc.2013.01.005

Fernandez, R., Kozlowski, S. W. J., Shapiro, M. J., & Salas, E. (2008). Toward a definition of teamwork in emergency medicine. *Academic Emergency Medicine, 15*(11), 1104-1112. https://doi.org/10.1111/j.1553-2712.2008.00250.x

Galinsky, A. D., Rucker, D. D., & Magee, J. C. (2015). Power: Past findings, present considerations, and future directions. In *APA handbook of personality and social psychology, Volume 3: Interpersonal relations.* (pp. 421-460). American Psychological Association. https://doi.org/10.1037/14344-016

Gardner, H. K., & Kwan, L. (2012). Expertise dissensus: A multi-level model of teams' differing perceptions about member expertise. *Harvard Business School Working Paper, Nr. 12-070*. http://www.hbs.edu/faculty/Publication%20Files/12-070_3ac36b43-cafc-4831-a82c-9ff874cca074.pdf

Greenberg, C. C., Regenbogen, S. E., Studdert, D. M., Lipsitz, S. R., Rogers, S. O., Zinner, M. J., & Gawande, A. A. (2007). Patterns of communication breakdowns resulting in injury to surgical patients. *Journal of the American College of Surgeons, 204*(4), 533-540. https://doi.org/10.1016/j.jamcollsurg.2007.01.010

Guzzo, R. A., & Dickson, M. W. (1996). Teams in organizations: Recent research on performance and effectiveness. *Annual Review of Psychology, 47*(1), 307-338. https://doi.org/10.1146/annurev.psych.47.1.307

Helmreich, R. L., & Schaefer, H.-G. (1994). Team performance in the operating room. In M. S. Bogner (Ed.), *Human error in medicine* (pp. 225-253). Lawrence Erlbaum Associates, Inc.

Hollenbeck, J. R., Beersma, B., & Schouten, M. E. (2012). Beyond team types and taxonomies: A dimensional scaling conceptualization for team description. *Academy of Management Review, 37*(1), 82-106. https://doi.org/10.5465/amr.2010.0181

Hu, Y.-Y., Parker, S. H., Lipsitz, S. R., Arriaga, A. F., Peyre, S. E., Corso, K. A., Roth, E. M., Yule, S. J., & Greenberg, C. C. (2016). Surgeons' Leadership Styles and Team Behavior in the Operating Room. *Journal of the American College of Surgeons, 222*(1), 41-51. https://doi.org/10.1016/j.jamcollsurg.2015.09.013

Huckman, R. S., Staats, B. R., & Upton, D. M. (2009). Team familiarity, role experience, and performance: Evidence from Indian software services. *Management Science, 55*(1), 85-100. https://doi.org/10.1287/mnsc.1080.0921

Hughes, A. M., Gregory, M. E., Joseph, D. L., Sonesh, S. C., Marlow, S. L., Lacerenza, C. N., Benishek, L. E., King, H. B., & Salas, E. (2016). Saving lives: A meta-analysis of team training in healthcare. *Journal of Applied Psychology, 101*(9), 1266-1304. https://doi.org/10.1037/apl0000120

Ishak, A. W., & Ballard, D. I. (2012). Time to re-group: A typology and nested phase model for action teams. *Small Group Research, 43*(1), 3-29. https://doi.org/10.1177/1046496411425250

Kenny, D., Kashy, D., & Cook, W. (2006). *Dyadic data analysis*. Guilford.

