

# Development and Psychometric Evaluation of a Questionnaire for the Assessment of Safety Climate in Outpatient Diagnostic Imaging Services

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**Assessment of the Safety Climate in Outpatient Diagnostic Services:  
Development and Psychometric Evaluation of a Questionnaire**

## **Abstract**

**Introduction:** Safe practice and safety culture are important issues in outpatient diagnostic imaging services. As questionnaires assessing safety culture through the measurement of safety climate in this setting are not yet available, the present study aimed at developing and validating such an instrument.

**Materials and Methods:** After adaptation of an existing questionnaire and qualitative pretesting, the instrument was tested by collaborators from three outpatient imaging services in Switzerland. Results were first assessed using descriptive statistics. Scores of individual services were compared using a Wilcoxon test assessing differences between rank distributions. The final instrument was tested for validity using inter-rater agreement measures, such as reliability within groups ( $r_{WG}$  and  $r_{WG(j)}$ ), and an intraclass correlation coefficient measure (ICC(1)). These measures allowed the assessment of validity of aggregation into a total score ( $r_{WG(j)}$ ) and validate the instrument for its capacity to distinguish various safety climates of different groups by comparing inter-rater agreement in the overall sample to inter-rater agreement of individual services ( $r_{WG}$ ) and by measuring group effects (ICC(1)). Furthermore, the final instrument was tested for internal consistency and reliability using Chronbach's Alpha.

**Results:** Safety climate scores vary significantly between services. Inter-rater agreement measures show that item aggregation is justified and that the instrument distinguishes various patterns of safety climate. The final instrument proves to be valid, consistent and reliable.

**Conclusions:** The final instrument presents a valid, consistent and reliable option to assess safety climate in outpatient diagnostic imaging services. Results can be used as a basis for quality improvement.

**Key words**

- Outpatient service
- Safety
- Psychometrics
- Organizational Culture
- Surveys and Questionnaires

**Key Points**

- An adapted questionnaire assesses safety climate in outpatient diagnostic imaging services. The questionnaire was developed and tested in Switzerland.
- Psychometric evaluation showed the questionnaire to be a valid, consistent and reliable instrument.
- Results are of interest for imaging services as well as for but also for stakeholders interested more globally in monitoring and quality improvement

**Abbreviations**

rwg = Reliability within groups

rwg(j) = Reliability within groups for multiple judgments

ICC(1) intraclass correlation coefficient

EQUAM = Externe Qualitätssicherung in der ambulanten Medizin; IRA = Inter-rater Agreement

SAQ = Safety Attitude Questionnaire

CSS = Culture of Safety Survey

HSOPS = Hospital Survey on Patient Safety

aQUA Institut = Institut für angewandte Qualitätsförderung

## Introduction

As the Bonn Call-for-Action shows, safe practice and safety culture are important issues in radiology. Still, safe practice might be under pressure for various reasons; for example, when competition between services develops, as is the case in Switzerland. In parallel with the healthcare sector in general, the use of diagnostic radiology services has grown in Switzerland during the past years. From 2010 to 2016, the number of board-certified radiologists rose from 647 to 856 (+32%), while the number of inhabitants per radiologist dropped from 11'593 to 9'836 (-15%) [1] and profits were reduced for a selection of diagnostic imaging procedures [2]. Thus, each service has tried to maximise the operating grade of their infrastructure as much as possible. In consequence, the imaging services staff might work longer hours, run shorter imaging protocols and/or reduce manpower in order to keep the services at their current return on investments. However, this might have a negative impact on safe practice and safety culture.

As prior field observations conducted by one of the authors, but also literature suggests [3], safe practice and safety culture in outpatient radiology is not only influenced by radiographers and radiologists but also, to an important extent, by patient administration staff. Indeed, staff administrating referrals, planning slots for examinations, scheduling patient appointments as well as instructing patients on preparation for the examination, inherit an important role in safe practice. To a certain degree, this is similar to the telephone triage performed in physicians' outpatient offices [4]. But in contrast to general medical offices, members of the patient administrative staff in out-patient diagnostic imaging services often do not have any medical education.

