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# The Team Climate Inventory: application in hospital teams and methodological considerations

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## ABSTRACT

**Objective:** To test the validity, reliability and discriminating capacity of an instrument to assess team climate, the Team Climate Inventory (TCI), in a sample of Dutch hospital teams. The TCI is based on a four-factor theory of team climate for innovation.

**Design:** Validation study.

**Setting:** Hospital teams in The Netherlands.

**Participants:** 424 healthcare professionals; 355 nurses working in 22 nursing teams and 69 nurses and doctors working in 14 quality-improvement teams.

**Main outcome measures:** Exploratory and confirmatory factor analyses, Pearson's product moment correlations, internal homogeneity of the TCI scales based on Cronbach alpha, and the TCI capability to discriminate between two types of healthcare teams, namely nursing teams and quality-improvement teams.

**Results:** The validity test revealed the TCI's five-factor structure and moderate data fit. The Cronbach alphas of the five scales showed acceptable reliabilities. The TCI discriminated between nursing teams and quality-improvement teams. The mean scores of quality-improvement teams were all significantly higher than those of the nursing teams.

**Conclusion:** Patient care teams are essential for high-quality patient care, and team climate is an important characteristic of successful teams. This study shows that the TCI is a valid, reliable and discriminating self-report measure of team climate in hospital teams. The TCI can be used as a quality-improvement tool or in quality-of-care research.

Optimal collaboration between professionals is important for offering continuous and coordinated care. A patient-care team that functions well is crucial for providing high-quality care for patients.<sup>1-4</sup> Team functioning is determined not only by structural determinants such as workload, team size or team composition,<sup>5, 6</sup> but also by team processes. There is a large body of research on the relationship between team processes and team effectiveness,<sup>7-14</sup> which shows that a team climate in which team members are encouraged to develop and implement new ideas can lead to better healthcare and healthcare outcomes.

West presents the most studied model of this "team climate aimed at innovation" and suggests that four climate factors, "vision," "participative safety," "task orientation" and "support for innovation," are essential for developing and implementing innovations.<sup>12</sup> This theoretical model led to the development of a questionnaire to measure team climate, the Team Climate Inventory (TCI). The TCI has been used as an improvement tool for assessing team function to identify areas that could be improved.<sup>15, 16</sup> In addition, it has been used in

research as an outcome measure of quality-improvement strategies or to predict the success or failure of such a strategy.<sup>5, 17, 18</sup>

The TCI has been translated into several languages, including Norwegian,<sup>19</sup> Swedish,<sup>20</sup> Finnish,<sup>21</sup> Italian<sup>22</sup> and German,<sup>23</sup> and it has been tested on many different teams (eg, management, social services, psychiatric, oil company, industrial and primary care teams; table 1). Given this utilisation of the TCI tool in multiple countries and industries, it may become a helpful vehicle in the translation of learning among countries and industries. However, none of these studies tested the questionnaire specifically for hospital teams.

Delivering integrated care is becoming increasingly important for hospital teams, and a good team climate is crucial for delivering high-quality care and quality improvement in healthcare. Therefore, it is important to determine the psychometric characteristics of the TCI in this specific setting.

The present study extends the research work on the TCI by investigating the psychometric properties of a Dutch version of the TCI on a population of hospital teams. In this paper, we describe how we systematically assessed the validity, reliability and discrimination capacity of the TCI in hospital teams.

