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Teamwork in Rural Emergency Health Care

A Simulation-Based Cross-over Study of Co-located and Distributed Teams

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Introduction: Despite the increasing use of distributed healthcare teams, performance evaluation is largely lacking. This study examined rural emergency health care in Sweden to determine the effect of teams being either co-located or distributed with remote physicians accessible via telemedicine.

Method: In this crossover study, 17 three-person teams were video recorded during co-located and distributed simulated scenarios. Team performance in the video recordings was evaluated using the TEAM instrument.

Results: Co-located scenarios had significantly higher Total ratings for the instrument (items 1–11), in the teamwork domain (items 3–9), and in overall performance (item 12) compared with distributed scenarios ($P < 0.005$). Item-level analysis revealed that co-located teams were better at completing tasks on time (item 4) and showed greater adaptability to changing situations (item 7).

Conclusions: The higher rating of the performance of co-located teams underscores the challenges facing distributed teams. Given that distributed healthcare teams are a reality in rural areas in northern Sweden, education and training must be adapted to address these challenges. This adaptation is crucial for ensuring high-quality patient care by distributed teams.

Key Words: Teamwork, team performance, simulation, distributed team, TEAM instrument, observations, assessments, rural health care

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BACKGROUND

Advances in technology and globalization have led to a rise of distributed teams, that is, teams whose members are located in different geographic regions and use technology to collaborate.[1–4] In the field of health care, information and communication technology have enabled connections between on-site medical staff and off-site specialists, facilitating the extension of healthcare services to remote areas.[5] The COVID-19 pandemic has accelerated the adoption of these distributed teams,[6–9] highlighting the crucial role of telemedicine in managing unforeseen catastrophic scenarios.[6] This rapid shift has, however, revealed global disparities in telemedicine adoption, with China experiencing high levels of implementation. At the same time, Africa has seen relatively low adoption rates, influenced by informatics literacy and existing infrastructure.[10]

Despite the growing prevalence of distributed healthcare teams, more research is needed on their function. However, some insights can be gleaned from existing research. For instance, in the realm of specialized health care, where resources are readily available, Bolle et al demonstrated the benefits of videoconferencing rather than traditional telephone communication for improving communication and collaboration within distributed trauma teams.[11] Similarly, Butler et al found that telemedicine has the potential to effectively manage distributed workloads during pediatric resuscitation without compromising care quality or teamwork.[12] However, there is a significant lack of understanding of the broader impact of distributed teamwork, particularly in rural emergency contexts where resources are scarce.

Rural areas in Sweden are defined as locations more than a 45-minute drive from an urban center with more than 3000 residents.[13] There are challenges in delivering health care to these areas. For example, it can take more than 30 minutes for an ambulance to arrive and an equal amount of time for the ambulance to transport the patient to a healthcare facility.[13] In inland areas in northern Sweden, small 'cottage hospitals' offer 24/7 treatment for various medical conditions in much the same way as urban hospitals. In a registry study, Hedman et al found that the most common diagnoses in these hospitals were diseases typical of older adults, particularly heart failure and pneumonia.[14] These hospitals in rural areas have been

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shown to have higher patient mortality rates,[15] and healthcare delivery may be challenging to medical staff due to the lack of backup, logistical hurdles, and a sense of isolation.[16]

Interprofessional teams are essential in rural cottage hospitals, where various healthcare professionals collaborate to enhance patient care and safety. During emergencies, these teams typically include general physicians, registered nurses, and assistant nurses. In Sweden, registered nurses hold at least a bachelor's degree after 3 years of university studies,[17] while assistant nurses are undergraduate professionals with vocational training from secondary school.[18] Their roles are not interchangeable due to the difference in qualifications and scope of practice. Ultimately, the interplay of different roles and each member's unique perspective and expertise within the team is essential for building a comprehensive approach to patient care.[19] In this context, evaluating team performance during simulations is crucial as it helps clinicians understand critical teamwork skills and can guide their training.[20]

When planning training for interprofessional teams, it is essential to consider their specific challenges and environment, as the clinical context significantly influences how team members collaborate.[21,22] Geographical distances present particular challenges in rural areas. Registered nurses and assistant nurses work independently on-site during evenings and nights at cottage hospitals in northern inland Sweden. One general physician is on call, overseeing several cottage hospitals scattered across a vast rural area of over 55,000 km^2. These geographical distances create challenges for timely presence when emergencies occur, so the on-site medical staff connect to the on-call physician via telemedicine for assessment and treatment.[23]

