



# The Swedish Version of the TeamSTEPPS<sup>®</sup> Teamwork Perceptions Questionnaire (T-TPQ): A Validation Study

This article was published in the following Dove Press journal:  
*Journal of Multidisciplinary Healthcare*

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**Purpose:** The delivery of effective and safe healthcare to patients is highly dependent on careful collaboration between healthcare professionals. Although teamwork is an important component for patient safety, effective teamwork is not always carried out in hospital wards, leading to negative consequences for the patients. Teamwork measurements can be used to evaluate and provide feedback to healthcare professionals to support team performance and to identify areas for improvement. The TeamSTEPPS<sup>®</sup> Teamwork Perceptions Questionnaire (T-TPQ) evaluates Team Structure and four core competences of teamwork (Leadership, Situation Monitoring, Mutual Support, and Communication) among healthcare professionals in various healthcare settings. The questionnaire was judged to be relevant in a Swedish healthcare context and was translated into Swedish. This study aimed to test the reliability and construct validity of the Swedish version of the T-TPQ.

**Methods:** A total of 450 (of 1176) frontline healthcare professionals working at four hospitals responded to the questionnaire. A confirmatory factor analysis was carried out to test the factor structure. Cronbach's alpha was used to measure internal consistency.

**Results:** The hypothesized five-factor model of the five dimensions showed acceptable goodness-of-fit indexes. Cronbach's alpha coefficient for the total T-TPQ was 0.94, and the Cronbach's alpha coefficients for the dimensions ranged from 0.79 to 0.92. The intercorrelation coefficients ranged from 0.27 to 0.74.

**Conclusion:** The Swedish version of the T-TPQ showed acceptable reliability and validity for measuring healthcare professionals' individual perceptions of teamwork at the group level. Due to the low response rate, further studies are required to test the validity of the Swedish T-TPQ.

**Keywords:** healthcare professionals, perceptions, questionnaire, teamwork performance, validation study

## Introduction

Healthcare organizations operate in a complex context of conflicting demands and objectives. Healthcare is multifaceted and it has challenging tasks and many different professions.<sup>1</sup> The delivery of effective and safe healthcare to patients is highly dependent on careful collaboration between healthcare professionals.<sup>2</sup> The process of providing healthcare is interdisciplinary and requires people in various professions, such as physicians, nursing staff and allied health professionals, to work in teams.<sup>3</sup> A team can be described as two or more individuals who work together to achieve specified and shared goals, have task-specific competencies and

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specialized work roles, use shared resources, and communicate to coordinate and adapt to change.<sup>4</sup> Teamwork is a critical component of patient safety and is described in terms of behavior, cognitions and attitudes that make interdependent performance possible.<sup>5</sup> Xyrichis and Ream defined teamwork as

A dynamic process involving two or more health professionals with complementary backgrounds and skills, sharing common health goals and exercising concerted physical and mental effort in assessing, planning or evaluating patient care. This is accomplished through interdependent collaboration, open communication and shared decision-making. (p.238)<sup>6</sup>

A meta-analysis found that teamwork had a medium-sized effect on clinical performance in various healthcare settings.<sup>7</sup> Effective teamwork contributes to fewer medical errors,<sup>3</sup> decreased mortality,<sup>8</sup> higher patient satisfaction, higher nurse retention, lower hospital cost,<sup>9</sup> and improved job satisfaction.<sup>10,11</sup> Insufficient interprofessional communication is the most frequent cause of unsatisfactory teamwork<sup>12</sup> and contributes to patients being less likely to receive appropriate care,<sup>13</sup> and contributes to harm among patients.<sup>14</sup> Furthermore, teamwork without common health goals, open communication and information sharing is correlated with reduced organizational performance.<sup>15</sup> Hence, teamwork, communication, collaboration<sup>16,17</sup> and patient safety culture<sup>18,19</sup> have been shown to be improved by team training.