## METHODS

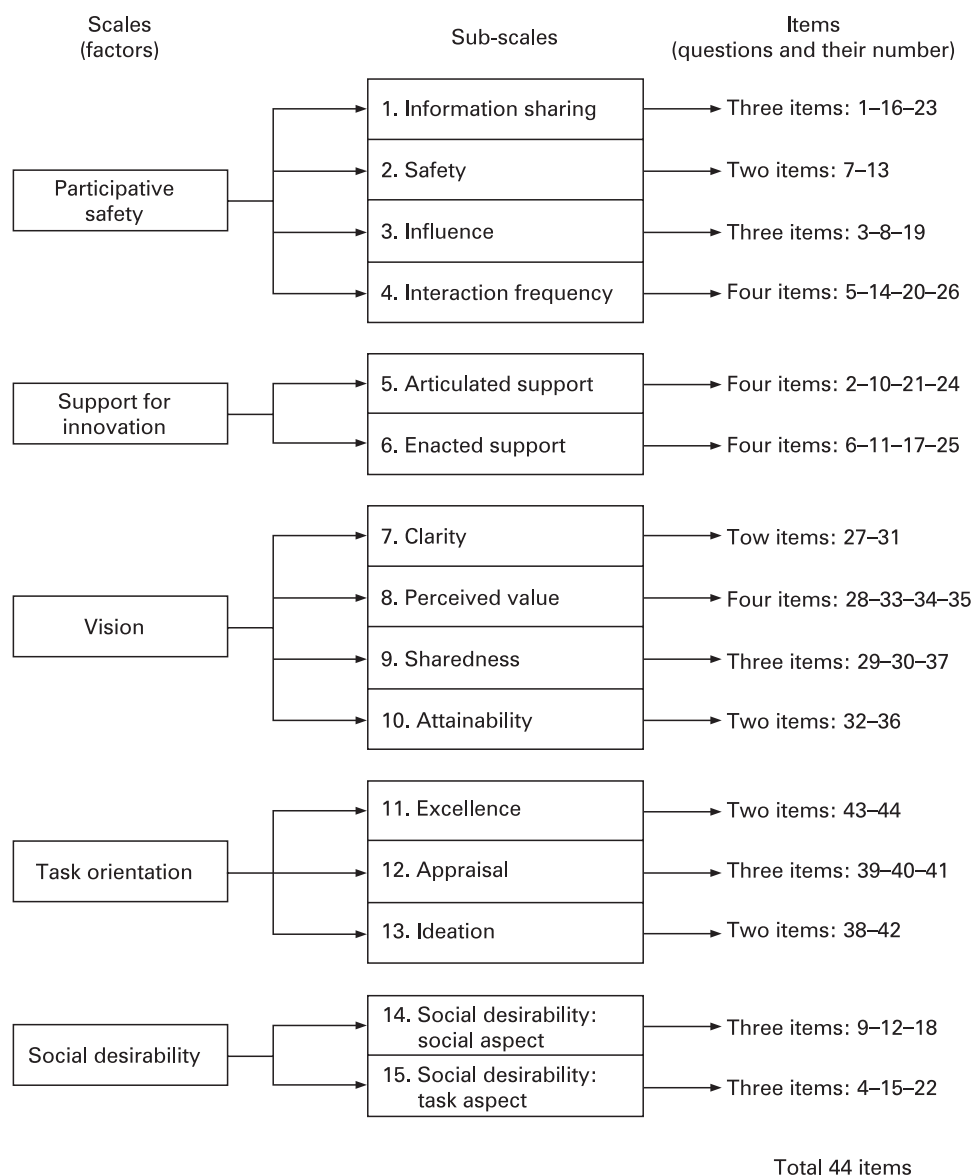
### TCI questionnaire and Dutch translation

The original 116-item TCI of West underwent exploratory and confirmatory factor analyses, which resulted in a 44-item version.<sup>15, 24, 25</sup> The 44-item TCI includes four scales, "vision," "participative safety," "task orientation," and "support for innovation" and 13 subscales (fig 1). The questionnaire includes a fifth scale that was designed to detect socially desirable answers. For the Dutch translation, four people used Beaton's guidelines<sup>26</sup> to systematically and independently translate and back-translate the TCI. One translator was a native-English speaker fluent in Dutch, and the other three were Dutch researchers fluent in English.

### Study population

On the basis of a 10:1 ratio of participants to items<sup>27</sup> for each of the 38 items in the questionnaire (excluding the six items for social desirability), we aimed at including 380 healthcare professionals. Two types of hospital teams were invited to participate: monodisciplinary teams of nurses and multidisciplinary quality-improvement teams. We contacted all the head nurses of the nursing teams at one university hospital and invited their teams to participate in the study. We contacted the facilitators of quality-improvement teams participating in national breakthrough collaboratives. Participation was voluntary.

**Figure 1** Structure of the 44-item Team Climate Inventory. © Anderson and West/ASE (1999). NFER-NELSON, Darvill House, 2 Oxford Road East, Windsor, UK.



### Procedure

The Dutch TCI was handed to the contact person of each participating team. All members completed the questionnaire individually and anonymously. The respondents were asked to indicate on a five-point scale to what extent they agreed with each item. Each respondent returned the survey in a sealed envelope, which was sent to the researchers.