Klein, K. J., Ziegert, J. C., Knight, A. P., & Xiao, Y. (2006). Dynamic delegation: Shared, hierarchical, and deindividualized leadership in extreme action teams. *Administrative Science Quarterly, 51*(4), 590-621. https://doi.org/10.2189/asqu.51.4.590

Kolbe, M., Grote, G., Waller, M. J., Wacker, J., Grande, B., Burtscher, M. J., & Spahn, D. R. (2014). Monitoring and talking to the room: Autochthonous coordination patterns in team interaction and performance. *Journal of Applied Psychology, 99*(6), 1254-1267. https://doi.org/10.1037/a0037877

Krenz, H. L., & Burtscher, M. J. (2020). Investigating voice in action teams: a critical review. *Cognition, Technology & Work*. https://doi.org/10.1007/s10111-020-00646-9

Künzle, B., Kolbe, M., & Grote, G. (2010). Ensuring patient safety through effective leadership behaviour: A literature review. *Safety Science, 48*(1), 1-17. https://doi.org/10.1016/j.ssci.2009.06.004

Kurmann, A., Keller, S., Tschan-Semmer, F., Seelandt, J., Semmer, N. K., Candinas, D., & Beldi, G. (2014). Impact of team familiarity in the operating room on surgical complications. *World Journal of Surgery, 38*(12), 3047-3052. https://doi.org/10.1007/s00268-014-2680-2

Kvarnström, S. (2008). Difficulties in collaboration: A critical incident study of interprofessional healthcare teamwork. *Journal of Interprofessional Care, 22*(2), 191-203. https://doi.org/10.1080/13561820701760600

Lewis, K. (2003). Measuring transactive memory systems in the field: Scale development and validation. *Journal of Applied Psychology, 88*(4), 587-604. https://doi.org/10.1037/0021-9010.88.4.587

Lingard, L., Espin, S., Whyte, S., Regehr, G., Baker, G. R., Reznick, R., Bohnen, J., Orser, B., Doran, D., & Grober, E. (2004). Communication failures in the operating room: an observational classification of recurrent types and effects. *Quality and Safety in Health Care*, 330-334.

Lingard, L., Reznick, R., DeVito, I., & Espin, S. (2002). Forming professional identities on the health care team: discursive constructions on the 'other' in the operating room. *Medical Education, 36*, 728-734.

Littlepage, G., Robison, W., & Reddington, K. (1997). Effects of task experience and group experience on group performance, member ability, and recognition of expertise. *Organizational Behavior and Human Decision Processes, 69*(2), 133-147. https://doi.org/10.1006/obhd.1997.2677

Littlepage, G. E., Schmidt, G. W., Whisler, E. W., & Frost, A. G. (1995). An input-process-output analysis of influence and performance in problem-solving groups. *Journal of Personality and Social Psychology, 69*(5), 877-889. https://doi.org/10.1037/0022-3514.69.5.877

Manser, T. (2009). Teamwork and patient safety in dynamic domains of healthcare: A review of the literature. *Acta Anaesthesiologica Scandinavica, 53*(2), 143-151. https://doi.org/10.1111/j.1399-6576.2008.01717.x

Manser, T., Harrison, T. K., Gaba, D. M., & Howard, S. K. (2009). Coordination patterns related to high clinical performance in a simulated anesthetic crisis. *Anesthesia & Analgesia, 108*(5), 1606-1615. https://doi.org/10.1213/ane.0b013e3181981d36

Mazzocco, K., Petitti, D. B., Fong, K. T., Bonacum, D., Brookey, J., Graham, S., Lasky, R. E., Sexton, J. B., & Thomas, E. J. (2009). Surgical team behaviors and patient outcomes. *The American Journal of Surgery, 197*(5), 678-685. https://doi.org/10.1016/j.amjsurg.2008.03.002

Michinov, E., Olivier-Chiron, E., Rusch, E., & Chiron, B. (2008). Influence of transactive memory on perceived performance, job satisfaction and identification in anaesthesia teams. *British Journal of Anaesthesia, 100*(3), 327-332. https://doi.org/10.1093/bja/aem404

Muthén, L. K., & Muthén, B. O. (1998-2015). *Mplus User's Guide* (7th ed.). Muthén & Muthén.

