Video-Assisted Peer Teaching for Surgical Skills Training - Innovative Potential for the Medical Curriculum and Beyond: A Randomized Controlled Trial

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OBJECTIVE: Hygienic healthcare standards are essential for avoiding hospital infections. However, medical students and staff lack training in this field, which may be due to high personnel resources of present educational approaches. Thus, there is an urgent need for a novel and efficient approach. Aim of the study is to compare a newly developed video-assisted peer feedback (VAPF) method for teaching wound dressings to the traditional teaching method with qualified instructor feedback (QIF) with respect to essential learning outcomes.

DESIGN, SETTING AND PARTICIPANTS: In this randomized controlled noninferiority trial, 251 medical undergraduates were randomly assigned to one of two interventions (QIF n = 127; VAPF n = 124). In QIF, participants received feedback from a qualified instructor. In VAPF, participants video-recorded each other while performing a wound dressing and gave each other feedback assisted by a standardized checklist. Outcome measures were participants' score in an objective structured practical examination (OSPE) and a written exam after the course.

RESULTS: Noninferiority of VAPF (n = 123) compared to QIF (n = 127) was confirmed for both OSPE (QIF: 8.83 ± 1.30; VAPF: 8.88 ± 1.04; mean difference -0.04, 95% CI -0.34 to 0.25) and written exam (QIF: 8.99 ± 1.06; VAPF: 9.14 ± 1.05; mean difference -0.15, 95% CI -0.41 to 0.12).

CONCLUSIONS: VAPF is a cost-efficient and viable alternative to QIF commonly used in medical education. It provides comparable training outcomes to the traditional training method with lower personnel investment. VAPF is a promising educational method for improving essential clinical competencies. (J Surg Ed 79:441–451. © 2021 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

ABBREVIATIONS: AHA, American Heart Association BLS, basic life support CPR, cardiopulmonary resuscitation CONSORT, consolidated standards of reporting trials ERC, European Resuscitation Council OSCE, objective structured clinical examination OSPE, objective structured practical examination QI, qualified instructor QIF, qualified instructor feedback VAPF video-assisted peer feedback

KEY WORDS: Faculty resource, Peer-teaching, Nosocomial infection, Wound dressing, Surgical education, Cost-efficient

COMPETENCIES: Practice-Based Learning and Improvement, Interpersonal and Communication Skills

INTRODUCTION

In surgical care, the compliance with hygienic rules is crucial to avoid hospital infections. In fact, nosocomial infections are increasing worldwide and a severe

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problem when treating in-patients. They are associated with an extended length of stay, extra costs, and attributable mortality.[1-4] Nosocomial infections influence the surgical outcome critically and lead to an increased personnel and monetary resource consumption.[1,5] In terms of decreasing nosocomial infections, medical staff needs to be trained in basic hygienic competencies such as hand hygiene.[4,6] Therefore, practical skills requiring high hygienic standards like performing sterile wound dressings have to be taught accurately in medical schools/institutions worldwide and assessed in exams for addressing competency-based education.[7,8] This concerns many clinical competencies that are later needed in patient care, but no longer fit into the medical curriculum because of the constant increase in theoretical and clinical teaching content. However, implementing the clinical teaching in medical curricula requires a high personnel investment in the teaching staff. This could be a potential reason for the limited number of courses for basic surgical skill training available to undergraduates in various countries.[8-11] However, in times of restricted resources, increasing expenditures, and a constant need for more efficiency in hospital procedures, medical education has to deal with the issue of providing highest teaching quality under the condition of saving cost and time.[12-15]