Assessing and comparing safe practice and safety culture across services in a way that respects specific safety issues is gaining more and more importance for services

themselves but also for shareholders and initiatives such as the Bonn Call-for-Action that are interested in more global monitoring and quality improvement. One way to assess safety culture is to measure safety climate as perceived by the staff. Safety climate may be defined as shared perceptions or attitudes about the norms, policies, and procedures related to safe practice and patient safety among members of a group, and points to the underlying concept of safety culture, measuring its surface, so to speak [5, 6]. Safety climate is thus associated with various aspects of safety culture itself having an impact on patient safety. Some aspects of safety climate can be quite directly related to issues of patient safety. Excessive workload, for example, can lead to taking dangerous shortcuts while performing examinations. For other aspects, the relation can be somewhat more mediated. Thus, mutual support within the team can be said to foster patient safety by creating a culture of trust where, for example, a lack of knowledge about a certain procedure can be discussed. Thus, studies show that for various instruments, positive associations between safety climate and patient safety can be found [7]. Still, an instrument measuring safety climate specifically in outpatient diagnostic imaging services is, to the best of our knowledge, not yet available.

The measurement of safety climate by questionnaire has first been developed for inpatient settings [8, 9, 10]. Some of the instruments, like the Hospital Survey on Patient Safety (HSOPS) [11], the Safety Attitude Questionnaire (SAQ) [12], or the Culture of Safety Survey (CSS) [13], have been adapted to a German or Swiss context [14, 15, 16]. However, these instruments inherit several weaknesses when it comes to outpatient settings [17]. First, outpatient radiology services are often considerably smaller than inpatient settings. Thus, questions related to management or the relation between departments are difficult to answer. Second, the patient population in outpatient services significantly differ, for example in terms of morbidity,

compared to inpatient settings. Safety issues might thus be quite different. Third, these questionnaires strongly focus on medical staff, largely ignoring the important role of administrative personnel without medical qualifications.

The last point especially often remains an issue when instruments are adapted to outpatient settings and even when they are directly developed for outpatient settings [18, 19]. For example Modak et al. [19] report that radiographers, referral coordinators or outpatient administrative representatives did not answer many items of the SAQ adapted to outpatient setting. Instruments specifically developed for imaging services focus on radiology-specific issues such as magnetic resonance imaging [20] and, again, largely exclude patient administration staff. The SafeQuest, however, which was developed by de Wet et al. [21], is designed to suit both medical as well as administrative staff issues and was specifically created for outpatient services. This instrument uses items issued from 13 existing questionnaires and also incorporates parts of the outpatient version of the SAQ. In their validation study however, 35% of respondents classified themselves as being administrative staff [21]. Having been recently translated into German by the aQua Institute (based in Göttingen), this survey was chosen as the basis for this study and adapted to the needs of Swiss outpatient diagnostic imaging services.

The present article describes the adaptation and validation of the SafeQuest survey instrument for outpatient diagnostic imaging services. The aim was to develop an instrument that is able to assess and compare safety climates across services in a valid, consistent, and reliable way.