Although it is known that team training improves teamwork, team training has not routinely been implemented in clinical practice. To improve the quality and safety in health care in the US, the Department of Defense and the Agency for Healthcare Research and Quality (AHRQ) developed the Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS<sup>®</sup>), which is an evidence-based program. TeamSTEPPS was developed according to the framework of the “Big Five”, including the core components of effective teamwork: team leadership, mutual performance monitoring, backup behavior, adaptability and team orientation.<sup>20</sup>

As a part of TeamSTEPPS, the American Institute of Research developed two questionnaires: the TeamSTEPPS<sup>®</sup> Teamwork Attitudes Questionnaire (T-TAQ) and the TeamSTEPPS<sup>®</sup> Teamwork Perceptions Questionnaire (T-TPQ). The T-TAQ measures individuals’ general attitudes about teamwork and the T-TPQ was designed to measure individuals’ perceptions of teamwork in their workplace. Both questionnaires are related to the five dimensions of

teamwork, namely, Team Structure, Leadership, Situation Monitoring, Mutual Support and Communication, which represent the core teamwork competencies that mostly affect team performance.<sup>21</sup> In the current study, the results of a validation of the T-TPQ are reported, while validation of the T-TAQ is planned to be performed in another study. The original English version of the T-TPQ has been psychometrically validated.<sup>21,22</sup> Furthermore, the T-TPQ has been tested among healthcare professionals in Norway<sup>23</sup> and among nurses in Korea.<sup>24</sup> The questionnaire, which is not limited to specific departments or specialties, measures how healthcare professionals perceive the present state of teamwork.<sup>21</sup> The T-TPQ can be used to evaluate and provide feedback to managers and personnel to support team performance.<sup>25</sup> As we did not find any Swedish questionnaire measuring perceptions of teamwork and because the T-TPQ seemed to be relevant for a Swedish healthcare context, the questionnaire was translated into Swedish. When a questionnaire is translated into another language and is to be used in another culture, measurement equivalence is required.<sup>26</sup> The aim of this study was to test the reliability and construct validity of the Swedish version of the TeamSTEPPS<sup>®</sup> Teamwork Perceptions Questionnaire (T-TPQ).

## Methods

### The Questionnaire

The T-TPQ was translated with the permission of the United States AHRQ from the TeamSTEPPS 2.0 National Implementation (accessible at <http://teamstepps.ahrq.gov/>). The T-TPQ consists of 35 items with seven items in each of the following five dimensions: Team Structure, Leadership, Situation Monitoring, Mutual Support and Communication. Each item has five response options on a Likert scale ranging from 1 = strongly disagree with the statement to 5 = strongly agree with the statement. The scores for the total scale and for each dimension were calculated by adding all items and dividing the score by the number of items in each dimension and in the total scale.<sup>21,22</sup>

### Translation Procedures

The model of Brislin<sup>27</sup> inspired the translation of the T-TPQ into Swedish. A professional bilingual translator with Swedish as her native language conducted the forward translation of the original English version of the T-TPQ into Swedish. The research group reviewed the translated version of the T-TPQ, resulting in some semantic and conceptual adjustments. Another professional bilingual