Based on this, there is a need to find teaching methods combining low financial, logistical, and personnel requirements with high-quality education.[8,12] For the latter, qualified feedback on one's own performance plays an essential role in enhancing learning and, consequently, for educational quality.[16-18] For some practical skills it has been shown that efficient assessment and feedback by peers can be as effective as, for example, feedback from elaborately trained medical staff.[18-21] With regard to the Basic Life Support (BLS) competency, there is good evidence that training with peer feedback can offer similar learning outcomes.[22,23] Preliminary studies assessing cardiopulmonary resuscitation (CPR) training indicate that a comparable learning success can be achieved with using peer feedback, while involving significantly fewer medical lecturers.[24] Training methods based on peer feedback are even recommended in the current international guidelines on CPR published by the American Heart Association (AHA) and the European Resuscitation Council (ERC).[25] Thus, it is reasonable to assume that the use of medical staff resources is not mandatory for skills training, especially when previously trained peers adhere to standardized checklists while giving feedback.[20,26]

Despite being well investigated,[19,27,28] peer feedback is only scarcely implemented in practical clinical education, probably due to its nonprofessional and nonstandardized nature. A potential solution may lie in the combination with video feedback.[29,30] In times of widely accessible smartphones offering optimal, easy-to-create video recordings, this may possibly improve feedback and increase acceptance among learners.[30-32] It is reasonable to assume that a combination of peer feedback and video recordings could be at least as efficient as training with highly qualified medical instructors.[20,28] We assumed that video feedback provides additional security and standardization by enabling objective observation by peers as well as the participants themselves. This may strengthen and objectify the feedback and at the same time the checklists may also provide higher standards in feedback. There are two main reasons for this assumption. First, it seems reasonable to assume that the video will increase the recipient's acceptance of the feedback by adding an objective component. Since both peers can watch the video together, the video can reduce discrepancies about whether (or how) an action has been performed. Second, the video can improve feedback quality by cognitive relief of the provider. In other words, the provider can focus more on observation and less on memorizing since the video can be watched multiple times if necessary. This appears even more important given the complexity of the task and the lacking experience of the trainees.

Therefore, the aim of this study was to evaluate the potential of a standardized video-assisted peer feedback (VAPF) approach for training of a wound dressing skills. Compared to qualified instructor feedback (QIF), VAPF is characterized by lower personnel and financial requirements. To assure that VAPF achieved a comparable learning outcome to QIF, we compared both approaches in a noninferiority study. In addition to theoretical knowledge, the focus was on practical skills of the learner.

MATERIAL AND METHODS

This randomised controlled noninferiority trial is reported in line with the Consolidated Standards of Reporting Trials 2010 (CONSORT).[33]

Participants

All third-year undergraduates at the Medical School of RWTH Aachen University were invited to participate in the study (N = 257) (Fig. 1). Informed consent had to be given prior to participation in the study. We included all undergraduates independent of level of previous basic surgical knowledge.

Ethics Approval

This study was conducted in accordance with the principles of the Declaration of Helsinki and Good Clinical