## **Materials and Methods**

### Questionnaire development

The designing of the questionnaire was part of a broader initiative, aiming to develop quality indicators for outpatient imaging services. The initiative and the development of the questionnaire was organized by the EQUAM foundation (based in Bern). First, the German version of the SafeQuest was compared to its English original and some adaptations to Swiss context were made. No questions about safety concerning specific examinations were added. Further, attention was given to only include questions that were equally important for both smaller and bigger organizations. With this choice, the instrument might, on the one hand, miss certain safety climate aspects that mostly concern a specific professional group or questions about specific procedures that might be more common in a certain type of organization. On the other hand, this choice allowed presenting the same questionnaire to the entire staff while at the same time minimizing the risk of low answering rates by certain types of staff. After adaptation, a qualitative pre-test [22] was conducted with two radiologists, two radiographers, and two people working in patient administration, and was adapted accordingly. Thereafter, the instrument was applied to a sample group for the first time. Survey items are presented as statements asking for the degree of agreement on a seven-point Likert scale ("To what extent do you agree to the following statements?" ranging from one "not at all" to a maximum of seven "to a very great extent"). The questionnaire was composed of 30 items and was organized using de Wet et al.'s [21] thematic structure (see table 2 for a list of all items). In addition to that, respondents were asked to provide demographic data, namely gender, profession, number of years of professional experience and number of years of employment at the respective service. A survey copy is available as supplementary material.

### Sample and Procedures

The questionnaire was presented as an online survey and invitations for participation sent to 124 individuals, including employees as well as (co)owners of the services, working at three outpatient imaging services in the German-speaking part of Switzerland. The completion of the questionnaire could be interrupted and continued at another time. Recipients were asked to complete the questionnaire within two weeks. Participation was voluntary and anonymous. Recipients who had not answered within a two-week period received a reminder.

### Statistical Methods

Descriptive statistics (distributions, means, missing answers) assessed the quality and distribution of data. Following Gai et al. [23], an individual mean score was calculated for each respondent by aggregating all of his/her questionnaire's item ratings (individual means). Total mean scores and their corresponding distributions were calculated as the overall mean scores of individual mean scores (averaged individual means) and the overall distribution of mean scores. Consequently, the total scores give more weight to bigger organizations in this procedure, but it allows the linking of descriptive statistics to validation measures of content validity, requiring total numbers not be aggregated on an organizational level (see below). Further, the percentage of positive responses, calculated item-wise as recommended by the Agency for Healthcare Research and Quality [24] was calculated. Negatively worded items were reversely coded to ensure that higher scores indicated a more positive assessment of safety climate for every item.

Differences between services were assessed by using a two-sided, two-sample Wilcoxon test, also known as the Mann-Whitney test [25, 26] applied to the distribution of the individual mean scores of the questionnaire. This test assesses differences between rank distributions. A test result  $<0.05$  was regarded as statistically significant.

Content validity was assessed using measures of inter-rater agreement. Inter-rater agreement (IRA) refers to the consensus in scores furnished by multiple judges for one or more targets. In our case, the targets of interest were the total and the item results of the questionnaire, while the judges refer to all persons having answered the questionnaire. The question that IRA measures try to answer is whether scores given by judges show similar patterns, or whether varying judgments appear between individuals or groups of individuals [32].

IRA is most commonly measured by so-called reliability within group ( $r_{WG}$ ) indices. The  $r_{WG}$  indices compare observed variance in ratings by judges of a certain group to the variance one would expect with random answers and thus measure inter-rater agreement [27, 28, 29]. The  $r_{WG}$  indices range between 0 and 1, with higher values indicating stronger agreement. For our analysis, we used two different  $r_{WG}$  measures:  $r_{WG}$  and  $r_{WG(j)}$ .

As Ginsburg et al. [29] describe,  $r_{WG(j)}$  measures agreement amongst all judgments ( $j$ ), in our case, all the items of the questionnaire. It is a good indicator to assess whether an instrument measures one circumscribable concept and thus item aggregation of total scores is valid. Smith-Crowe et al. [30] give significance levels for  $r_{WG(j)}$  for questionnaires up to 10 items. For instruments with 10 items, 100 respondents and 7 categories, which is the closest to our present instrument, an  $r_{WG(j)}$  of 0.63 is claimed to be sufficient for aggregation of a total score.