**Table 1** The Swedish Version of the T-TPQ

<p>Teamstruktur</p> <ol style="list-style-type: none"> <li>1. Kompetensen hos personalen är tillräckligt överlappande så att arbetsuppgifter kan delas vid behov.</li> <li>2. Personalen hålls ansvariga för sina handlingar.</li> <li>3. Personalen på avdelningen delar med sig av information, vilket möjliggör att snabba beslut kan fattas av teamet som ansvarar för den patientnära vården.</li> <li>4. Min avdelning nyttjar resurser på ett effektivt sätt (till exempel personal, utrustning, information).</li> <li>5. Personalen förstår vad de har för roller och ansvar.</li> <li>6. Min avdelning har tydligt formulerade mål.</li> <li>7. Min avdelning fungerar mycket effektivt.</li> </ol> <p>Ledarskap</p> <ol style="list-style-type: none"> <li>8. Ledarna på avdelningen tar hänsyn till personalens bedömningar när det ska fattas beslut om patientens vård.</li> <li>9. Ledarna på avdelningen ger möjligheter att diskutera avdelningens insatser efter att en avvikelse har inträffat.</li> <li>10. Ledarna på avdelningen tar sig tid att delta i möten med personalen för att utveckla patientvården.</li> <li>11. Ledarna på avdelningen ser till att tillräckliga resurser (till exempel personal, utrustning, information) finns tillgängliga.</li> <li>12. Ledarna på avdelningen löser konflikter på ett framgångsrikt sätt.</li> <li>13. Ledarna på avdelningen är förebilder som teamledare.</li> <li>14. Ledarna på avdelningen informerar personalen om situationer eller förändringar som kan påverka patientvården.</li> </ol> <p>Situationsövervakning</p> <ol style="list-style-type: none"> <li>15. Personalen är bra på att förutse varandras behov.</li> <li>16. Personalen observerar andra teammedlemmars arbetsinsatser.</li> <li>17. Personalen utbyter relevant information när den blir tillgänglig.</li> <li>18. Personalen läser av vårdmiljön kontinuerligt för att identifiera situationer som kan ha betydelse för patientens vård.</li> <li>19. Personalen delar med sig av information om eventuella problem som uppstår (till exempel förändringar hos patienter, tillgängliga vårdplatser).</li> <li>20. Personalen träffas för att omvärdera målen för patientens vård när situationen förändras.</li> <li>21. Personalen rättar till varandras misstag för att säkerställa att rutiner följs på rätt sätt.</li> </ol> <p>Ömsesidigt stöd</p> <ol style="list-style-type: none"> <li>22. Personalen hjälper varandra vid hög arbetsbelastning.</li> <li>23. Personalen ber varandra om hjälp när de upplever att de har för mycket att göra.</li> <li>24. Personalen uppmärksammar varandra på potentiellt farliga situationer.</li> <li>25. Återkoppling inom personalgruppen ges på ett sätt som främjar ett positivt samspel och som leder till framtida förändringar.</li> <li>26. Personalen företräder patienten även när de kommer i konflikt med en "senior" kollegas uppfattning.</li> <li>27. När personalen är orolig för patientsäkerheten säger de tydligt ifrån tills de är säkra på att det har hörtsammats.</li> <li>28. Personalen löser sina konflikter även när konflikterna är personliga.</li> </ol> <p>Kommunikation</p> <ol style="list-style-type: none"> <li>29. Information om patientens vård ges till patient och närstående på ett vardagligt språk.</li> <li>30. Personalen vidarebefordrar relevant information inom rimlig tid.</li> <li>31. När personalen kommunicerar med patienterna ges tillräckligt med tid för frågor.</li> <li>32. Personalen använder ett enhetligt fackspråk och känd terminologi när de kommunicerar med varandra.</li> <li>33. Personalen bekräftar muntligt den information de får av varandra.</li> <li>34. Vid patientöverlämning följer personalen en standardiserad metod (till exempel SBAR) för informationsöverföring.</li> <li>35. Personalen söker information från alla tillgängliga källor (till exempel patienten, närstående, teamet, journalen, laboratoriesvar).</li> </ol>
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**Notes:** See Table 3 for English translation. Reproduced from Teamwork Perceptions Questionnaire (T-TPQ) & Manual. Team Strategies & Tools to Enhance Performance & Patient Safety (TeamSTEPPS®) 2.0. Agency for Healthcare Research and Quality; Rockville, Maryland USA. March 2014. Available from: <https://www.ahrq.gov/teamsteps/instructor/tools.html>.<sup>40</sup>

translator with English as her native language who was "blinded" to the original English version conducted back-translation of the reviewed Swedish version to English. Members of the research group compared the original version and the back-translated version of the T-TPQ. Few discrepancies were revealed, leading to some minor revisions to the Swedish T-TPQ. To establish semantic

equivalence, the translated version was pilot-tested among 15 healthcare professionals working in clinical practice (3 physicians, 8 registered nurses, 2 midwives, 1 nursing assistant and 1 physiotherapist). For each item, the participant had the opportunity to comment on the language, understandability and clarity. A review of the participants' responses led to some changes to clarify the language and

the concepts in the questionnaire. Table 1 shows the Swedish version of the questionnaire.

## Design

The study had a cross-sectional design.

## Setting and Sample

Frontline healthcare professionals (physicians, registered nurses, midwives, nursing assistants and allied health professionals) working at four hospitals (Hospital A, Hospital B, Hospital C, and Hospital D) in three healthcare regions in Sweden were included (N = 1176). They were employed in medical wards (Hospital A and Hospital B), emergency rooms (Hospital B), obstetric care wards (Hospital A, Hospital C and Hospital D), gynecological and intensive care wards, and anesthesia and operating rooms (Hospital A). In total, 450 healthcare professionals (38.3%) responded to the T-TPQ. The numbers and percentages of the different healthcare professions who were invited to the study and responded to the questionnaire are shown in Table 2.