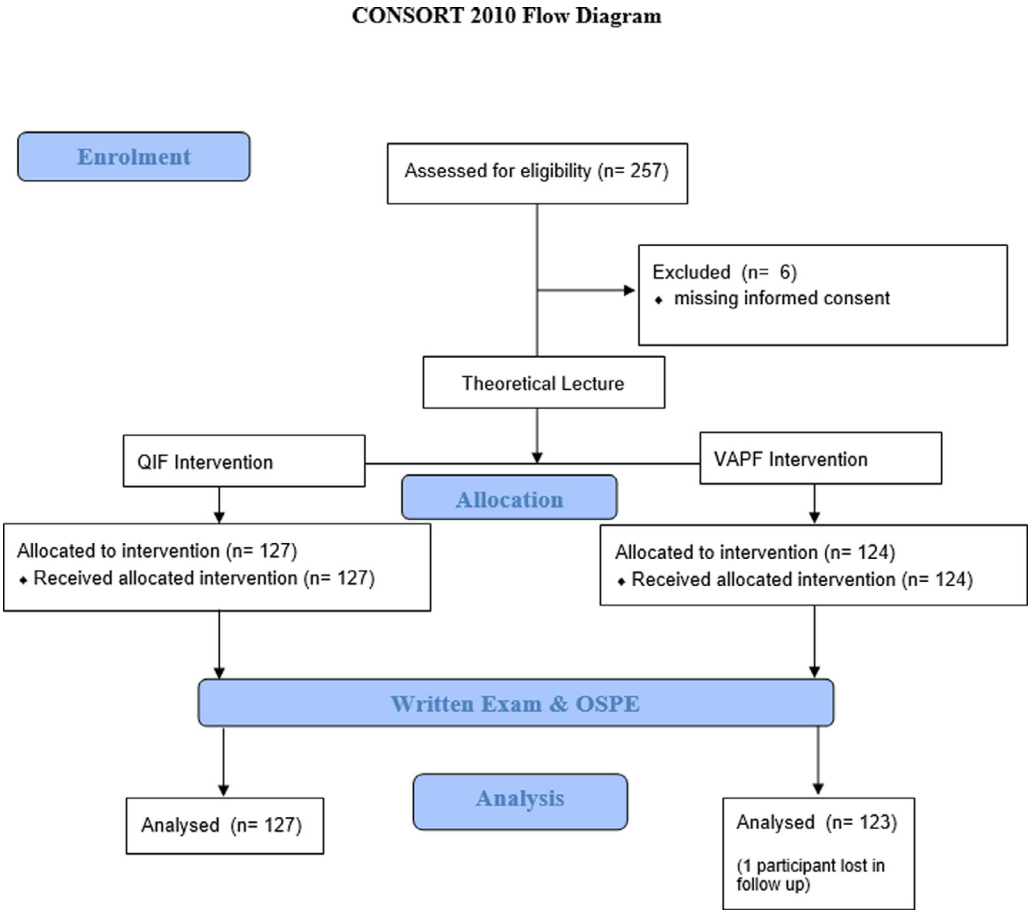

FIGURE 1. CONSORT 2010 flow diagram of the study.
In total, 251 undergraduates participated in the training of the Central Unit of Hospital Hygiene. After exclusion of 1 participant from analysis due to missing data, the study sample came to n = 250. Abbreviations: QIF, qualified instructor feedback; VAPF, video-assisted peer feedback.

Practice guidelines. The study was approved by the Ethics Committee of the Medical Faculty at the University Hospital RWTH Aachen, Germany (EK 376/19).

Randomization

An independent administrative advisor blinded to the study design randomized all students into 26 training groups of 9 to 10 students each. Allocation was performed following a sequence of random numbers. In a next step, training groups were randomly allocated to one of the two interventions (Fig. 1).

Interventions

To ensure identical instructions, all students were familiarized with a standardized and common teaching methodology called "Peyton's 4-step approach" (Demonstration by instructor > Explanation > Instructor guided by learner > Demonstration by learner/time to practice).

The first three steps were identical for all groups independent of intervention (Table 1). In contrast, teaching of the fourth step of Peyton's 4-step approach differed depending on the intervention the groups were assigned to as follows:

- Intervention 1 (QIF): Participants were supervised by and received feedback from a qualified physician of the central unit of hospital hygiene. The ratio between qualified instructor and participants was 1:9 to 1:10. Participants had to perform a sterile wound dressing under the supervision of the QI. Individual feedback by the QI on students' performance was given.
- Intervention 2 (VAPF): Participants were trained without any support of a QI. Instead, each training group was supervised by a student instructor, who did not provide any feedback, but assisted the students in using a provided checklist describing the different steps of wound dressing. Each training group was

TABLE 1. Peyton's 4 Steps[34]

	QIF	VAPF
1) Demonstration	The instructor demonstrates all steps of a correct wound dressing to the participants.	
2) Deconstruction	The instructor describes all of his actions and sub-steps whilst demonstrating a correct wound dressing to the participants.	
3) Comprehension	The instructor performs the wound dressing by following instructions given by a participant.	
4) Performance	The participant performs the wound dressing by himself. Feedback is provided by the QI.	Participants work in pairs: One of them performs the wound dressing while the other one videotapes, and vice versa. Feedback is given by the partner.