Nagpal, K., Vats, A., Lamb, B., Ashrafian, H., Sevdalis, N., Vincent, C., & Moorthy, K. (2010). Information transfer and communication in surgery: A systematic review. *Annals of Surgery, 252*(2), 225-239. https://doi.org/10.1097/SLA.0b013e3181e495c2

Noort, M. C., Reader, T. W., & Gillespie, A. (2019). Speaking up to prevent harm: A systematic review of the safety voice literature. *Safety Science, 117*, 375-387. https://doi.org/https://doi.org/10.1016/j.ssci.2019.04.039

O'Connor, P., O'Dea, A., Lydon, S., Offiah, G., Scott, J., Flannery, A., Lang, B., Hoban, A., Armstrong, C., & Byrne, D. (2016). A mixed-methods study of the causes and impact of poor teamwork between junior doctors and nurses. *International Journal for Quality in Health Care*. https://doi.org/10.1093/intqhc/mzw036

O'Reilly, C. A., & Roberts, K. H. (1977). Task group structure, communication, and effectiveness in three organizations. *Journal of Applied Psychology, 62*(6), 674-681. https://doi.org/10.1037/0021-9010.62.6.674

Oborn, E., Barrett, M., Gibson, S., & Gillard, S. (2019). Knowledge and expertise in care practices: the role of the peer worker in mental health teams. *Sociology of Health & Illness, 41*(7), 1305-1322. https://doi.org/10.1111/1467-9566.12944

Paige, J. T., Garbee, D. D., Yu, Q., & Rusnak, V. (2017). Team Training of Inter-Professional Students (TTIPS) for improving teamwork. *BMJ Simulation and Technology Enhanced Learning*. https://doi.org/10.1136/bmjstel-2017-000194

Patel, V. L., Cytryn, K. N., Shortliffe, E. H., & Safran, C. (2000). The collaborative health care team: the role of individual and group expertise. *Teaching and Learning in Medicine, 12*(3), 117-132. https://doi.org/10.1207/s15328015tlm1203_2

Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology, 63*(1), 539-569. https://doi.org/10.1146/annurev-psych-120710-100452

Powell, A. E., & Davies, H. T. O. (2012). The struggle to improve patient care in the face of professional boundaries. *Social Science & Medicine, 75*(5), 807-814. https://doi.org/http://dx.doi.org/10.1016/j.socscimed.2012.03.049

Raemer, D. B., Kolbe, M., Minehart, R. D., Rudolph, J. W., & Pian-Smith, M. C. M. (2016). Improving anesthesiologists' ability to speak up in the operating room: A randomized controlled experiment of a simulation-based intervention and a qualitative analysis of hurdles and enablers. *Academic Medicine, 91*(4), 530-539. https://doi.org/10.1097/acm.0000000000001033

Reader, T. W., Flin, R., Mearns, K., & Cuthbertson, B. H. (2009). Developing a team performance framework for the intensive care unit. *Critical Care Medicine, 37*(5), 1787-1793. https://doi.org/10.1097/CCM.0b013e31819f0451

Schmutz, J. B., Meier, L. L., & Manser, T. (2019). How effective is teamwork really? The relationship between teamwork and performance in healthcare teams: a systematic review and meta-analysis. *BMJ Open, 9*(9), e028280. https://doi.org/10.1136/bmjopen-2018-028280

Sexton, J. B., Thomas, E. J., & Helmreich, R. L. (2000). Error, stress, and teamwork in medicine and aviation: cross sectional surveys. *The BMJ, 320*(7237), 745-749. https://doi.org/10.1136/bmj.320.7237.745

Sundstrom, E., McIntyre, M., Halfhill, T., & Richards, H. (2000). Work groups: From the Hawthorne Studies to the work teams of the 1990s. *Group Dynamics:Theory, Research, and Practice, 4*(1), 44-67. https://doi.org/10.1037//1089-2699.4.1.44

Tan, K. T., Adzhahar, F. B. B., Lim, I., Chan, M., & Lim, W. S. (2014). Transactive memory system as a measure of collaborative practice in a geriatrics team: implications for continuing interprofessional education. *Journal of Interprofessional Care, 28*(3), 239-245. https://doi.org/10.3109/13561820.2014.901938