## Data Collection

A paper version of the T-TPQ with an information letter about the study was distributed to the healthcare professionals between September and December 2018. The chief managers provided information to the healthcare professionals about the study. They also reminded the healthcare professionals to respond to the questionnaire via e-mail or during reports. Completed questionnaires were returned anonymously in self-addressed envelopes.

**Table 2** The Healthcare Professionals

	Invited	Responded
	N	N (%)
All healthcare personnel	1176	450 (38.3)
Profession		
Physician	229	68 (15.1)
Registered nurse	387	133 (29.6)
Midwife	222	116 (25.7)
Nursing assistant	313	111 (24.7)
Allied health professional	25	7 (1.6)
Missing		15 (3.3) <sup>a</sup>

**Note:** <sup>a</sup>Did not respond to the item of profession.

## Data Analysis

Descriptive statistics were analyzed with IBM SPSS statistics, version 25, to describe the median, range, mean, and standard deviation of the scores of the total questionnaire, the teamwork dimensions and the individual items. SPSS was also used to obtain the Cronbach's alpha coefficients to assess the reliability of the total questionnaire and each of the five teamwork dimensions. Cronbach's alpha coefficients equal to or greater than 0.70 are considered acceptable.<sup>26</sup> Finally, construct interdependence was examined based on the intercorrelations between the five dimensions using Pearson's *r*.

The construct validity, ie, the hypothesized five-factor model, was tested in two models (Model 1 and Model 2) by confirmatory factor analysis (CFA) in IBM AMOS, version 25. CFA indicates whether the dimensionality of a construct is similar between an adapted measure and the original measure.<sup>26</sup> Data from the respondents who answered all items were included in the CFA (n = 416). CFA provides goodness-of-fit indexes, which show how well the factor pattern complies with the hypothesized model.<sup>26</sup> Starting with Model 1, we used the goodness-of-fit indexes to evaluate how well the data fit the hypothesized five-factor model. In accordance with the study by Keebler et al<sup>22</sup> who examined the construct validity (via CFA) of the original version of the T-TPQ, we decided to analyze a second model (Model 2).

To assess the strength of the two models, goodness-of-fit indexes were calculated. We included the chi-square goodness of fit ( $\chi^2$ ), for which the p-value should exceed 0.05; the normed chi-square (chi-square/df), which should be <3; the root-mean-square error of approximation (RMSEA), for which a value of <0.06 indicates a good fit;<sup>28</sup> the Tucker-Lewis index (TLI) and the comparative fit index (CFI), which both should exceed 0.95.<sup>26</sup> The RMSEA takes into account the error of the approximation in the population,<sup>29</sup> and the TLI and CFI evaluate the goodness of fit of a hypothesized model in comparison with a null model.<sup>26,29</sup>

## Results

Table 3 presents the median, range, mean, and standard deviation for the total questionnaire, the five teamwork dimensions and the 35 items. At the dimension level, the highest mean score was found for the Communication dimension, and the lowest mean score was obtained for the Leadership dimension. Items 22, 35, 23, and 19 demonstrated the strongest agreement, while items 28 and 12 showed the strongest disagreement.

**Table 3** Median, Range, Mean and Standard Deviation for the Total Questionnaire, The Five Dimensions and the Items (T-TPQ) (n = 450)