Abbreviations: QIF, qualified instructor feedback; VAPF, video-assisted peer feedback.

divided into pairs, in which one student performed all steps of a sterile wound dressing, while the other student recorded the performance and then gave VAPF. To that end, students compared the video recordings to a standardized checklist, which was provided to structure and objectify the feedback. The checklist was created especially for the teaching module by the responsible faculty based on existing recommendations of the Robert Koch Institute (German Reference Centre for Hygiene Standards) in the module wound dressing. Feedback was provided to the learner by the peer using the checklist. The ratio between supervising student and participants was on average 1:9 - 1:10. After the training, all videos were deleted.

The study team ensured that the videos were watched in the video peer feedback group. Both groups had access to the checklist and could use it at any time during the training, Time for training was approx. 2h in both study arms.

Outcomes

Objective Structured Practical Examination (OSPE) − Practical Assessment

Practical skills regarding handling of sterile wound dressings were assessed 7 to 10 days after the training. Performance was rated on a 0 to 10 scale by a physician. Each participant had a set time limit of 10 minutes to perform a complete wound dressing. The assessor was blinded to the intervention of the participants, who were asked not to reveal their assignment. Six medical lecturers conducted the OSPE and came from the hospital hygiene and plastic surgery departments. The physician examiners were briefed in a standardized way before the OSPE and had sufficient time to prepare for the examination format.

Exam Grades

In addition to the practical assessment, all students completed a mandatory course exam in written form, in which a maximum of 10 points could be achieved.

Definition of Noninferiority Margins

Noninferiority[35] margins (Δ) were defined for OSPE and written exam. Since the OSPE was designed for this study, no previous data was available as a basis for the noninferiority margin. We defined a difference of −0.5 points as the noninferiority margin (Δ) (5% of the maximum score). Since there was no reliable data available for the practical exam, we applied the same, relatively conservative noninferiority margin (Δ) to the OSPE.

Sample Size Planning

Following Julious's [36] method for noninferiority testing, sample size was calculated using the Sealed Envelope Power Calculator for continuous outcomes. We assumed an α-significance level of .05 and a power (1-β) of 90%.

The written exam had been introduced rather shortly before the study. Therefore, only two previous time points were available for estimation of the standard deviation (SD). However, the SDs from these time points were highly similar (11.45% and 11.65% of total achievable points), which encouraged us to use the mean value of 1.155 (11.55% of 10 points) as an SD estimate for sample size planning. With a noninferiority limit (Δ) of −0.5 points, we reached an estimated sample size of n = 184 (92 per study arm) with respect to written exam results.

For the OSPE results, the assumed standard deviation of 1.357 (13.57% of 10 points) was based on standard deviations of other OSPEs carried out by our medical school. The data from these previous OSPEs were remarkably consistent (min SD = 12.48%; max SD = 14.36% of total achievable points), which encouraged us to use the mean SD of these values (13.57%) as an estimate. This appeared even

more justified since the other OSPEs covered various parts of the curriculum (e.g., urogenital system, musculoskeletal system, gastroenterology, and neurology).

The noninferiority limit (Δ) of −0.5 points yielded an estimated sample size of n = 254 (127 per study arm) regarding the OSPE results.

We decided for the larger estimate (n = 254, n = 127 per study arm) in order to cover both outcomes.

Statistical Analyses

Statistical analyses were carried out with IBM SPSS Statistics Version 25 (IBM Corp., Armonk, NY). Study sample characteristics are presented as frequency and percentage for categorical data. Chi-Square tests were used to rule out any significant differences between the two interventions prior to the training.

The aim of this study was to show noninferiority of VAPF compared to QIF regarding exam results. To that end, we examined noninferiority by comparing the average points reached in both the OSPE and the written exam in both interventions. In line with the recommendations of the CONSORT statement, a two-sided 95% confidence interval (CI) was used to assess significance of noninferiority.

