Medizinische Fakultät der Martin-Luther-Universität Halle-Wittenberg

„Die Integration rechtsmedizinischer Lehrinhalte in das SkillsLab und die Etablierung und Weiterentwicklung korrespondierender OSCE Stationen und neuer Lehr-und Lernmethoden.“

Dissertation

zur Erlangung des akademischen Grades

Doktor der Medizin (Dr. med.)

vorgelegt

der Medizinischen Fakultät

der Martin-Luther-Universität Halle-Wittenberg

von Alexandra Biolik

geboren am 04.05.1987 in Bad Frankenhausen

Betreuer: Herr apl. Prof. Dr. med. S. Heide

Gutachter:

Prof. Dr. med. R. Lessig

Prof. Dr.med. M. Bohnert (Universitätsklinikum Würzburg)

08.11.2019

05.06.2020

Referat

Die Ursachen für die immer wieder ersichtlichen Mängel in der Qualität der ärztlichen Leichenschau wurden in den letzten Jahren zunehmend diskutiert und diesbezüglich verschiedene Verbesserungsvorschläge unterbreitet, unter anderem auch in einem Positionspapier der Deutschen Gesellschaft für Rechtsmedizin. Darin wurde, neben der Intensivierung der rechtsmedizinischen Ausbildung im Medizinstudium, ein kontinuierliches und verpflichtendes Fort- und Weiterbildungsangebot gefordert. Die Umsetzung dieser Empfehlungen erfolgte an der Medizinischen Fakultät der Martin-Luther-Universität Halle-Wittenberg 2015 durch ein Kooperationsprojekt des Instituts für Rechtsmedizin und dem Dorothea Erxleben Lernzentrum. Begleitend zu der bisherigen rechtsmedizinischen Ausbildung wurde ein e-learning Modul und eine SkillsLab Station zum Thema Leichenschau und Todesbescheinigung entwickelt. Die Überprüfung der erworbenen rechtsmedizinischen Fertigkeiten erfolgte anschließend in zwei korrespondierenden OSCE (Objective Structured Clinical Examination) Stationen. Nach der erstmaligen Durchführung der zwei rechtsmedizinischen OSCE Stationen im Jahr 2016 erfolgte die Auswertung der Prüfungsergebnisse. Der Großteil der Studierenden erreichte bei beiden Prüfungsstationen gute bis sehr gute Prüfungsergebnisse. Durch die erweiterte itemspezifische Analyse wurden Stärken und Schwächen der Studierenden aufgezeigt, wodurch eine stetige Verbesserung von Lehr- und Prüfungsmethoden möglich war. Weiterhin konnten Rückschlüsse für eine kontinuierliche Optimierung dieses Prüfungsformates gezogen werden. Allerdings war auch festzustellen, dass die Durchführung der OSCE einen hohen personellen und materiellen Aufwand erfordert. Infolgedessen wurde die Station „Todesbescheinigung“ modifiziert und seit 2017 computerbasiert geprüft. Die Entwicklung und Anwendung neuer Prüfungsformen, anstelle der herkömmlichen Methoden, erforderte aber auch die Überprüfung der Gleichwertigkeit. Deshalb wurde die Station „Todesbescheinigung“ zunächst sowohl konventionell, als auch computerbasiert geprüft und die Resultate ausgewertet. Es war ersichtlich, dass die Ergebnisse beider Prüfungsformate vergleichbar sind. Zusammenfassend zeigte sich, dass die OSCE als geeignetes Prüfungsformat für die Kontrolle rechtsmedizinischer Kompetenzen eingesetzt werden kann. Der alternative Einsatz computerbasierter Prüfungen erwies sich hinsichtlich der Reduzierung materieller und personeller Kosten, bei gleichzeitiger Verbesserung der objektiven Beurteilung der Prüfungsleistung, als vorteilhaft. Durch die Weiterentwicklung der eingeführten Lehr-, Lern- und Prüfungsmethoden und die Integration neuer Technologien in die Aus- und Fortbildung können rechtsmedizinische Kompetenzen hinsichtlich der Qualität der ärztlichen Leichenschau verbessert werden.

Abstract

Causes for repeatedly reported deficiencies in the quality of medical inspection of corpses were increasingly discussed during the last years. Several improvements have been proposed - amongst others within a position paper of the German Association of Forensic Medicine. Here, an intensification of forensic education during medical studies was demanded as well as a continuing and mandatory education curriculum in postgraduate training.

The realization of these requirements at the Medical Faculty of the Martin-Luther-University Halle-Wittenberg took place within a cooperation project between the local Institute of Forensic Medicine and the Dorothea-Erxleben-Learning Centre. Additional to the current education in forensic medicine, an e-learning module and SkillsLab station on inspection of corpses and death certificates were established. Two corresponding OSCE (Objective Structured Clinical Examination) stations were used for evaluation of acquired skills in forensic medicine.