	Median	Range	Mean	SD
Total questionnaire	3.74	1.5–4.9	3.75	0.58
Team Structure dimension	3.86	1.4–5.0	3.79	0.77
1. The skills of staff overlap sufficiently so that work can be shared when necessary.	4	1–5	3.74	1.07
2. Staff are held accountable for their actions.	4	1–5	3.94	1.02
3. Staff within my unit share information that enables timely decision-making by the direct patient care team.	4	1–5	3.97	0.94
4. My unit makes efficient use of resources (eg staff supplies, equipment, information).	4	1–5	3.66	1.09
5. Staff understand their roles and responsibilities.	4	1–5	3.99	0.97
6. My unit has clearly articulated goals.	4	1–5	3.67	1.11
7. My unit operates at a high level of efficiency.	4	1–5	3.55	1.12
Leadership dimension	3.71	1–5	3.56	0.99
8. My supervisor/manager considers staff input when making decisions about patient care.	4	1–5	3.78	1.15
9. My supervisor/manager provides opportunities to discuss the unit's performance after an event.	4	1–5	3.80	1.16
10. My supervisor/manager takes time to meet with staff to develop a plan for patient care.	4	1–5	3.67	1.22
11. My supervisor/manager ensures that adequate resources (eg staff, supplies, equipment, information) are available.	4	1–5	3.38	1.23
12. My supervisor/manager resolves conflicts successfully.	4	1–5	3.08	1.26
13. My supervisor/manager models appropriate team behavior.	4	1–5	3.37	1.26
14. My supervisor/manager ensures that staff are aware of any situations or changes that may affect patient care.	4	1–5	3.82	1.09
Situational Monitoring dimension	3.86	1.43–5.0	3.80	0.68
15. Staff effectively anticipate each other's needs.	4	1–5	3.58	0.92
16. Staff monitor each other's performance.	4	1–5	3.61	0.95
17. Staff exchange relevant information as it becomes available.	4	1–5	3.99	0.87
18. Staff continuously scan the environment for important information.	4	1–5	3.93	0.89
19. Staff share information regarding potential complications (eg patient changes, bed available).	4	1–5	4.11	0.81
20. Staff meets to reevaluate patient care goals when aspects of the situation have changed.	4	1–5	3.72	0.98
21. Staff correct each other's mistakes to ensure that procedures are followed properly.	4	1–5	3.66	0.94
Mutual Support dimension	3.71	1.6–5.0	3.74	0.68
22. Staff assist fellow staff during high workload.	4	1–5	4.22	0.90
23. Staff request assistance from fellow staff when they feel overwhelmed.	4	1–5	4.14	0.88
24. Staff caution each other about potentially dangerous situations.	4	1–5	4.03	0.87
25. Feedback between staff is delivered in a way that promotes positive interactions and future change.	4	1–5	3.50	1.04
26. Staff advocate for patients even when their opinion conflicts with that of a senior member of the unit.	4	1–5	3.52	0.92
27. When staff have a concern about patient safety, they challenge others until they are sure the concern has been heard.	4	1–5	3.78	1.00
28. Staff resolve their conflicts, even when the conflicts have become personal.	4	1–5	3.01	1.01
Communication dimension	3.86	1.7–5.0	3.83	0.62
29. Information regarding patient care is explained to patients and their families in lay terms.	4	2–5	4.04	0.84
30. Staff relay relevant information in a timely manner.	4	1–5	3.95	0.81
31. When communicating with patients, staff allow enough time for questions.	4	1–5	3.55	1.04
32. Staff use common terminology when communicating with each other.	4	1–5	3.99	0.86
33. Staff verbally verify information that they receive from one another.	4	1–5	3.58	0.97
34. Staff follow a standardized method of sharing information when handling off patients.	4	1–5	3.53	1.12
35. Staff seek information from available sources.	4	1–5	4.20	0.87

**Notes:** Scale: from 1 = strongly disagree with the statement to 5 = strongly agree with the statement. Reproduced from Teamwork Perceptions Questionnaire (T-TPQ) & Manual. Team Strategies & Tools to Enhance Performance & Patient Safety (TeamSTEPS®) 2.0. Agency for Healthcare Research and Quality; Rockville, Maryland USA. March 2014. Available from: <https://www.ahrq.gov/teamsteps/instructor/tools.html>.<sup>40</sup>

For reliability, the Cronbach's alpha coefficient for the total T-TPQ was 0.94, and the Cronbach's alpha coefficient for each dimension ranged from 0.79 to 0.92 (Table 4).

The intercorrelation coefficients of the five teamwork dimensions ranged from 0.27 to 0.74 (Table 5).