Thomas, E. J., Sexton, J. B., & Helmreich, R. L. (2003). Discrepant attitudes about teamwork among critical care nurses and physicians. *Critical Care Medicine, 31*(3), 956-959. https://doi.org/10.1097/01.CCM.0000056183.89175.76

Tschan, F., Seelandt, J. C., Keller, S., Semmer, N. K., Kurmann, A., Candinas, D., & Beldi, G. (2015). Impact of case-relevant and case-irrelevant communication within the surgical team on surgical-site infection. *British Journal of Surgery, 102*(13), 1718-1725. https://doi.org/10.1002/bjs.9927

Tschan, F., Semmer, N. K., Gautschi, D., Hunziker, P., Spychiger, M., & Marsch, S. U. (2006). Leading to recovery: Group performance and coordinative activities in medical emergency driven groups. *Human Performance, 19*(3), 277-304. https://doi.org/10.1207/s15327043hup1903_5

Vashdi, D. R., Bamberger, P. A., & Erez, M. (2013). Can surgical teams ever learn? The role of coordination, complexity, and transitivity in action team learning. *Academy of Management Journal, 56*(4), 945-971. https://doi.org/10.5465/amj.2010.0501

Weiss, M., Kolbe, M., Grote, G., Spahn, D. R., & Grande, B. (2017). Why didn't you say something? Effects of after-event reviews on voice behaviour and hierarchy beliefs in multi-professional action teams. *European Journal of Work and Organizational Psychology, 26*(1), 66-80. https://doi.org/10.1080/1359432x.2016.1208652

Wildman, J. L., Shuffler, M. L., Lazzara, E. H., Fiore, S. M., Burke, C. S., Salas, E., & Garven, S. (2012). Trust development in swift starting action teams: A multilevel framework. *Group & Organization Management*. https://doi.org/10.1177/1059601111434202

Williams, M., Hevelone, N., Alban, R. F., Hardy, J. P., Oxman, D. A., Garcia, E., Thorsen, C., Frendl, G., & Rogers Jr, S. O. (2010). Measuring communication in the surgical ICU: better communication equals better care. *Journal of the American College of Surgeons, 210*(1), 17-22. https://doi.org/10.1016/j.jamcollsurg.2009.09.025

Wilson, K. A., Burke, C. S., Priest, H. A., & Salas, E. (2005). Promoting health care safety through training high reliability teams. *Quality and Safety in Health Care, 14*(4), 303-309. https://doi.org/10.1136/qshc.2004.010090

Xu, R., Carty, M., Orgill, D., Lipsitz, S., & Duclos, A. (2013). The teaming curve: A longitudinal study of the influence of surgical team familiarity on operative time. *Annals of Surgery, 258*(6), 953-957. https://doi.org/10.1097/SLA.0b013e3182864ffe

Appendix A: Areas of expertise for anesthesia

- Operating the ventilator
- Handling stressful situations
- Infection control
- Intubation
- Dealing with ventilation problems
- Dealing with hemodynamic instability
- Drug administration
- Dealing with airway management problems
- Operating the syringe driver

Tables

Table 1

Means (M), Standard Deviations (SD), and Intercorrelations for variables of sample 1 (CH)

a) Switzerland

	ExAsP	ExAs_N	Com_P	Com_N	Coor_P	Coor_N	Exp_N	Fam
ExAs_N	.49*	-						
Com_P	-.07	-.03	-					
Com_N	-.08	.08	.55*	-				
Coor_P	.16	-.01	.71*	.44*	-			
Coor_N	-.01	.09	.48*	.82*	.50*	-		
Exp_N	-.30*	-.61*	.08	.00	.16	.22	-	
Fam	-.16	-.07	.20	.02	.28	.06	.19	-
Mean	2.15	2.73	5.83	5.83	5.93	5.93	5.17	2.50
SD	2.56	3.23	1.10	1.15	0.80	0.91	0.81	0.85