Given these challenges, the ongoing global health crises, such as pandemics and war, and the fact that approximately 2 billion rural inhabitants worldwide are not included in health care[24] highlight the need for resilient healthcare systems. Distributed teams, supported by telemedicine, are crucial in maintaining healthcare services during such events. Most existing research on telemedicine focuses on patient survival.[25] One contributing factor to this outcome measure may be team functioning, as this relationship is found in situations with co-located teams.[22] Findings from our study may help develop healthcare models in which distributed teams are better prepared for emergencies, ensuring that patients receive high-quality care even in demanding situations. Investigating the performance of distributed versus co-located teams in rural emergency health care is timely and essential for addressing current gaps. The insights from this study will provide a foundation for improving the implementation and development of distributed healthcare teams.

Hence, our study aims to explore how teamwork is affected by team situatedness in the Swedish rural context. We assess this with the Team Emergency Assessment Measure (TEAM) developed by Cooper et al to evaluate team performance in the specific context of cardiac resuscitation.[26] The instrument was subsequently recognized as valid and reliable for emergencies in simulated and clinical settings[27–30] and has been validated for use in distributed team contexts.[31] Using this measure, we compare co-located teams with distributed teams that have a remote physician participating via telemedicine. This study defines telemedicine as information and communication technology connecting general physicians with on-site medical staff in rural cottage hospitals. We focus on distributed teamwork, using simulations as an investigational method to create an opportunity to compare clinical teamwork in the 2 settings.

METHODS

Study Design

The study originated as part of the larger research program Teamwork in Geographically Dispersed Emergency Teams in Rural Settings (TIGER). TIGER aims to improve quality and safety in rural emergency care by redefining teamwork and patient-centeredness in distributed teams. Some studies in the research program have been published,[31–34] and others are planned. This study used a cross-over design to evaluate the team performance of healthcare personnel during video-recorded simulated scenarios. It was conducted in the emergency departments of seven cottage hospitals in Västerbotten County in northern Sweden between 2019 and 2021.

Setting

Simulations were video recorded in situ in the participants' everyday working environments. For increased realism, authentic medical equipment from the cottage hospitals' emergency departments was used in the simulations. Participants were guided through simulations lasting approximately 90 minutes using a standardized format (Fig. 1).

Scenarios

In the initial phases of the TIGER research program, a group of experienced physicians and nurses with contextual knowledge in the specific area formulated 2 clinical situations. Their participation ensured that the patient diagnoses were clinically relevant and authentic to a rural cottage hospital setting. The simulations were carefully designed to be comparable in complexity and to simulate a medical emergency that required immediate action. In *Scenario A*, the patient had urosepsis, and in Scenario B, a myocardial infarction. Each scenario was designed so the patient's condition would further deteriorate 2 minutes after the team assessed the vital signs (see PDF, Supplemental Digital Content 1, http://links.lww.com/SIH/B109, which includes the scripted Scenarios A and B). Each scenario lasted approximately 20 minutes. In *Scenario A,* all team members were proximal to the patient in the same location (ie, a co-located team). In *Scenario B*, 2 proximal staff were in the emergency department, and the physician participated via telemedicine (ie, a distributed team) (Figs. 2A, B). The scenarios were presented in randomized order to prevent bias in team performance caused by participants' prior exposure, which could potentially influence study outcomes. However, we chose not to randomize both diagnoses (urosepsis and myocardial infarction) across both settings (co-located and distributed teams) to maintain a manageable sample size and avoid the complexities of balancing multiple variables, which would have required a larger sample size for statistical power.