### Analyses

As in the preceding TCI psychometric studies, the six social desirability items were excluded from analyses.

### Factor structure and intercorrelations

To test the validity of the TCI in healthcare teams, we performed exploratory (principal-component factor analysis, including a varimax rotation, SPSS version 12) and confirmatory factor analyses (using LISREL), to see which items cluster together. Confirmatory factor analyses tested the robustness of the factor solution. LISREL is a statistical program for structural equation modelling, a form of multivariate data analysis that tests the goodness of fit of the empirical data and a specified or hypothesised model. In order to evaluate the fit of the models, we examined the

five most used criteria [the chi-square ( $\chi^2$ , lower scores mean a better fit); the ratio of maximum-likelihood chi square ( $\chi^2/df$ , scores from 2 to 5), the Goodness-of-Fit Index (GFI>0.90), the Comparative Fit Index (CFI $\geq$ 0.95) and the root-mean-square error of approximation (RMSEA $\leq$ 0.10)]. The confirmatory factors for the total sample and for the nursing and quality-improvement teams were analysed separately. Once we had defined the structure, we computed the Pearson product moment correlations of the factors with the subscales that we identified.

### Internal homogeneity

To assess the reliability of the TCI in healthcare teams, we calculated the internal homogeneity by calculating Cronbach alpha coefficients for the scales emerging from the factor analyses. A Cronbach alpha score of 0.7 or higher is usually regarded as indicative of acceptable reliability.<sup>28</sup>

### Discriminating capacity

To see if the TCI discriminates between different types of healthcare teams, we tested its ability to discriminate between nursing teams and quality-improvement teams. We tested the difference in the TCI scores for nursing teams and

**Box 1 Improving multidisciplinary team working in care for patients with head and neck cancer<sup>3</sup>**

The management of care for patients with head and neck cancer is very complex. This type of cancer has a very significant impact on patients because of the location of the tumour and needs to be managed by different disciplines in a multimodal treatment. The multidisciplinary team (MDT) plays a crucial role in delivering a high quality of care for this group of patients. The assessment of the team climate of the MDT using the Team Climate Inventory (TCI) showed overall high scores (74%) but also room for improvement regarding information sharing, safety of team members, and task orientation. After some improvements—for example “adding extra experts to the team” and “redefining tasks and goals”—the TCI scores improved with 11%.

**Box 2 Improving team climate in teams of students<sup>16</sup>**

In this study, the Team Climate Inventory (TCI) was used in teams of students working together in research projects, to promote critical self-awareness about one's own attitudes and to help team members diagnose their team climate. The teams were encouraged to take specific actions, based upon their TCI scores. Aspects that were working well in a team were reinforced. Regarding aspects that reflected a problem within a team, actions were taken. Some teams, for example, introduced meeting agendas in which time limits were set at the beginning of the meeting. Other teams participated in communication skills training and tried to make effective use of communications technologies. There were significant improvements in TCI scores after the improvement actions.

quality-improvement teams with mixed model analysis in which we corrected for clustering in teams.

**RESULTS****Study population**

The study participants consisted of 424 healthcare workers: 355 were part of one of the 22 monodisciplinary hospital teams of nurses, and 69 were part of one of the 14 multidisciplinary quality-improvement teams. The nursing

teams came from 22 specialities in surgery, internal medicine and childcare, and each team consisted of 10 or more people (mean 16; range 6–36). The improvement teams were breakthrough collaborative teams aiming at improving care for patients with diabetes, perioperative care and care for patients with head and neck cancer. The multidisciplinary teams consisted of a minimum of three people (mean 5; range 3–13), and each included at least one nurse and one physician.