RESULTS

Characteristics of Participants

Out of the 257 undergraduates eligible for the study, 7 had to be excluded due to missing written consent (n = 6) or missing data (n = 1), leaving n = 250 (70.3% female) as our final study sample (Fig. 1).

Details about the study sample can be found in Table 2. Chi-Square tests did not yield any significant differences between the two interventions (all $p > 0.05$) prior to the course regarding previous knowledge or training.

TABLE 2. Sample Characteristics

Characteristic	QIF (n = 127)	VAPF (n = 123)
Female, n (%)	95 (74.8)	80 (65.6)
At least one medical clerk ship completed, n (%)	97 (76.4)	96 (79.3)
Seen a wound dressing before, n (%)	57 (44.9)	52 (43.0)
Prior vocational training, n (%)	26 (20.5)	25 (20.5)
Paramedic, n (%)	10 (7.9)	8 (6.6)
Nurse, n (%)	9 (7.1)	6 (4.9)
Auxiliary nurse, n (%)	2 (1.6)	1 (0.8)
Federal voluntary service, n (%)	6 (4.7)	5 (4.1)
Other, n (%)	4 (3.1)	8 (6.6)

Abbreviations: QIF, qualified instructor feedback; VAPF, video-assisted peer feedback.

Noninferiority Tests

Figures 2 and 3 show the respective results of the noninferiority analyses regarding both written exam and OSPE. They depict the mean differences between both interventions and the 95% CI values. Values < 0 favor QIF and values > 0 favor VAPF. The noninferiority margin (Δ) is represented by the line marked d (Δ).

Practical Outcomes – OSPE results

Participants in the QIF intervention reached a mean of 8.83 points (SD ± 1.30) in the OSPE (0-10 points), whereas participants in the VAPF intervention achieved 8.88 points (SD ± 1.04). This resulted in a mean difference of -0.04. The 95% CI for the mean difference was -0.34 to 0.25, the lower bound thus lying above the inferiority margin of Δ = -0.5. Therefore, significant noninferiority of the VAPF training regarding OSPE results was confirmed.

Written Exam Results

In the written exam (0-10 points), participants of the QIF intervention achieved 8.99 points (SD ± 1.06), participants in the VAPF intervention scored 9.14 points (SD ± 1.05). The mean difference thus laid at -0.15. The 95% CI for the mean difference was -0.41 to 0.12. Since the lower CI was above the inferiority margin of Δ = -0.5, significant noninferiority of the VAPF training regarding written exam results can be assumed.

Influence of Prior Knowledge

To investigate if the level of prior knowledge had an influence on the OSPE results, we compared those participants who had either undergone a prior vocational training or had seen a wound dressing before (n = 130) to those who had experienced neither of these options (n = 120) with respect to their OSPE performance and written exam results, using independent samples *t*-tests. Remarkably, both groups had highly similar mean OSPE scores (prior knowledge: 8.84 ± 1.29; no prior knowledge: 8.84 ± 1.05) and written exam results (prior knowledge: 8.97 ± 1.09; no prior knowledge: 9.15 ± 1.00), with no significant group difference ($t = .02$; $p = 0.98$ and $t = 1.36$; $p = 0.18$, respectively).

To investigate a potential interaction of prior knowledge with the study arms, we moreover calculated univariate analyses of variance (ANOVA) with two factors (prior knowledge/study arm) for both the OSPE performance and the written exam results. For both ANOVAs, we found no significant interaction of prior knowledge x study arm (OSPE performance: $F = .56$, $p = 0.45$; written exam: $F = 2.57$, $p = 0.13$). In summary, we found no