In both scenarios, we employed a standardized patient (SP) to simulate an actual patient[37] for the participants. The actor was a registered nurse with experience in the context, trained to follow a script that included medical and social

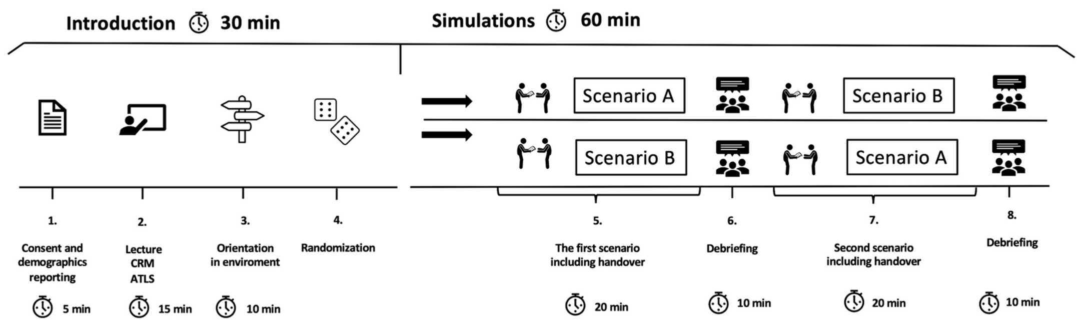

FIGURE 1. Step-by-step procedure for simulation-based team training. 1) Participants were briefed on the primary goal of the simulations and the study's overall aim. They were also requested to report their basic demographics in a questionnaire. 2) A facilitator gave a lecture on patient safety and teamwork based on Crew Resource Management[35] and Advanced Trauma Life Support.[36] 3) Participants received orientation regarding the training structure, available resources, emergency department equipment, and the role of the educational staff during the scenarios. 4) A randomization before the simulations determined the order of the scenarios. Each team took part in 2 scenarios. 5) The first scenario. The facilitator provided a brief overview of the patient's current medical issue at the beginning of each scenario. In Scenario A, all participants received the information simultaneously, while in Scenario B, the nurses received the initial information. After the initial patient assessment, in Scenario B, the nurses were instructed to use the videoconferencing system to connect with the physician who waited in a remote location, usually just in time for the patient's condition to deteriorate as scripted. The facilitator ended the scenario when the team stabilized the patient's vital signs and communicated a diagnosis and a care plan. 6) A facilitator-led debriefing focused on medical treatment and teamwork skills. 7) The second scenario followed the details set out in step 5. 8) A facilitator-led debriefing followed the details in step 6.

history and to respond to participants' questions and interventions accurately and convincingly. The SP's outfits and makeup were changed to reflect the different scenarios.

Simulation Environment

The simulations were facilitated by a local prehospital emergency care nurse who had expertise in facilitating simulations at cottage hospitals. The facilitator was present in the emergency department to give information on clinical assessments that the SP could not display. We installed a facilitator-controlled vital sign monitor in the emergency department, displaying the patient's heart rate, blood pressure, and peripheral oxygen saturation.

In *Scenario A*, the healthcare team were co-located in the emergency departments. In *Scenario B*, the proximal staff used a videoconferencing system to connect with a physician following their initial patient assessment. Although the emergency departments shared similar environments, the views presented to the remote physicians differed across cottage hospitals. For instance, the screen might be behind the patient, in front of the patient, or at the patient's side, depending on each hospital's specific environment and solutions. Recording cameras were mounted in the emergency department to show different angles. The remote physician in *Scenario B* was recorded through the live video feed.

Participants

Eligible participants were healthcare personnel (assistant nurses, registered nurses, and general physicians) employed at 1 of the 7 cottage hospitals in Västerbotten County, in northern inland Sweden. Participants were voluntarily recruited by their respective managers for the study. Before the study, participants were given the opportunity to decline to participate. Oral and written informed consent was obtained before study participation, and the participants were informed of their right to withdraw their consent without additional explanation. In addition, participants were assured that video-recorded material would be treated confidentially, securely stored, and archived in a location inaccessible to unauthorized personnel. The Swedish Ethical Review Authority reviewed our application (registration number: 2019-00148; decision date: 2019-01-08) for an advisory opinion. The review authority had no ethical reservations regarding the methods or procedures used in this study.