**Table 1** Overview of tested versions of the Team Climate Inventory and some psychometric characteristics

Population and study	Psychometric results
English: Anderson and West <sup>24</sup> 155 individuals on 27 hospital management teams 971 individuals on 121 teams (35 primary healthcare teams, 42 social service teams, 20 psychiatric teams, 24 oil company teams)	Internal homogeneity (Cronbach alpha) 0.84–0.94 Exploratory factor analysis: 61 items→five factors; four factors possible  Confirmatory factor analysis: 38 items→five factors (four are possible) Criterion validity is acceptable
Norwegian: Mathisen <i>et al</i> <sup>19</sup> 1487 and 1436 individuals on 195 industrial teams and 106 public sector teams	Internal homogeneity (Cronbach alpha) 0.83–0.94 Exploratory factor analysis→five factors Confirmatory factor analysis→five factors
Swedish: Agrell and Gustafson <sup>20</sup> 124 individuals on 17 teams (production or management teams in public and private organisations)	Internal homogeneity (Cronbach alpha) 0.86–0.91  Exploratory factor analysis→four factors Criterion validity is acceptable
Finnish: Kivimaki <i>et al</i> <sup>21</sup> 2265 individuals (number of teams unknown) (local government employees in healthcare and social service departments)	Internal homogeneity (Cronbach alpha) 0.83–0.94  Exploratory factor analysis→five factors in one sample Exploratory factor analysis→five OR four factors in another sample
Extra: In high-complexity teams, “Interaction frequency” is an extra factor	Confirmatory factor analysis→five factors Criterion validity not estimated
Italian: Ragazzoni <i>et al</i> <sup>22</sup> 199 individuals on 27 teams (healthcare/rehabilitation centres 386 individuals on 48 company teams)	Internal homogeneity (Cronbach alpha) 0.56–0.91  Exploratory factor analysis→five factors Confirmatory factor analysis→not done Criterion validity not estimated
German: Brodbeck and Maier <sup>23</sup> 810 individuals on 146 teams (industrial production and administration, youth and family care, 15 nursing teams, software development, students)	Internal homogeneity (Cronbach alpha) 0.81–0.89  Exploratory factor analysis→not done Confirmatory factor analysis→best fit five factors; four factors possible Criterion validity acceptable

**Table 2** Factor loadings for the Dutch version of the Team Climate Inventory in healthcare teams

Scales	1	2	3	4	5
1. Vision					
29 How far are you in agreement with these objectives?	0.798				
33 How worthwhile do you think these objectives are to you?	0.782				
34 How worthwhile do you think these objectives are to the organisation?	0.782				
28 To what extent do you think they are useful and appropriate objectives?	0.744				
35 How worthwhile do you think these objectives are to the wider society?	0.744				
36 To what extent do you think these objectives are realistic and can be attained?	0.722				
27 How clear are you about what your team objectives are?	0.672				
32 To what extent do you think your team's objectives can actually be achieved?	0.670				
30 To what extent do you think other team members agree with these objectives?	0.651				
31 To what extent do you think your team's objectives are clearly understood by other members of the team?	0.631				
37 To what extent do you think members of your team are committed to these objectives	0.624				
2. Participative safety: interaction and information sharing					
14 We interact frequently		0.866			
05 We keep in regular contact with each other		0.837			
20 We keep in touch with each other as a team		0.790			
26 Members of the team meet frequently to talk both formally and informally		0.661			
23 There are real attempts to share information throughout the team		0.547			
16 People keep each other informed about work-related issues in the team		0.529			
01 We share information generally in the team rather than keeping it to ourselves		0.437			0.443
03 We all influence each other		0.374			
3. Support for innovation					
25 Team members provide practical support for new ideas and their application			0.683		
06 In this team we take the time needed to develop new ideas			0.669		
24 This team is always moving towards the development of new answers			0.666		
10 The team is open and responsive to change			0.663		
02 Assistance in developing new ideas is readily available			0.656		
21 People in this team are always searching for fresh, new ways of looking at problems			0.604		
11 People in the team cooperate in order to help develop and apply new ideas			0.487		
17 Members of the team provide and share resources to help in the application of new ideas			0.318		
4. Task orientation					
41 Does the team critically appraise potential weaknesses in what it is doing in order to achieve the best possible outcome?				0.755	
40 Are team members prepared to question the basis of what the team is doing?				0.669	
44 Does the team have clear criteria which members try to meet in order to achieve excellence as a team?				0.580	
39 Do you and your colleagues monitor each other so as to maintain a higher standard of work?				0.577	
43 Is there a real concern among team members that the team should achieve the highest standards of performance?				0.550	
42 Do members of the team build on each other's ideas in order to achieve the best possible outcome?				0.522	
38 Do your team colleagues provide useful ideas and practical help to enable you to do the job to the best of your ability?				0.348	0.470
5. Participative safety: safety and influence					
07 People feel understood and accepted by each other			0.415		0.567
19 There is a lot of give and take					0.533
08 Everyone's view is listened to, even if it is in a minority					0.483
13 We have a "we are in it together" attitude					0.413

The items are numbered in accordance with the numbering of the original version of the inventory. Items are classified to their best-fitting factor by loading or content. All loadings of 0.4 or higher on more than one factor are displayed.