The construct validity of the T-TPQ was confirmed by goodness-of-fit indexes. The CFA (Model 1) showed a moderate fit with the data:  $\chi^2$  (df) 1402 (550),  $p < 0.001$ , normed chi-square = 2.54, RMSEA = 0.061, TLI = 0.877, CFI = 0.758. To improve the fit of the model, post-hoc modifications (Model 2) according to Keebler et al<sup>22</sup> were made, which concerned four sets of items with high modification indexes. This included two items in the Leadership dimension (12 and 13), four items (22 and 23; and 26 and 27) in the Mutual Support dimension, and two items (29 and 31) in the Communication dimension. Model 2 showed that the hypothesized model of the five dimensions fit the data adequately:  $\chi^2$  (df) 1230 (546),  $p < 0.001$ , normed chi-square = 2.25, RMSEA = 0.055, TLI = 0.901, CFI = 0.909 (Table 6).

## Discussion

The results of the present study demonstrated that the reliability of the total questionnaire and each of the dimensions were considered acceptable. Other studies also showed acceptable Cronbach's alpha values for this questionnaire.<sup>21,23</sup> Compared to our study, the studies by Battles and King<sup>21</sup> and Keebler et al<sup>22</sup> demonstrated slightly higher values on all the dimensions, while that of Ballangrud et al<sup>23</sup> showed somewhat lower values in all dimensions except for Communication.

The hypothesized five-factor model of Team Structure, Leadership, Situation Monitoring, Mutual Support and Communication had acceptable goodness-of-fit indexes, indicating that this questionnaire can be used to measure teamwork perceptions among healthcare professionals in a hospital setting in Sweden. We conducted the CFA with

post hoc modifications in accordance with the study by Keebler et al.<sup>22</sup> Post hoc modification may improve the fit due to high modification indexes, which was the case with four pairs of items in three of the five dimensions of the T-TPQ.<sup>22</sup> When modifications are used with CFA, it is important that the final model does not deviate from the theoretical model.<sup>30</sup> Although each of the four sets of correlated items contained similar content, the items in one dimension showed low correlation with the items in the other dimensions, which indicates that none of the items measures more than one dimension.<sup>22</sup>

The RMSEA, which is recognized as one of the most informative criteria in CFA,<sup>29</sup> had an acceptable fit after the post hoc modification (Model 2). The RMSEA value in this study was almost identical to those reported in the previous research conducted with healthcare personnel.<sup>22,23</sup> Hwang and Ahn,<sup>24</sup> who performed CFA, demonstrated an RMSEA just below 0.7, which can be explained by the fact that only nurses were included in their sample. The confidence interval in our study was narrow, which could indicate the high precision of the RMSEA in reflecting the model fit in the population.<sup>29</sup> Both the CFI and TLI had values below the recommended value ( $>0.95$ ) in the present study. The values were lower than those in the study by Keebler et al,<sup>22</sup> but slightly higher than in the other two studies that conducted CFA.<sup>23,24</sup> The better outcome in the study by Keebler et al<sup>22</sup> can be explained by the large sample of 1700 staff members. Hu and Bentler<sup>28</sup> suggested a TLI close to 0.95 for large samples and noted that when the sample size is small, both the RMSEA and TLI tend to overreject true population models. A sample size of at least 10 cases for each variable is desirable,<sup>30</sup> which means a minimum of 350 cases in the analyses in our study. However, even though we had a sample size of 416 for our CFA, larger samples are preferable.<sup>26</sup> On the other hand, the chi-square goodness-of-fit ( $\chi^2$ ) index was significant, probably due to the sample size. The  $\chi^2$  index is sensitive to sample size and therefore seldom used as the only criterion for model fit.<sup>26</sup> It is desirable for the normed chi-square value to be less than 3, which was achieved in the present study.

The fit indexes for the final model provide support for the hypothesized theoretical model showing that the five dimensions of the T-TPQ are important components for measuring individual perceptions of teamwork in healthcare settings. We do not recommend changes to the questionnaire. No changes were made after the validation of the original English version of the T-TPQ<sup>22</sup> and the T-TPQ manual states that items in the T-TPQ should not be modified.<sup>21</sup>

**Table 4** Internal Consistency for the T-TPQ Total Scale and the Dimensions

	Cronbach Alpha
Total questionnaire	0.94
Dimensions	
Team Structure	0.85
Leadership	0.92
Situation Monitoring	0.87
Mutual Support	0.85
Communication	0.79