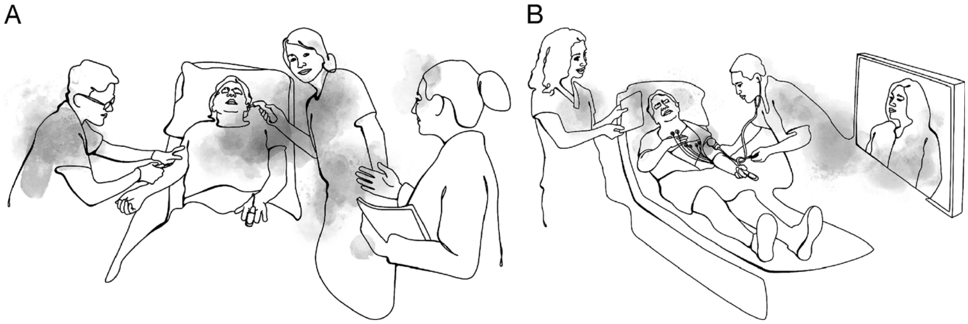

FIGURE 2. A, Team setting scenario A. Scenario A – co-located (ie, all team members in the same location). Illustration by Christina Heitmann. Used with permission. © 2023 Christina Heitmann. B, Team Setting Scenario B. Scenario B – distributed (ie, proximal staff in the emergency department and the physician participating via telemedicine). Illustration by Christina Heitmann. Used with permission. © 2023 Christina Heitmann.

Data Measurement

The team's performance was assessed using the Team Emergency Assessment Measure (TEAM).[26] This observational instrument was developed by Cooper and colleagues and consisted of 11 items divided into three domains: *Leadership* (2 items), *Teamwork* (7 items), and *Task Management* (2 items). Each item was rated on a 5-point scale, ranging from 0 (never) to 4 (always).[26] In total (items 1–11), the maximum score was 44. In this study, we used the mean of the total and the domains in the analysis, which means the possible range is 0–4. The instrument used in this study included a 12th item concerned with *Overall Performance*, rated on a 10-point scale, with 10 indicating excellent performance. All items in the TEAM instrument are presented in Table 1.

Before using the TEAM instrument in this study, we validated it as part of the TIGER research program to ensure its applicability to the distributed team setting.[31] Psychometric tests confirmed that the TEAM instrument is valid and reliable in this context.

Raters underwent training to ensure consistency in their assessments. This training and calibration process was first used in the previous validation study[31] and later in this study. The training began with a 2-hour session in which raters were introduced to the TEAM instrument and its items and discussed its interpretation. Over the next 2 weeks, the raters practiced using the TEAM instrument by individually watching video-recorded simulated scenarios comparable to those in this study and providing rating scores as part of the calibration process. Following this, the raters participated in a 2-hour video meeting to review and discuss their rating scores. During this meeting, they resolved discrepancies and ensured a common understanding of the TEAM instrument.

The study's video recordings were coded so that raters were blinded to the randomization order of each team's scenarios, and the recordings were presented to each rater in random order. In the final stage, in May 2023, 2 raters independently assessed the video recordings included in this study over a 2-month period. Their scores for the actual assessments remained unchanged.

TABLE 1. Items in the TEAM Instrument

Leadership
1. The team leader let the team know what was expected of them through direction and command.
2. The team leader maintained a global perspective.

Teamwork
3. The team communicated effectively.
4. The team worked together to complete the tasks in a timely manner.
5. The team acted with composure and control.
6. The team morale was positive.
7. The team adapted to changing situations.
8. The team monitored and reassessed the situation.
9. The team anticipated potential actions.

Task management
10. The team prioritized tasks.
11. The team followed approved standards/guidelines.

Overall
12. On a scale of 1–10, give your global rating of the team's performance.

The raters had broad experience in intensive care and anesthesia and as simulation facilitators. One of the raters was a critical care registered nurse with a PhD in nursing; the other was a consultant physician in anesthesia and intensive care and a PhD student at the time.

Statistical Methods

Because the TIGER program's data collection was designed to answer many research questions, the sample size calculation was based on comparing 2 independent groups. A sample size of 17 teams was required to be able to detect a difference of one standard deviation between 2 scenarios using the TEAM instrument (total score, items 1–11) with 80% power and a significance level of 0.05.[38,39]

SPSS Statistics for Windows version 28[40] was used to compute descriptive statistics and the analyses. Basic demographic information, including age, gender, medical education, and work experience, was collected through a questionnaire. Measures such as means, standard deviations, medians, and quartiles were computed to summarize the central tendency and variability of the relevant variables for the entire study population and each subgroup (assistant nurses, registered nurses, and general physicians). The percentage of missing values is indicated for variables where data was not disclosed.