## Factor structure and correlations

### Exploratory factor analysis

The principal-component factor analysis indicated that there should be five factors instead of the original four factors. These five factors together accounted for 60% of the total variance. Table 2 presents the items of the scales and their factor loadings on the five-factor solution, after varimax rotation. Overall, all items from the scales "vision," "support for innovation" and "task orientation" load on their theoretical scale except for item 38 ("provide each other useful ideas") which loaded higher on the scale "participation safety." The original scale "participation safety" fell apart into two scales: the first part contained all items of the subscales "interaction frequency," "information sharing" and item

3 ("we all influence each other"); the second part consisted of all items of the subscales "safety" and "influence" except for item 3. Two items besides item 38 had high factor loadings ( $r > 0.4$ ) on one other factor than their theoretical scale, namely, item 1 ("share information rather than keeping it to oneself") and item 7 ("people feel understood and accepted by each other").

### Confirmatory factor analysis

The results of the confirmatory factor analysis with LISREL indicated that the five-factor model has the best fit (table 3). The fit indices show that the five factors fit the model moderately. Further LISREL analyses of the models for nursing teams and improvement teams also suggested that a five-factor

**Table 3** Fit statistics for the LISREL confirmatory nested models of the Team Climate Inventory

Model	$\chi^2$	$\chi^2/df$	Goodness-of-Fit Index (>0.90)	Comparative Fit Index (>0.95)	Root mean square residual (<0.05)
Total sample					
Original four factors	2628.98	3.99	0.75	0.96	0.084
Four factors	2511.57	3.81	0.76	0.96	0.082
Five factors	2255.49	3.44	0.78	0.97	0.076
Nursing teams					
Original four factors	2370.70	3.60	0.74	0.95	0.086
Four factors	2305.37	3.50	0.74	0.95	0.084
Five factors	2077.06	3.17	0.76	0.96	0.078
Improvement teams					
Original four factors	952.35	1.44	0.58	0.90	0.081
Four factors	943.77	1.43	0.58	0.90	0.080
Five factors	915.09	1.40	0.59	0.90	0.076

**Table 4** Intercorrelations and reliabilities among Team Climate Inventory scales

Scale	Items	Alpha coefficient	Inter-item correlations (lowest to highest)	Inter-scale intercorrelations			
				1	2	3	4
1. Vision	11	0.93	0.41 to 0.80				
2. Interaction and information sharing	8	0.86	0.37 to 0.84 (03 = 0.18)	0.47*			
3. Support for innovation	8	0.88	0.34 to 0.62	0.60*	0.65*		
4. Task orientation	7	0.83	0.20 to 0.57 (38 = 0.17)	0.55*	0.56*	0.67*	
5. Participation safety	4	0.84	0.46 to 0.69	0.50*	0.68*	0.72*	0.63*

\*Correlation is significant at the 0.01 level (two-tailed).

solution provides the best fit to the data for both groups. However, all fit indices of the improvement teams were lower than those for the nursing teams.

### Intercorrelations

All factors or scales are significantly and positively correlated (table 4). Scale correlations range from 0.47 (“vision” and “interaction and information sharing”) to 0.72 (“support for innovation” and “participation safety”). The interitem correlations show adequate levels of interscale correlation for the factors “vision,” “support for innovation” and “participation safety” (table 4). The items of the factor “interaction and information sharing” all show high interitem correlations ( $\geq 0.37$ ) except for item 3 (“we all influence each other”; score 0.18). The lowest interitem correlation within the factor “task orientation” was caused by item 38: “providing useful ideas and practical help.”

### Internal homogeneity

The Cronbach alpha analysis of the five scales revealed alphas between 0.83 and 0.93 (table 4), which indicates good reliability for all five factors of the instrument.

**Table 5** Comparison of nursing teams and quality-improvement teams

Scales	Quality-improvement teams			Nursing teams			p Value
	Mean	SD	Range	Mean	SD	Range	
Vision	46.1	5.0	11–55	38.8	7.0	11–55	0.000*
Interaction and information sharing	32.3	3.6	8–40	29.8	3.9	8–40	0.001*
Support for innovation	31.0	3.4	8–40	26.6	4.4	8–40	0.000*
Task orientation	27.3	3.1	7–35	24.2	4.1	7–35	0.000*
Participation safety	16.0	1.8	5–20	13.7	2.7	5–20	0.000*

\*Significant at 0.01.