Note. ExAs_P = expertise asymmetry physician, ExAs_N = expertise asymmetry nurse, Com_P = communication openness physician, Com_N = communication openness nurse, Coor_P = coordination quality physician, Coor_N = coordination quality nurse, Exp_N = expertise nurse, Fam = team familiarity

N = 47 teams; * = $p < .05$

Table 2

APIMs predicting coordination quality and communication openness in sample 1 (CH)

	Coordination quality						Communication openness					
	Physician			Nurse			Physician			Nurse		
Predictors	*b*	β	*p*	*b*	β	*p*	*b*	β	*p*	*b*	β	*p*
Expertise asymmetry physician	0.08	.27	.09	-0.02	-.07	.66	-0.02	-.04	.81	-0.07	-.16	.35
Expertise asymmetry nurse	-0.00	-.00	.95	0.11	.40	.04	0.01	.04	.84	0.07	.21	.31
Team familiarity	0.27	.29	.04	-0.00	-.00	.98	0.24	.19	.20	-0.01	.00	.98
Expertise nurse	0.14	.18	.29	0.37	.44	.01	0.06	.06	.76	0.08	.08	.69

Notes. b = unstandardized path coefficient; β = standardized path coefficient: p = p-value of the unstandardized path coefficient; grey shaded cells indicate actor effects; N = 47 teams

Table 3

Means (M), Standard Deviations (SD), and Intercorrelations for variables in sample 2 for teams with resident physicians (upper table) and teams with attending physicians (lower table, see next page)

Resident physicians								
	ExAsP	ExAs_N	Com_P	Com_N	Coor_P	Coor_N	Exp_N	Fam
ExAs_N	-.13	-						
Com_P	-.29	-.17	-					
Com_N	-.04	-.29	-.05	-				
Coor_P	-.29	-.23	.81*	-.17	-			
Coor_N	.04	.05	-.09	.08	-.21	-		
Exp_N	-.04	-.53*	.33	-.29	.50*	-.19	-	
Fam	.14	-.03	-.02	-.04	.06	-.23	-.05	-
N	25	25	24	25	24	25	25	25
Mean	2.37	1.83	5.45	6.06	5.68	5.72	5.91	2.52
SD	3.17	2.50	0.95	0.66	0.88	0.54	1.10	0.94

ExAs_P = expertise asymmetry physician, ExAs_N = expertise asymmetry nurse, Com_P = communication openness physician, Com_N = communication openness nurse, Coor_P = coordination quality physician, Coor_N = coordination quality nurse, Exp_N = expertise nurse, Fam = team familiarity; * = $p < .05$

Attending physicians

	ExAsP	ExAs_N	Com_P	Com_N	Coor_P	Coor_N	Exp_N	Fam
ExAs_N	-.14	-						
Com_P	-.70*	.11	-					
Com_N	-.27	.29	.24	-				
Coor_P	-.51*	.08	.90*	.24	-			
Coor_N	-.07	.28	-.14	.79*	-.08	-		
Exp_N	.05	-.65*	.20	-.01	.25	-.10	-	
Fam	-.23	-.05	.44*	-.21	.37	-.34	.03	-
N	23	23	20	19	22	21	23	22
Mean	4.36	1.96	5.95	6.00	5.94	5.90	5.67	3.75
SD	5.44	1.79	1.27	0.85	1.10	0.76	0.96	0.86

ExAs_P = expertise asymmetry physician, ExAs_N = expertise asymmetry nurse, Com_P = communication openness physician, Com_N = communication openness nurse, Coor_P = coordination quality physician, Coor_N = coordination quality nurse, Exp_N = expertise nurse, Fam = team familiarity; * = $p < .05$

Table 4

APIMs predicting coordination quality and communication openness for teams with resident physicians (upper part) and teams with attending physicians (lower part) in sample 2 (UK)