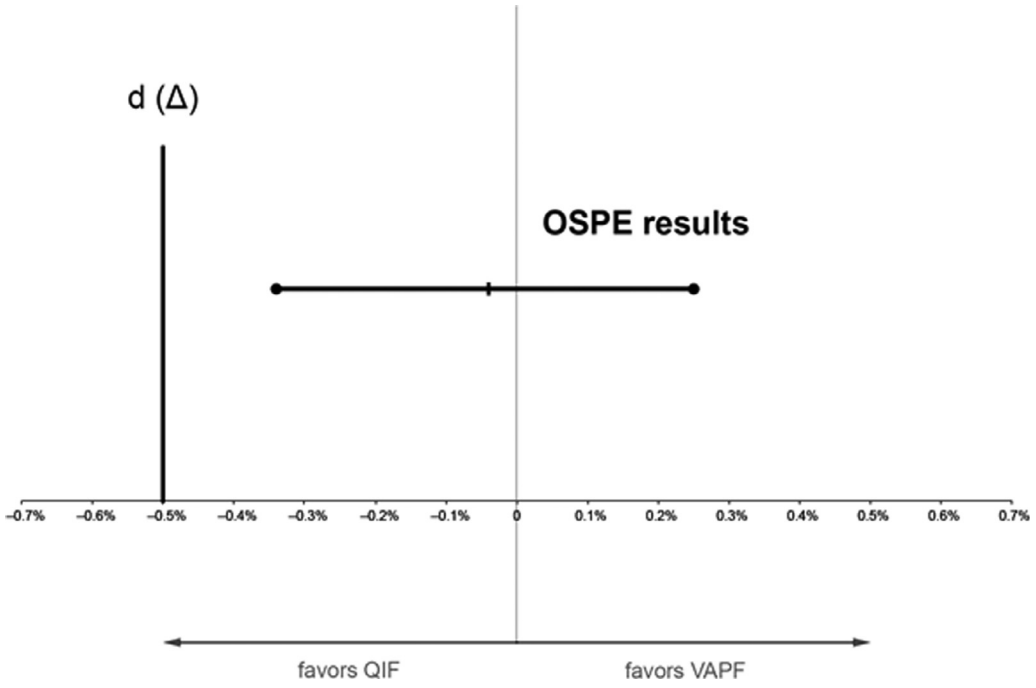

FIGURE 2. Noninferiority test for the OSPE results.
Mean difference (-0.04) between the QIF and VAPF training method and 95% CI values (upper CI = 0.25, and lower CI = -0.34). Values < 0 favor QIF and values > 0 favor VAPF. The line marked "d" shows the noninferiority margin (Δ = -0.5). Significant noninferiority is given since the lower CI lies above d.