### Discriminating capacity

The analysis of the difference between nursing and quality-improvement teams revealed significant TCI-score differences (table 5). The mean scores of the improvement teams were significantly higher on all scales than those of the nursing teams. The greatest difference was on the scale “vision,” and the least on “participation safety.”

### DISCUSSION

This is the first study in which the Team Climate Inventory (TCI), an instrument for measuring team climate, has been studied exclusively in a population of hospital teams. We found five factors in exploratory and confirmatory factor analyses, as did Anderson and West.<sup>24</sup> However, their fifth scale consists of all items from the subscale “interaction frequency,” while our scale “participative safety” fell into two subscales, namely, “information sharing and interaction frequency” and “safety and influence.” The Cronbach alpha scores in our study of 0.83

### Box 3 Evaluating the effect of the use of integrated care pathways on team working in stroke care<sup>17</sup>

A good team climate in multidisciplinary stroke rehabilitation teams is required to provide optimal care. In a quasi-experimental (before and after) design, it was evaluated if the use of an integrated care pathway by a multidisciplinary stroke rehabilitation team would improve team working. The Team Climate Inventory was used to explore attitudes to team working before and after introducing the integrated care pathway. The evaluated intervention appeared to have little effect in improving staff attitudes regarding team climate. External factors over which the team had no control (eg, establishment of a new academic stroke unit nearby) may have been more important.

#### Box 4 Evaluating the effect of three forms of multidisciplinary team care in stroke rehabilitation<sup>18</sup>

The Team Climate Inventory (TCI) was used in this study to evaluate the effect of three forms of multidisciplinary team (MDT) care: a standard weekly MDT meeting using a standard form for documentation; a standard weekly MDT meeting using a newly devised form to enhance the documentation of patients' needs, their goals and their involvement with their rehabilitation; a weekly MDT ward round including the doctor and patients' relatives. The TCI was applied to find out whether the different forms of MDT care resulted in improved team working. The MDT ward rounds resulted in a significantly better consideration of patients' needs and greater patient involvement. It was also shown that this form of MDT care resulted in improved team working (measured using the TCI) compared with MDT meetings alone.

or more indicated good reliability, and the significant differences found between nursing teams and quality-improvement teams show that all the TCI scales have a discriminating capacity.

A five-factor solution was found in all the validation studies, including Anderson and West's, except from the study in Sweden.<sup>19–23</sup> However, all the studies that found a fifth factor identified it as the subscale "interaction frequency." Our study of healthcare teams is the first study to found another partitioning of the items. Further research should be done to see if this is specific for hospital teams. High scores on internal homogeneity that are as good or better than those of other studies highlight the reliability of our factor solution.<sup>19–23</sup> The discriminating capacity of the TCI has not been tested before.

A limitation of this study is that we studied only two types of hospital teams, namely, nursing teams and quality-improvement teams. It is unclear whether the differences in scores of these kinds of teams are influenced by their size or composition. All nursing teams were large monodisciplinary teams (consisting of more than 10 people each), and all improvement teams were small, multidisciplinary teams. Further research should be done to test the TCI on more hospital teams with various sizes and compositions.

We also recommend research into shortening the TCI. The high interitem correlations may mean that different items actually measure the same phenomenon to a significant degree. For example, "How far are you in agreement with the objectives of the team?" and "To what extent do you think these objectives are useful and appropriate?" have an intercorrelation of 0.80. A short version of the Finnish TCI has already been developed<sup>29</sup> but needs further testing in healthcare teams.

Patient care teams are key components in the delivery of high-quality patient care.<sup>4–30</sup> Studies show that team climate is an important characteristic of successful teams, either working in a microsystem of healthcare, as teams of nurses do, or coming together as a quality-improvement team.<sup>31–32</sup> Our study shows that the TCI is a valid, reliable and discriminating measure of team climate among hospital teams. Further research within the healthcare setting is needed to estimate its usefulness as a quality-improvement tool or as a predictor of quality-improvement outcome.

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**Competing interests:** None.

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