An  $r_{WG}$  on the other hand measures inter-rater agreement on the level of single items - in our case the total scores of the questionnaire. This measure was used to compare inter-rater agreement specific for each service to inter-rater agreement among all respondents. The hypothesis was that if our instrument proved to be valid, it should be able to distinguish specific safety climates of various services. Thus,  $r_{WG}$  among all respondents should be lower compared to that measured for each service. Further, the comparison of  $r_{WG}$  across services allows not only the comparison of safety climate levels, but also of safety climate strength [29, 31]. Indeed, the  $r_{WG}$  as a measure of inter-rater-agreement shows to what extent the perception of a certain safety climate level, as typically measured by the mean, is strongly present in a service.

Reliability within group measures are well suited to assess and compare patterns of team safety climate for small teams as about 100 respondents are considered to represent large groups [30].

Additionally, the validity of the instrument was measured using the Intraclass correlation ICC(1) measure. This measure estimates the effect that a certain target, in this case, the fact of being a collaborator within a certain service, has upon the ratings of respondents [29, 32]. According to Ginsburg et al. [29], an  $ICC(1) > 0.05$  shows a group effect and thus confirms that an instrument measures the safety climate perceived by a certain group of individuals.

Internal consistency and reliability were measured with Cronbach's Alpha [33]. This measure can be viewed as the expected correlation of two tests measuring the same construct, varying between 0 and 1. A value of  $> 0.7$  was regarded as sufficient.

All analyses were performed with the Open Source Software R, Version 3.4.3 from 2017 [34].

## Results

In total, 106 questionnaires were returned, resulting in a response rate of 86% (106/124). Three questionnaires were excluded due to an excess of missing data, yielding a final sample of 103 completed surveys (83%). Among those persons who answered at least 80% of the questions (99/103) and completed the survey the same day (89/103), the median completion time was 12 minutes, with a 25%-quantile of 8 minutes and a 75%-quantile of 21 minutes. Table 1 summarizes the study sample's basic characteristics. As can be seen, the sample includes one larger and two smaller outpatient radiology services. Most of the respondents were women with more than 10 years of working experience, who had been working in the current outpatient service between one and five years. Most respondents identified either as radiographers or as working in the service's patient management department (Table 1).

### Descriptive Statistics, Aggregation and Safety Climate Levels and Strength

In total, 87% (90/103) of the questionnaires had all safety climate items answered. None of the returned questionnaires presented more than five missing answers for the questions concerning safety climate. Analysis of distributions also showed coherent answering behaviour for reversed items. Therefore, all questions are included in the final instrument and analysis.

Table 2 summarizes the results of the final instrument and provides both total scores as well as individual scores of the services. Distribution of answers was close to a normal distribution, as the medians for the total score show, reported in Table 2. Thus, means and standard deviations were used in order to allow for a more detailed view of the discontinuous data of the Likert scale. Analysis for the entire sample revealed the highest score for the statement: "The quality and safety of patient care

in the service is taken seriously“, with a mean of 6.0 on a seven-point Likert-scale. In individual analysis within the three services, this statement ranged between the top to the third highest score. The statement: “The service is a good place to work“, received the second highest score (5.9), based on answers from all services. Among the 3 services, this statement ranged second for services 2 and 3, and eighth for service 1. The second highest score (5.9) was also obtained for disagreement with the statement: “Collaborators frequently disregard rules, protocols and procedures.” This item scored fourth for service 1, sixth for service 2, and fourth for service 3. Comparing the overall results to positive response rates, the latter were very high for the items “The quality and safety of patient care in the service is taken seriously,” (84%), “Collaborators frequently disregard rules, protocols and procedures,” (84%) and “The service is a good place to work“ (85%) with only the item “Collaborators treat each other with respect” scoring higher with 86% positive responses. In contrast to that, the statements “The service leadership communicates its long-term plans for the development of the service”, “Collaborators always have enough time to complete work tasks safely” and “The opinions of all concerned collaborators are taken into account for the development of processes” scored lowest with an overall result of 4.2 on a seven-point Likert-Scale and also scored lowest for the positive response rates with 46% for the item asking about participation in development processes and 48% for the two other items. These items ranged among the lowest four scores for the individual services, excluding the second item for service 2 and the third item for service3 (Table 2). Concerning the positive response rate, the item “ All concerned collaborators have the opportunity to participate in the analysis of critical incidents” also scored second lowest with 48% while it scored a 4.3 as the mean on the seven-point Likert scale.