Descriptive measures regarding the TEAM instrument and its domains were represented by means, standard deviations, medians, and quartiles. Mean values were also used to illustrate the ratings for individual items, both in terms of total and domain scores. The assumption of normal distribution was investigated using skewness, and internal consistency was investigated with Cronbach's α. To investigate the association between outcome measures (TEAM instrument in total, its domains, and overall performance) and scenario, a generalized estimating equation was used with a scale linear response, controlling for correlation within teams with an exchangeable correlation matrix. The regressions were adjusted for order of randomization and rater. Generalized estimating equations with an ordinal logistic outcome were used to investigate the association between individual items and the scenario (because the ordinal item only had five levels). No rating data were missing.

RESULTS

Study Population

A sample of 51 healthcare professionals participated in the simulations (Table 2): assistant nurses (n = 13), registered nurses (n = 21), and general physicians (n = 17). They formed 17 3-person teams. Teams were created based on participant availability, considering individual schedules, work shifts on a specific day, and willingness to participate. Of these 17 teams, 13 consisted of 1 assistant nurse, 1 registered nurse, and 1 general physician, while 4 contained 2 registered nurses and 1 physician. Most of the participants were female (n = 42), and their ages ranged between 35 and 51 years. Most of them had prior experience working with one or both of their team members, with only a minority (n = 6) being unfamiliar with each other. In addition, 14 (29%) participants had prior experience in a distributed team setting.

TABLE 2. Study Population Characteristics

	Participants All *N* = 51	Assistant Nurses *n* = 13	Registered Nurses *n* = 21	General Physicians *n* = 17
Age, median (Q1–Q3)	42 (35–51)	37 (28–49)	38 (32–54)	43 (40–55)
Age, mean (SD)	43 (12)	39 (13)	41 (13)	47 (9)
Not disclosed, n (%)	1 (2)			1 (6)
Female, n (%)	42 (82)	12 (92)	19 (90)	11 (65)
Male, n (%)	9 (18)	1 (8)	2 (10)	6 (35)
Experience health care				
Years median (Q1–Q3)	16 (6–26)	20 (5–26)	16 (5–27)	17 (10–27)
Not disclosed, n (%)	2 (4)	1 (8)		1 (6)
No previous experience in simulation training, n (%)	7 (14)	2 (33)	4 (25)	1 (8)
Previous experience in simulation training <10 events, n (%)	27 (53)	4 (67)	13 (76)	10 (84)
Previous experience in simulation training ≥10 events, n (%)	1 (2)			1 (8)
Not disclosed, n (%)	16 (31)	7 (54)	4 (19)	5 (29)
Previous experience of working in a distributed team, n (%)	14 (29)	2 (15)	7 (35)	5 (33)
Not disclosed, n (%)	3 (6)		1 (5)	2 (12)

Outcome Data

There was a slight negative skewness in the TEAM instrument and its domains, as reflected in the mean and median, with the result that higher values rather than low ones were indicated for the instrument (Table 3). However, the results for Cronbach's α showed good internal consistency, and the skewness values also showed enough normality to use linear regression.

Table 4 shows that the co-located scenario received significantly higher ratings for Total (0.22 units higher, mean of items 1–11), as well as in the Teamwork domain (0.28 units higher, mean of items 3–9), and for Overall Performance (0.50 units higher, item 12).

Further analysis of individual items (items 1–11) revealed no significant associations between the scenarios and scores for most of the TEAM items. However, significant associations were found between the scenarios and item 4 (*the team worked together to complete the tasks in a timely manner*) and item 7 (*the team adapted to changing situations*), even after adjusting for the order of randomization and rater. The co-located teams had higher scores. In Figure 3, the estimated cumulative percentages depict ratings on different levels for items 4 and 7. Co-located teams were more frequently highly rated than distributed teams for these specific items.

In addition, Table 4 demonstrates that the order of randomization is significant in 4 of 5 outcomes, indicating that the second simulation received significantly higher ratings in Total, Leadership, Teamwork, and Overall. The rater was not significantly associated with the ratings.