**Table 5** Intercorrelations of the T-TPQ Dimensions

Dimensions	Leadership	Situation Monitoring	Mutual Support	Communication
Team Structure	0.534*	0.617*	0.619*	0.525*
Leadership		0.309*	0.408*	0.268*
Situation Monitoring			0.739*	0.549*
Mutual Support				0.562*

**Note:** \*Correlation is significant at the 0.01 level (2-tailed).

**Table 6** Confirmatory Factor Analysis Fit Indexes for Each Model (N = 416)

	Model 1 (Unmodified)	Model 2* (Modified)
$\chi^2$ (df), p-value	1402, 617 (550), $p < 0.001$	1230, 105 (546), $p < 0.001$
Normed chi-square	2.54	2.25
RMSEA (CI)	0.061 (0.057, 0.065)	0.055 (0.051, 0.059)
TLI	0.877	0.901
CFI	0.758	0.909

**Notes:** \*Included four sets of items with high modification indexes: Leadership dimension: items 12 and 13, Mutual Support dimension: items 22 and 23, and items 26 and 27, Communication dimension: items 29 and 31.

**Abbreviations:** RMSEA, root mean square error of approximation; CI, confidence interval; TLI, Tucker-Lewis index; CFI, comparative fit index.

The T-TPQ can be used as an assessment of teamwork perceptions to identify areas for improvement and can be administered before and after the implementation of a team training program for comparison and follow-up. In previous studies, the questionnaire was used to evaluate the implementation of the TeamSTEPPS program within various health care specialties<sup>19,31-33</sup> and the implementation of other teamwork improvement initiatives.<sup>34,35</sup> The T-TPQ was also used to evaluate learning interventions for undergraduate students.<sup>36,37</sup> The T-TPQ has the advantage of being sensitive to changes in teamwork perceptions. It is important, however, to be aware of that the T-TPQ is designed to measure perceptions of the five teamwork dimensions and may not be appropriate for the assessment of other aspects of teamwork or objective measures of teamwork behaviors.<sup>22</sup> Further efforts to advance research about teamwork may include analyses of the relationship between teamwork perceptions and other outcome measures, such as organizational (eg patient safety culture), professional (eg job satisfaction) and patient outcomes (eg quality of care).

## Limitations

The study has several limitations. The sample size was considered sufficient to perform CFA,<sup>30</sup> however, the response rate was low and the risk of bias may, therefore,

have influenced the external validity.<sup>38</sup> The response rate varied somewhat among the profession groups. Midwives had the highest response rate, while physicians and allied health professionals had the lowest response rate. High workload, time pressure and the possibility that teamwork was not a fully known concept for everyone may have influenced the motivation to answer the questionnaire. Since the questionnaire was answered anonymously, it was not possible to carry out a dropout analysis of those who did not reply, which is also a limitation.

## Conclusion

The Swedish version of the T-TPQ showed acceptable reliability and construct validity to measure healthcare professionals' individual perceptions of teamwork at the group level. Teamwork is an important component of patient safety and a core element of highly reliable organizations.<sup>39</sup> In hospital settings, measuring teamwork as one component of patient safety can be valuable. Since the T-TPQ is a reasonable time- and cost-effective survey, it can be used in addition to objective measures of teamwork behaviors to evaluate healthcare professionals' perceptions of teamwork. Due to low response rates and varying response rates in the different profession groups in the current study, further studies are necessary to test the reliability and validity of the Swedish T-TPQ.

## Ethics

The Research Ethics Committee at Karlstad University approved the study (C2018/50) and the head manager at each division gave permission to conduct the study. By completing and returning the questionnaire, the healthcare professionals consented to participate in the study.

## Acknowledgments

The authors want to thank the healthcare professionals who participated in the study. We also want to thank Jari Appelgren, Karlstad University, Sweden, for statistical support.

## Author Contributions

All authors made substantial contributions to the conception and design, data acquisition, or data analysis and interpretation; drafted or written, or substantially revised or critically reviewed the article; agreed on the journal to which the article was submitted, reviewed and agreed on all versions of the article before submission, and during revision; and agreed to be accountable for the contents of the article.

## Funding

The authors received no specific funding for this work.

## Disclosure

The authors report no conflicts of interest in this work.

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