	Coordination quality						Communication openness					
	Physician			Nurse			Physician			Nurse		
Predictors	*b*	β	*p*	*b*	β	*p*	*b*	β	*p*	*b*	β	*p*
Expertise asymmetry resident	-0.08	-.28	0.09	0.01	.06	.78	-0.09	-.29	.12	-0.03	-.15	.37
Expertise asymmetry nurse	-0.00	-.01	0.98	-0.02	-.07	.75	-0.02	-.05	.81	-0.17	-.65	.00
Team familiarity	0.12	.12	0.45	-0.14	-.25	.20	0.04	.04	.84	-0.05	-.07	.65
Expertise nurse	0.39	.49	0.01	-0.12	-.23	.30	0.25	.29	.18	-0.38	-.64	.00
Expertise asymmetry attending	-0.08	-.42	0.01	-0.02	-.10	.60	-0.15	-.64	.00	-0.05	-.32	.12
Expertise asymmetry nurse	0.22	.36	0.12	0.14	.33	.25	0.16	.22	.22	0.18	.38	.20
Team familiarity	0.36	.29	0.10	-0.28	-.31	.26	0.53	.35	.01	-0.21	-21	.40
Expertise nurse	0.57	.50	0.01	0.09	.11	.66	0.49	.37	.01	0.24	.27	.29

Notes. *b* = unstandardized path coefficient; β = standardized path coefficient: *p* = p-value of the unstandardized path coefficient; grey shaded cells indicate actor effects; $N_{Resident}$ = 25 teams; $N_{Attendning}$ = 23 teams.

Table 5

Summary of effects across all six APIMs

	Coordination quality			Communication openness		
	CH	UK resident	UK attending	CH	UK resident	UK attending
Expertise nurse	+	+	+		-	+
Expertise asymmetry	+		-		-	-
Team familiarity	+					+

Note. ‘+’ = positive effect; ‘-‘ = negative effect

Figures

Figure 1.

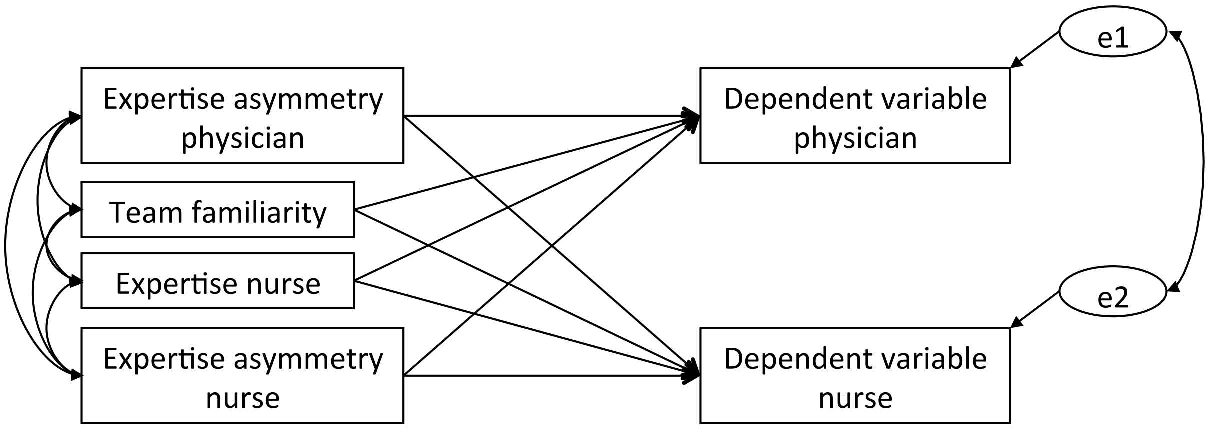

Figure 1: APIM predicting coordination quality or communication openness

Dependent variables for physician and nurse represent either communication openness or coordination quality; e1 and e2 represent regression residuals; directed arrows represent directed effects (path coefficients); double headed arrows represent correlations.