DISCUSSION

This study investigated the impact of team situatedness (co-located vs distributed teams) on team performance in rural emergency care. We found that co-located teams performed better than distributed teams. Co-located teams scored higher on the Total TEAM instrument (items 1–11), the Teamwork domain (items 3–9), and Overall Performance. The strength of co-located teams was particularly evident in items 4 and 7, which assessed *their ability to complete the tasks on time* and *adapt to changing situations*. According to the description of the TEAM instrument, behavioral markers for good practice for item 4 involve rapid applicability, prioritization of treatment and care, clarity of task and role allocation within the team, and tasks linked in a coordinated fashion. For item 7, good behavioral skills involve adaptability to changing situations (within professional roles), flexibility within and between roles, and openness to new ideas.[41]

In a distributed team setting, the absence of a general physician may require registered nurses to assume clinical examination responsibilities typically undertaken by a physician. This situation may create confusion regarding roles and

TABLE 3. Descriptive Information Regarding the Outcome Variables Measured With the TEAM Instrument (Total, Leadership, Teamwork, Task Management, and Overall)

	Total Items 1–11	Leadership Items 1–2	Teamwork Items 3–9	Task Management Items 10–11	Overall Item 12
TEAM instrument (possible range)	0–4	0–4	0–4	0–4	1–10
Min–max	0.73–3.82	0.00–4.00	1.00–3.86	0.50–4.00	2–10
Mean (SD)	2.69 (0.68)	2.73 (0.85)	2.63 (0.69)	2.85 (0.79)	6.44 (1.81)
Median	2.72	3.00	2.64	3.00	7.00
Skewness	−0.56	−0.92	−0.44	−0.75	−0.60
Cronbach's α	0.94	0.83	0.91	0.82	

TABLE 4. Associations Between the Outcome Variables and the Independent Variables Scenario, Order, and Rater

	Total Item 1–11 β (SE) *P*	Leadership Item 1–2 β (SE) *P*	Teamwork Item 3–9 β (SE) *P*	Task Management Item 10–11 β (SE) *P*	Overall Item 12 β (SE) *P*
Scenario					
Co-located	**0.22** (0.08) *0.005*	0.06 (0.12) *0.614*	**0.28** (0.07) *<0.001*	0.19 (0.13) *0.154*	**0.50** (0.22) *0.025*
Distributed	—	—	—	—	—
Order					
1st	**−0.23** (0.08) *0.004*	**−0.28** (0.12) *0.019*	**−0.22** (0.07) *0.002*	−0.25 (0.13) *0.066*	**−0.44 (0.22)** *0.046*
2nd	—	—	—	—	—
Rater					
Rater 1	0.09 (0.18) *0.620*	0.25 (0.20) *0.213*	−0.02 (0.18) *0.927*	0.29 (0.21) *0.158*	−0.76 (0.50) *0.130*
Rater 2	—	—	—	—	—

The analysis was performed with generalized estimating equations, using a scale linear response, and controlling for correlation within the teams. Values shown are parameter estimates (β) with corresponding *P* values.

Boldface numbers indicate statistical significance.

responsibilities, as the proximal staff must take on additional responsibilities beyond their usual duties. This raises the issue of how competence and role clarity within distributed healthcare teams affect their performance. In low-resource settings, task shifting may be a viable strategy to address workforce shortages and improve healthcare delivery. It involves reassigning specific tasks from highly specialized healthcare professionals to those with fewer qualifications and less training, thus increasing the number of available personnel.[42] In rural and resource-limited areas, task shifting has been highlighted as an essential strategy to enhance healthcare access and service delivery. However, its successful implementation necessitates addressing various challenges, including training and supervision.[43]

It is well-known that short-term teams (ie, teams that collaborate for a limited time) and ad hoc teams (ie, temporarily assembled to solve a specific task) operate differently compared with established teams because team duration is critical to team performance.[44,45] Members of ad hoc teams do not have the time to build relationships and mutual trust or to learn about each other's competencies. They must start working immediately, especially in emergencies.