The  $r_{WG(j)}$  for the questionnaire was 0.94 for the 90 completely filled in questionnaires, thus allowing for the aggregation of total scores.

The total mean score for the overall sample was 5.0. Between the outpatient services, the total mean scores ranged from 6.1 for service 1 to 5.1 for service 2, and 4.7 for service 3. When calculating positive response rates, service 3 scored 56% across all items, while service 1 had a positive response rate of 85% and service 2 a positive response rate of 64%.

The two-sided Wilcoxon test for the difference between rank distributions was significant for differences between outpatient services 1 and 2 with a p-value of 0.0003 and between services 1 and 3 with a p-value of  $<0.001$ . The test showed no significant difference between service 2 and 3, with a p-value of 0.12. Figure 1 shows the distributions of individual mean total scores for each service (Figure 1).

#### Validity, Internal Consistency and Reliability

The  $r_{WG}$  ranged between 0.83 for service 1, 0.77 for service 2 and 0.71 for service 3, while the overall  $r_{WG}$  was 0.68 and thus smaller than the  $r_{WG}$  for each individual service.

The ICC(1) was 0.27, therefore pointing to a group effect. Cronbach's Alpha was 0.97 with a 95% confidence interval ranging from 0.96 to 0.98.

## **Discussion**

The present study aimed to develop a valid, consistent and reliable questionnaire assessing safety climate in outpatient imaging services.

The response rate was high and the rate of missing answers was very low. Given that the survey was voluntary and anonymous, these results suggest that the statements are easy to understand and relevant to respondents. Important to note, the great proportion of staff working in the call center and in administrative functions responding to the questionnaire underlines that the instrument is adapted to this professional group, thus avoiding the weaknesses of other instruments [17, 19].

According to literature, our sample involves a sufficient number of participants concerning the measurement of inter-rater agreement [28], but the possibility of comparison of safety climate level between services by means of the Wilcoxon test remains partially limited due to the small size of the participating organizations.

Statements which scored high both in the overall mean scores and positive response rates, as well as in mean scores of the individual services, indicate high safety climate levels for certain elements. Together, the highest-ranking items rather describe general impressions on the priority of safe practice, patient safety and quality as well as the workplace quality and culture.

On the contrary, lower scores were achieved regarding employees' involvement in the service's long-term development and improvement of processes, as well as participation in the analysis of critical incidents. Also, time management is an issue in the participating outpatient imaging services. This might indicate a mounting pressure upon services' staff with regard to increasing competition between different imaging services and monetary constraints after revision of the outpatient reimbursement system. Moreover, to closely monitor the evolution of employees' involvement in processes but also the pressure under which staff is working could be of great

interest; not only for the services themselves but also for stakeholders, who are generally interested in quality improvement.

The high value for the inter-rater agreement measure  $r_{WG(j)}$  shows that the instrument is indeed measuring a consistent concept, namely safety climate perceptions. On this basis, total scores can be calculated and compared between services or groups of staff.

Our results show differences in total mean scores and significantly varying overall distributions between the three services. Moreover, a higher mean score and distribution corresponded with a higher positive response rate and a higher score for the inter-rater agreement measure  $r_{WG}$ . According to literature [29, 31], it can thus be stated that service 1 incorporates a comparatively high level in strong safety climate, while service 2 shows an intermediate and service 3 a relatively low level in strength of safety climate. For radiology services, such results can be of interest for further analysis. For instance, a low inter-rater agreement can lead to closer examination of potential differences between professional groups or employees with more or less working experience. High inter-rater agreements, on the other hand, indicate a consistent agreement upon a certain climate level. Interventions aiming to improve safety culture can be based on such an evidence and can be specifically tailored to certain groups and/or issues.