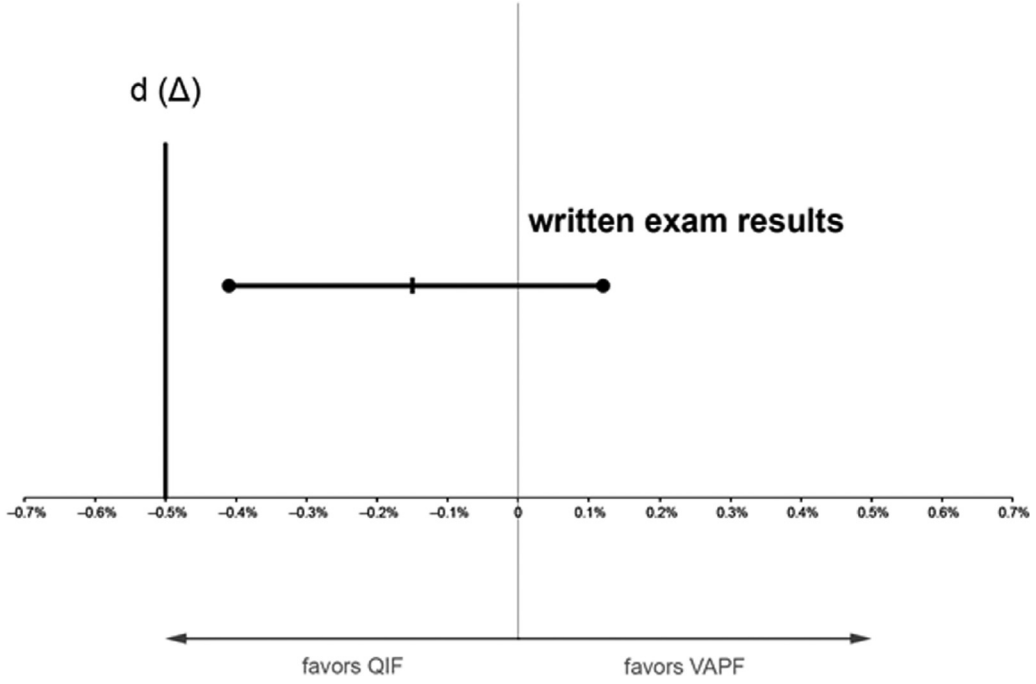

FIGURE 3. Noninferiority test for the written exam results.
Mean difference (-0.15) between the QIF and VAPF training method and 95% CI values (upper CI = 0.12, and lower CI = -0.41). Values < 0 favor QIF and values > 0 favor VAPF. The line marked "d" shows the noninferiority margin (Δ = -0.5). Significant noninferiority is given since the lower CI lies above d.

evidence to assume that the OSPE and written exam results have substantially been influenced by prior knowledge, and it seems unlikely that the noninferiority of the VAPF training can be attributed to an interaction of the study arm with prior knowledge.

Personnel Resources and Financial Expenditure

As the ratio of instructor to students and the time expenditure for both interventions was identical, no differences in the number of working hours between both interventions are to be claimed. Instructors differed by qualification. Given that a QI in the QIF condition earns 38.04 Euro per hour and a student instructor in the VAPF interventions earns 11 Euro of gross salary per hour, it can be stated that personnel costs differ by a factor of 3.5.

DISCUSSION

In the current study, the VAPF intervention showed comparable results in both practical and a written assessment regarding sterile wound dressing compared to the traditional QIF. Since the cost-benefit ratio of the VAPF group is more favourable in comparison to the cost-intensive QIF approach, it meets the anticipated goal of providing both a cost-efficient and expedient training.

Currently, undergraduates and young residents are not sufficiently trained in basic clinical (surgical) competencies during medical school.[8,37] In a nationwide study of the United Kingdom Medical Schools, there was only a small number of courses for basic surgical skill training available to undergraduates, fortunately supplemented by extracurricular training of the surgical societies.[8] Consequently, undergraduates and young residents were not able to perform basic surgical skills caused by a lack of education during their studies.[8,38] An essential skill is wound dressing.[38] Correctly performed and adhering to appropriate hygienic standards, this can help to prevent nosocomial infections[4,6] by starting to train medical experts in this area at an early stage, before they enter professional life. Besides skill acquisition, this method has enormous potential to update competencies of trained healthcare providers in order to reduce nosocomial infections by improving overall acceptance and clinical competencies for wound-dressing. This applies not only to the clinical competence of wound-dressing, but also to the many surgical and general clinical competences.

The VAPF method is ideal for learning and continuously improving clinical competences in general. It is well conceivable that the VAPF method can be optimally applied in the daily clinical routine, both in the study phase for learning clinical competencies as well as in the postgraduate phase as workplace-based learning elements. VAPF optimally applied in a workplace-based environment could have enormous potential here. It has probably been happening informally for decades that clinical skills are acquired alongside normal work and not in a protected structured learning environment. However, if structured methods such as VAPF and Workplace-Based Learning and Assessment are combined and used in a formalised way, enormous resources could be saved in clinical processes while clinical skills of medical staff improve. In order to enable a realistic implementation of such approaches, the educative authority responsible for continuing education would of course have to be involved in the implementation. The use of peer feedback in training has already been demonstrated successfully in other clinical competencies such as CPR and BLS.[19,23] For this reason, peer feedback should be assessed in the teaching of additional clinical competencies[39] and, if successful, implemented as broadly as possible across the curriculum in clinical competency training.[19,40] Investigating peer teaching in additional subject areas, with the resulting growing evidence for new domains of application and the associated description of the implementation process, could ensure a high level of acceptance among academic institutions.