After implementation of these two forensic OSCE stations in 2016 the examination results were analyzed. High proportions of students achieved good or very good grades. Advanced item analyses revealed strengths and weaknesses of students. These results facilitated a continuous improvement of education and examination methods. However, it was noted that the process of OSCE demand high human and material efforts. Thus, “death certificate” OSCE was modified and changed to computer based since 2017.

The development and utilization of new instead of conventional examination methods demanded an evaluation of equivalence. Hence, the “death certificate” OSCE was conducted conventionally as well as computer based. Results were compared and found to be comparable.

OSCE stations proofed to be suitable examination methods for forensic competencies in corpse inspection. By detailed analysis of examination results, conclusions for continuous improvements of these examination methods as well as for the corresponding education programs can be drawn. Computer based examinations were favorable in terms of higher objectivity and less demands of human and material resources. Further development of the implemented educational and examination methods and integration of new technologies in medical studies and postgraduate training improve forensic skills in inspection of corpses.

Biolik, Alexandra: Die Integration rechtsmedizinischer Lehrinhalte in das SkillsLab und die Etablierung und Weiterentwicklung korrespondierender OSCE Stationen und neuer Lehr- und Lernmethoden, Halle (Saale), Univ., Med.Fak., Diss. 36 Seiten, 2019

Einleitung und Zielstellung

In der Bundesrepublik Deutschland ist das Leichenschauwesen durch landesrechtliche Bestimmungen in den Gesetzen über das Leichen-, Friedhofs- und Bestattungswesen oder in entsprechenden Verordnungen geregelt. In allen Bundesländern muss dabei bei jedem Todesfall eine Leichenschau durch einen Arzt durchgeführt und darüber eine ärztliche Todesbescheinigung ausgestellt werden [1]. Mit den Bestimmungen zur Leichenschau wird persönlichkeitsrechtlichen, straf- und zivilrechtlichen, sozialen und gesundheitspolitischen Aspekten Rechnung getragen, wie z.B. der sicheren Todesfeststellung zur Vermeidung von Scheintodesfällen, der Bekämpfung übertragbarer Erkrankungen, der Gewinnung von Daten zur Todesursachenstatistik als Grundlage für gesundheitspolitische Entscheidungen, sowie der Gewährleistung von Rechtsinteressen im Hinblick auf die Erkennung fremdverschuldeter Todesfälle und die Wahrnehmung mutmaßlicher Interessen des Verstorbenen [1]. Auf Grundlage dieser weitreichenden Konsequenzen sollten sowohl bei der Leichenschau, als auch bei der Ausstellung der Todesbescheinigung auf eine vollständige und korrekte Durchführung gemäß der AWMF-Leitlinie (Deutsche Gesellschaft für Rechtsmedizin - Regeln zur Durchführung der ärztlichen Leichenschau) geachtet werden [1]. Dabei kann die Leichenschau jeder approbierte Arzt unabhängig von der Fachrichtung durchführen. Die Verpflichtung zur Leichenschau ist in den Bundesländern unterschiedlich geregelt. Sie besteht im Allgemeinen auf Verlangen für jeden Arzt. Ärzte im Rettungsdiensteinsatz sind von ihrer Verpflichtung zur Durchführung der vollständigen Leichenschau befreit. Ihre Pflicht beschränkt sich in der Regel auf die Feststellung der Personalien, des Todes, der Todeszeit und des Sterbeortes mit Ausstellung einer so genannten vorläufigen Todesbescheinigung [1]. Abgesehen von dieser Ausnahmeregelung ist der Leichenschauarzt auch zur Feststellung der Todesursache und Todesart verpflichtet. Sofern dabei eine nicht natürliche oder nicht aufgeklärte Todesart festgestellt wird, muss im Hinblick auf mögliche strafrechtliche Konsequenzen die Polizei bzw. Staatsanwaltschaft informiert werden.

In der praktischen Umsetzung der Leichenschau und der Ausstellung der Todesbescheinigung kommt es allerdings immer wieder zu eklatanten Mängeln, die in zurückliegenden, aber auch in mehreren aktuellen Studien berichtet werden. So beschreibt eine Studie aus Mecklenburg - Vorpommern schwerwiegende Fehler bei der Dokumentation. Neben einer nicht übereinstimmenden Kausalkette bei der Todesursache wird die Problematik der fehlenden Angaben des Leichenschauarztes erwähnt, wodurch eventuelle Nachfragen erschwert werden [2].

Ebenso wurden im Großraum München Todesbescheinigungen von Kliniken und niedergelassenen Ärzten im Zeitraum von 2010 bis 2015 ausgewertet. Bei dieser Analyse stellten Gleich et al. fest, dass auf Grund fehlerhafter Dokumentation jeder 10. Totenschein nachträglich durch den ausstellenden Arzt korrigiert werden musste [3]. Weiterhin wurden Diskrepanzen zwischen der eingetragenen Todesursache und der Todesart beschrieben [3]. In einem Vergleich der Datenerhebungen zwischen 2010-2013 und 2014-2015 konnte jedoch auch eine positive Tendenz der korrekten Klassifikation der Todesart verzeichnet werden [3]. Diese ist höchstwahrscheinlich auf eine Verbesserung der rechtsmedizinischen Lehre zurückzuführen [3].