Comparison between inter-rater agreement of each outpatient service versus inter-rater agreement of the overall sample using the  $r_{WG}$  measure reveals that the present instrument is able to measure differing safety climates of individual services. The intraclass correlation measure further strengthens this idea by showing a correlation between the results and the membership to a certain service's team. The instrument thus allows services and regulators to monitor effects of organizational change, for example on staffing or upon safety climate.

Cronbach's Alpha proved to be at a sufficient level, confirming that the final survey instrument is reliable and consistent.

To the best of our knowledge, this is the first validated questionnaire assessing safety climate of outpatient radiology services as judged by their employees, including personnel working in the call center or administration. However, a certain selection bias could be present as services participating in the study were highly motivated and already participating in a larger quality improvement project. Comparison of safety climate levels between services remains partially limited due to the small size of certain organizations, pointing to certain limitations in the quantitative measurement of safety climate in outpatient settings structured in quite small units. Further, it must be said that with its overall sample size, the results of our study cannot claim to be generally applicable to the climate safety levels of outpatient radiology services in Switzerland or beyond. Still, the instrument offers a valid means to conduct more encompassing studies.

The present questionnaire enables the evaluation of the safety climate of outpatient radiology services as perceived by their employees. Results can be used as a basis for quality improvement as well as to monitor the future development of the safety climate in the highly dynamic field of outpatient radiology services.

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### **Legends to Tables and Figures**

**Table 1.** Summary of the study sample's characteristics (n=103).

**Table 2.** Results (mean and standard deviation (SD)) of the 30 items which were included in the final instrument. Answers ranged from 1 to 7 on a Likert Scale.

**Figure 1.** Comparison of distributions of mean scores of the three services. Answers ranged from 1 to 7 on a Likert Scale.

| <b>Characteristic</b>                          | <b>N (%)</b> |
|--|--------------|
| <b>Imaging service</b>                         |              |
| Imaging Service 1                              | 18           |
| Imaging Service 2                              | 21           |
| Imaging Service 3                              | 64           |
| <b>Gender (5 answers missing)</b>              |              |
| Male   | 18 (17)      |
| Female   | 80 (78)      |
| <b>Profession (3 answers missing)</b>          |              |
| Radiologist                                    | 16 (16)      |
| Radiographer                                   | 51 (50)      |
| Patient administration                         | 33 (32)      |
| <b>Years of working experience (1 missing)</b> |              |
| Less than a year                               | 4 (4)        |
| 1-5 years                                      | 13 (13)      |
| 6-10 years                                     | 13 (13)      |
| 11-20 years                                    | 37 (36)      |
| More than 21 years                             | 35 (34)      |
| <b>Years in the service</b>                    |              |
| Less than a year                               | 14 (14)      |
| 1-5 years                                      | 44 (43)      |
| 6-10 years                                     | 22 (21)      |
| 11-20 years                                    | 16 (16)      |
| More than 21 years                             | 7 (7)        |