In this study, teams were both ad-hoc and short-term, and the absence of a sense of togetherness may adversely affect team members' participation and ability to attend to each other's verbal and nonverbal cues.[46] Familiarity with each other's roles and skills may also prove challenging in

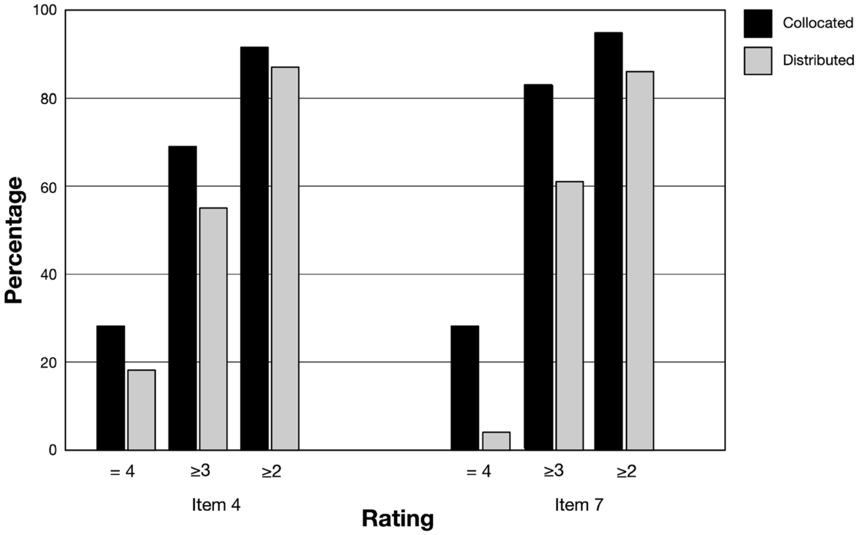

FIGURE 3. Cumulative distribution of ratings for item 4 and item 7 stratified by scenario: Cumulative distribution of ratings for item 4, which assesses the participant's ability to complete the tasks in a timely manner, and item 7, which assesses how well participants adapted to changing situations, with the data stratified by scenario.

distributed healthcare teams operating in rural areas, especially as the physician oversees several cottage hospitals. Effective teamwork can be hindered when team members are unaware of each other's competencies and roles. Such factors may have impacted the overall team performance, particularly in completing tasks on time (item 4) and adapting to changing situations (item 7), as outlined by the TEAM instrument.[41]

This study used the same videoconferencing technology implemented in rural cottage hospitals for real-life situations. The participants did not receive any pretraining before the simulation and had no time to familiarize themselves with the technology further beforehand. While some had prior experience with it, others did not. The available technology could not display the patient's vital signs to the remote physician, who had to rely on the on-site team to communicate this information verbally. Bolle et al found that videoconferencing in distributed teams led to misunderstandings when the patient's vital signs were not displayed on both sites.[11] They concluded that these issues could be resolved by implementing different technology or providing better training.

It has been found that relying on technology may increase the workload.[12] For instance, Fiore et al found that using technology in distributed teams can hinder the perception of nonverbal cues and decrease awareness of other team members' actions.[47] This may obstruct collaboration, coordination, and adaptability —all essential factors for optimal team performance. Videoconference conversations of the type used in this study are often seen as having fewer interruptions and being more polite than face-to-face communication. However, this politeness has the potential to slow down communication. Communication issues using technology do tend to fade as teams spend more time working together. However, this adaptation benefits ongoing teams more than temporary rural emergency teams.[48]

As regards leadership (items 1 and 2), we found no difference between co-located and distributed teams, nor was there a difference in team performance regarding task management (items 10 and 11). In the calibration process of the TEAM instrument, evaluating one of the behavioral markers in item 2 proved challenging in the distributed context. This behavioral marker considers whether the team leaders maintain a global perspective and, more specifically, remain hands-off and head-up (ie, physically positioned at the patient's feet).[41] Because of their physical absence, the physician in the distributed team did not have the option of performing technical tasks. Although most behavioral markers in item 2 can be assessed, the difficulty encountered with this specific component may have affected the overall evaluation of distributed leadership. In contexts where physical presence is not feasible, it is essential to consider alternative methods of evaluating leadership effectiveness in distributed teams.

Although the technology and methods for distributed teams have been established and are available in rural Sweden, only 29% of our participants had prior experience in such settings. Rural areas, comprising almost half of Sweden, have some of the lowest population densities in Europe, making healthcare access a significant challenge. Västerbotten County pioneered telemedicine in the 1990s,[49] and distributed teams are used during on-call hours. However, these teams are still not utilized to their full potential at cottage hospitals. Preliminary data from our upcoming interview study (in manuscript) within the TIGER research program indicate that staff discomfort with technology is one of the main reasons for this underutilization. In addition, managers may have directed participants who had yet to be involved in distributed teams, seeing it as an opportunity for training. Given that our study teams were short-term and ad hoc, they would benefit from introductory sessions, level setting, and more specific and focused training to establish clear roles, improve communication, and foster better teamwork.