An important aspect to address is the combination of peer feedback with video recordings.[20] On the one hand, an isolated video recording without further feedback or debriefing does not improve skills significantly or shows only minor improvements of practical performance.[41,42] On the other hand, peer feedback needs structure and standardisation to assure quality.[20,41] For this reason, standardised benchmarks have to be included in the assessment.[41,43] The use of standardised checklist-based assessments led to higher transparency and accuracy of the individual undergraduate's performance during their practical course. Furthermore, the given feedback by a video-based self-evaluation in combination with a standardised checklist-based peer feedback is not influenced by the instructor's personal bias. The method to assess practical performance with a standardised checklist as part of an Objective Structured Clinical Examination (OSCE) is also well established in medical education and highly appreciated by undergraduates [44,45]. So far, the combination of a standardised checklist with video self-assessment like the VAPF method used in this study has already been successfully implemented in several fields of medical education,[41] focussing mainly on aspects of communication,[46] and resuscitation teaching.[47]

A fundamental aspect that advocates for the use of the VAPF is that QIF suffers from lack of standardization with respect to different levels of education or cultural influences of the QIF.[48] Qualified medical teaching staffs

are probably difficult to standardise in their teaching activities. Training with the aim of standardising qualified medical staff in teaching would presumably involve enormous final costs and divide medical professionals from their clinical time. From the experience with peer-teaching, where peers are trained cost-efficiently and optimally follow the given standards, there is another argument for the use of peer teaching in the teaching of many basic practical skills.[20] Of course, this is not a plea to use peer teaching exclusively in clinical teaching, but on a need-specific basis. In our view, the ideal use of VAPF would be in basic clinical skills.

VAPF provides a highly standardized feedback method in combination with a supplementary checklist to evaluate the medical student's practical performance at a fraction of the costs. To ensure the sustainability of optimal medical treatment, medical care and medical education should be assessed by its quality and especially by its cost-effectiveness in the future. VAPF may solve the trade-off between high quality medical education and limited resources available for teaching medical core disciplines.

Limitations

A limitation that is important to consider is the participant sample investigated in our study. Our participants were third-year undergraduates at our Medical School, which constitutes a relatively specific sample. Thus, the present study cannot answer the question whether the same concept can also be successfully applied in other groups, e.g., for postgraduate training. However, our results suggest that the applicability seems to be rather broad and more or less independent of prior knowledge. Thus, we assume that the potential application fields extend beyond undergraduate teaching; nonetheless, further studies are needed to verify this assumption.

CONCLUSIONS

VAPF led to noninferior results in both a practical and a written exam regarding sterile wound dressings compared to the QIF method commonly used in medical education. Furthermore, staff costs needed for VAPF are only a fraction of the expenses for QIF, and cost containment in medical education is now and will be an important issue in the future.[49,50] The use of standardized checklists is likely to reduce possible behavioural biases from the instructor. In addition, due to the high availability of smartphones in the general population and the possibility of location-independent preparation of the assessment documents, VAPF can be applied worldwide ensuring highest quality standards of surgical education while keeping costs manageable. It seems to be a promising educational method for learning and improving essential clinical skills. With a more diverse use of this teaching method in terms of clinical competences, it could significantly impact future medical curricula (Figure 4).

Steps	TIF	VAPF
1) Demonstration	A skilled instructor demonstrates all steps of a correct wound dressing to the students	Students watch a video recording of an instructor demonstrating a correct wound dressing
2) Deconstruction	The instructor describes all of his actions and sub-steps whilst demonstrating a correct wound dressing to the students	Students watch a video recording of an instructor describing all sub-steps while demonstrating a correct wound dressing
3) Comprehension	The instructor performs the wound dressing by following instructions given by a student	
4) Performance	The student performs the wound dressing by himself.	

FIGURE 4. Peyton's 4 step approach.[34]

DECLARATIONS OF INTEREST

None.

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