**Table 1.** Summary of the study sample's characteristics (n=103).

|  | <b>Total</b>     |     | <b>Service 1<br/>(n=18)</b> |     | <b>Service 2<br/>(n=21)</b> |     | <b>Service 3<br/>(n=64)</b> |     |
|--|------------------|-----|-----------------------------|-----|-----------------------------|-----|-----------------------------|-----|
|  | Mean<br>(Median) | SD  | Mean<br>(Median)            | SD  | Mean<br>(Median)            | SD  | Mean<br>(Median)            | SD  |
| <b>Total Score</b>   | 5.0<br>(5.1)     | 1.1 | 6.1<br>(6.4)                | 0.8 | 5.1<br>(5.4)                | 1.0 | 4.7<br>(4.7)                | 1.1 |
| <b>Item</b>  |                  |     |                             |     |                             |     |                             |     |
| The performance of collaborators is impaired by excessive workload*  | 5.0              | 1.6 | 6.4                         | 1.0 | 5.7                         | 1.1 | 4.3                         | 1.5 |
| Collaborators always have enough time to complete work tasks safely  | 4.2              | 1.7 | 5.6                         | 1.6 | 4.7                         | 1.4 | 3.6                         | 1.5 |
| The level of staffing in the service is sufficient to manage the workload safely                             | 4.4              | 1.8 | 5.8                         | 1.5 | 5.1                         | 1.6 | 3.7                         | 1.7 |
| When pressure builds up, collaborators are expected to work faster even if it means working less accurately* | 5.1              | 1.6 | 5.9                         | 1.7 | 5.5                         | 1.6 | 4.8                         | 1.6 |
| Collaborators feel free to question the decisions of those with more authority                               | 4.4              | 1.7 | 5.1                         | 1.4 | 5.2                         | 1.6 | 3.9                         | 1.7 |
| Collaborators are comfortable in expressing concerns about the way things are done to the service leadership | 4.9              | 1.8 | 6.2                         | 1.8 | 5.3                         | 1.7 | 4.4                         | 1.7 |
| There is open communication between collaborators, their position notwithstanding                            | 4.6              | 1.8 | 5.9                         | 1.5 | 4.9                         | 1.8 | 4.1                         | 1.7 |
| Collaborators are kept up to date about service developments   | 4.4              | 1.7 | 5.9                         | 1.6 | 3.7                         | 1.5 | 4.3                         | 1.7 |
| The service leadership communicates its long-term plans for the development of the service                   | 4.2              | 1.9 | 5.7                         | 1.4 | 3.8                         | 1.6 | 3.8                         | 2.0 |
| The hierarchy in the service is a barrier to effective work*   | 5.6              | 1.6 | 6.4                         | 1.8 | 6.3                         | 1.3 | 5.1                         | 1.7 |
| Highlighting a significant event will likely result in negative repercussions for the person raising it*     | 5.8              | 1.4 | 6.6                         | 1.5 | 6.1                         | 1.3 | 5.5                         | 1.5 |
| The service leadership does not deal effectively with  | 5.1              | 1.7 | 5.9                         | 1.8 | 4.9                         | 2.0 | 4.9                         | 1.5 |

|  |     |     |     |     |     |     |     |     |
|--|-----|-----|-----|-----|-----|-----|-----|-----|
| problem collaborators*   |     |     |     |     |     |     |     |     |
| When collaborators suggest ways to improve processes, the service leadership does not take this seriously*                 | 5.1 | 1.8 | 6.4 | 1.1 | 5.3 | 1.6 | 4.7 | 1.8 |
| There is a low level of trust between practice team members*   | 5.7 | 1.6 | 6.5 | 1.8 | 6.0 | 1.7 | 5.4 | 1.7 |
| Collaborators frequently disregard rules, protocols and procedures*  | 5.9 | 1.2 | 6.4 | 1.0 | 6.0 | 1.3 | 5.7 | 1.3 |
| Collaborators treat each other with respect  | 5.8 | 1.3 | 6.3 | 1.7 | 5.3 | 1.6 | 5.8 | 1.1 |
| Collaborators always support one another   | 5.7 | 1.2 | 6.3 | 1.4 | 5.3 | 1.5 | 5.6 | 1.1 |
| Disagreements within the service team are resolved appropriately   | 4.8 | 1.5 | 6.0 | 1.9 | 4.6 | 1.7 | 4.5 | 1.5 |
| Collaborators work well together at all positions within the practice  | 5.0 | 1.4 | 5.7 | 1.0 | 5.0 | 1.1 | 4.8 | 1.2 |
| The service is a good place to work  | 5.9 | 1.2 | 6.3 | 1.6 | 6.2 | 1.0 | 5.7 | 1.1 |
| Collaborators are generally satisfied with their jobs  | 5.2 | 1.3 | 6.0 | 0.6 | 5.6 | 0.9 | 5.1 | 1.3 |
| Good teamwork is promoted and considered to be important by the service leadership   | 5.2 | 1.6 | 6.2 | 1.4 | 5.2 | 1.5 | 4.9 | 1.7 |
| All collaborators are encouraged to highlight critical incidents that happen in the service                                | 4.7 | 1.7 | 6.2 | 1.6 | 4.4 | 1.5 | 4.3 | 1.7 |
| Processes help to prevent critical incidents from happening  | 4.9 | 1.4 | 5.9 | 1.7 | 4.5 | 1.2 | 4.7 | 1.4 |
| The opinions of all concerned collaborators are taken into account for the development of processes                        | 4.2 | 1.8 | 6.0 | 1.3 | 4.4 | 1.5 | 3.7 | 1.7 |
| When processes are changing, the services take time to assess risks for patients, collaborators and the service in advance | 4.7 | 1.7 | 5.9 | 1.8 | 4.8 | 1.5 | 4.3 | 1.7 |
| All concerned collaborators have the opportunity to participate in the analysis of critical incidents                      | 4.3 | 1.8 | 6.1 | 0.9 | 4.4 | 1.8 | 3.8 | 1.7 |
| The quality and safety of patient care in the service is   | 6.0 | 1.2 | 6.6 | 1.6 | 6.1 | 1.2 | 5.7 | 1.3 |