Regardless of randomization order, we found that teams scored better in their second scenario. This aligns with the literature, which states that teams tend to learn from simulation training.[50] Our results align when comparing the total score of the TEAM ratings in the present study with those of other studies. For instance, the mean total scores in 2 simulation-based studies involving interprofessional teams were 57% and 73%, respectively.[30] These figures closely align with our study's mean score of 67% (ie, mean 2.69 divided by 4, Table 3).

Our study's findings underscore the need for additional research on distributed teams, emphasizing the importance of identifying and understanding challenges. Directly transferring traditional teamwork to a distributed setting may be inefficient and counterproductive. Teamwork in distributed emergency teams in which the physician participates via telemedicine involves changes in leadership, collaboration, and communication. Thus, there is a need to explore effective training strategies that foster high-quality distributed teamwork.

Strength and Limitations

A particular strength of our study was that the composition of the teams was similar to that found in rural clinical settings, making the scenario more authentic. In situ simulation added to the study's realism. The familiarity of the participants and facilitator with the context enhanced the study's credibility. However, a limitation of our study was that only 29% of the participants had previously worked in a distributed team, which may have impacted their performance and the generalizability of our findings. In addition, although participants received basic assistance from the facilitator to connect and start the technology, they did not receive prior training with the technology, which might have affected team performance. Moreover, our study is both experimental and empirical, reflecting the realities of rural healthcare. This mirrors what would occur if they connected in a real-life scenario, enhancing the study's relevance to actual clinical practice. This approach allowed us to observe their natural problem-solving abilities and adaptability since technological issues can occasionally arise in reality.

Employing an SP provided high authenticity and patient-perspective feedback. We engaged a locally knowledgeable nurse with acting experience, which was beneficial given the rural setting. The SP received thorough training using a detailed script and practiced simulations to ensure consistent and authentic behavior. We did not measure intraportrayal and interportrayal reliability, which is a limitation. Using only one SP may limit the representativeness and generalizability of the results, as multiple SPs would better reflect a broader patient population and reduce the cognitive load on the individual SP. In addition, the SP's vital signs, like skin temperature, reflected her healthy condition,[37] requiring participants to rely on the facilitator for patient information.

While the scenarios were carefully designed for realism, simulated situations inherently differ from real emergencies. However, replicating real-world scenarios in simulations makes standardization possible, which is impossible in real life.

By balancing the order of scenarios, carry-over effects were counteracted, allowing for a comparative performance analysis across 2 scenarios. While randomizing both the team setting and the diagnosis would have strengthened the results, it would have required a larger sample size to achieve meaningful statistical power. This was not feasible due to the rural location, constraints on recruiting within a limited timeframe, and additional challenges posed by the COVID-19 pandemic.

Moreover, video recordings allowed the raters to assess team performance from the same perspective. The ability to review and replay scenarios enhanced the accuracy of evaluations, ensuring a comprehensive analysis of team interactions.

CONCLUSIONS

In this rural healthcare context, co-located teams rated higher on teamwork performance measures than distributed teams. Specifically, co-located teams scored higher on the TEAM instrument's Total score, Teamwork, and Overall Performance. Based on our results, we suggest that training programs for distributed teams should focus on:

- Strengthening role clarity: Training should emphasize task delegation strategies and well-defined roles, ensuring team members know their responsibilities and how they can complete tasks efficiently.
- Building team cohesion and adaptation: Training should address the challenges of physical distance by fostering open and transparent communication, collaborative decision making, and opportunities for team members to build shared mental models, relationships, and trust.
- Optimizing technology use: Training should guide the effective use of technology, including familiarity, to minimize communication delays and enhance the sharing of vital information.

Further research is needed into the factors that optimize teamwork in distributed settings and to explore how training can be developed to improve high-quality patient care in distributed settings. In addition, exploring factors contributing to effective teamwork in distributed healthcare settings beyond Scandinavia may provide insights applicable across various global healthcare contexts.

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