|  |     |     |     |     |     |     |     |     |
|--|-----|-----|-----|-----|-----|-----|-----|-----|
| taken seriously  |     |     |     |     |     |     |     |     |
| The practice supports the continuing educational development of all collaborators                          | 5.3 | 1.6 | 6.2 | 0.6 | 5.1 | 1.6 | 5.1 | 1.6 |
| The service encourages learning from the ideas and constructive critique of collaborators in all positions | 4.8 | 1.6 | 6.1 | 1.2 | 4.7 | 1.5 | 4.5 | 1.6 |

**Table 2.** Results (mean and standard deviation (SD)) of the 30 items which were included in the final instrument. Answers ranged from 1 to 7 on a Likert Scale.

\* reverse coded

Dear collaborator,

With your work, you are making an important contribution to the quality of your radiology-service. At the same time, it is important that your service receives feedback about the extent to which the organization of work, communication, leadership, collaboration and the systemic level contribute to safety culture and thus to high quality work.

The following questionnaire leads you through these five dimensions of safety culture. Your answers are confidential.

When we talk about collaborators in the following questionnaire, we include all persons working in the institute, be it as employee or partner, working full- or part time.

Thanks for your collaboration,  
The EQUAM Foundation

### **Your gender**

- female
- male
- I prefer not to answer

### **How many years have you worked in your profession?**

- less than a year
- 1-5 years
- 6-10 years
- years
- more than 21 years

### **How many years have you worked at this service?**

- less than a year
- 1-5 years
- 6-10 years
- years
- more than 21 years

### **I am...**

- a radiologist
- a technical assistant
- working in the call centre / at the phone
- working in the administration
- other (please specify) \_\_\_\_\_





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**Compliance with ethical standards:****Guarantor:**

The scientific guarantor of this publication is Marianne Jossen

**Conflict of interest:**

The authors of this manuscript declare relationships with the following companies: Marianne Jossen works for the EQUAM foundation who uses the developed questionnaires as products.

**Funding:**

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**Statistics and biometry:**

One of the authors, Fabio Valeri, has significant statistical expertise.

**Informed consent:**

Written informed consent was not required for this study because data collection was anonymously, and participation was voluntary and did not include medical data.

**Ethical approval:**

Institutional Review Board approval was not required because data collection was anonymously, and participation was voluntary and did not include medical data.

**Methodology:**

- cross sectional study
- multicentre study