Aufgrund der fortbestehenden erheblichen Defizite erarbeitete die Deutsche Gesellschaft für Rechtsmedizin im Oktober 2015 „Vorschläge zur Verbesserung der Leichenschau und zur Aufdeckung von nicht natürlichen Todesfällen“ [4]. Dabei sollten vor allem - neben einer verpflichtenden Weiterbildung für Ärzte - auch eine Intensivierung dieser Thematik im Medizinstudium und die obligate Integration in das Lehrcurriculum aller medizinischen Fakultäten erfolgen [4].

Die Umsetzung dieser Empfehlungen wurde an der Medizinischen Fakultät der Martin-Luther-Universität Halle-Wittenberg 2015 durch ein Kooperationsprojekt zwischen dem Institut für Rechtsmedizin und dem Dorothea Erxleben Lernzentrum umgesetzt. Neben den herkömmlichen Vorlesungen bzw. Seminaren und Praktika wurden ein e-learning Modul und eine SkillsLab Station zur Thematik der Leichenschau etabliert. Die Absolvierung dieser unterschiedlichen Lehr- und Lernformen wurde zeitlich aufeinander abgestimmt, um das erlernte Wissen systematisch zu festigen.

Zunächst wurde das Praktikum der Leichenschau als Kleingruppenunterricht im Krematorium durchgeführt. Die Studierenden führten dabei unter Anleitung selbstständig eine Leichenschau durch. Auf Grundlage der gewonnenen Erkenntnisse wurde eine Todesbescheinigung ausgefüllt. Von dem anwesenden Rechtsmediziner erhielten sie im Anschluss ein Feedback.

Zeitnah dazu erfolgte im SkillsLab die Konsolidierung dieser erlernten Fertigkeiten. Dafür wurden zwei exemplarische Fallkonstellationen erarbeitet, die auf realen rechtsmedizinischen Leichenschauen basierten. Diese enthielten neben einer detaillierten Beschreibung auch Bilder zur Auffindungssituation bzw. Leichenschaubefunde, sowie weitere wichtige Informationen (z.B. Angaben zur medizinischen Vorgeschichte). Abhängig von diesen Konstellationen variierte die mögliche Todesursache und dementsprechend die Klassifikation der Todesart. Unter Aufsicht eines studentischen Tutors, der zuvor durch einen Rechtsmediziner geschult wurde, sollten die Studierenden anhand dieser Fallbeispiele jeweils einen Totenschein ausfüllen und

ihre Vorgehensweise und Entscheidungen erläutern. Die Todeszeitschätzung erfolgte dabei unter Verwendung der Henssge-Methode (Nomogramm und Website). Die dafür benötigten Angaben erhielten die Studierenden aus den Fallvignetten. Für die Recherche der benötigten ICD Codierungen war das Internet zugänglich. Des Weiteren mussten die Studierenden die Durchschläge des Totenscheines gemäß den in Sachsen-Anhalt geltenden Regelungen auch verteilen und verpacken. Abschließend erhielten sie ein konstruktives Feedback. Dabei wurden die Lösungsmöglichkeiten erläutert und auf Fragen, sowie Probleme bei der Dokumentation eingegangen. Die Notwendigkeit die Polizei bei einer nicht natürlichen bzw. nicht aufgeklärten Todesart zu informieren, stellte einen weiteren Schwerpunkt in der SkillsLab Station dar. Deshalb wurde diese Thematik ausführlich besprochen und den Studierenden die rechtlichen Konsequenzen erläutert.

Zum weiteren Ausbau der bisher erworbenen Kenntnisse und Fertigkeiten wurde den Studierenden auf einer passwortgeschützten Lernplattform ein e-learning Modul zur Verfügung gestellt. Analog der SkillsLab Station hatten sie hierbei die Möglichkeit, weitere Fallbeispiele durchzuarbeiten und einen virtuellen Totenschein auszufüllen. Die Auswertung erfolgte anschließend durch ein programmiertes Feedback, welches vom Computer automatisch generiert wurde.

Mit der Einführung von neuen didaktischen Lehr- und Lernmethoden (z.B. SkillsLab oder e-learning Modul) in der Medizin wurde auch die Etablierung von korrespondierenden Prüfungsmethoden erforderlich. Während theoretische Aspekte weiterhin durch eine Multiple Choice Klausur abgefragt werden können, ermöglicht die OSCE, neben der Prüfung von Kenntnissen, auch eine direkte Beurteilung von erlernten prozeduralen Fertigkeiten [5,6]. Durch solche Lehr- und Prüfungsformate können auch längerfristige Lerneffekte erzielt werden, als es durch herkömmliche Formate zu erreichen ist [7]. Diese Prüfungsmethode wurde bereits für viele klinische Fächer eingesetzt und sollte auch in der rechtsmedizinischen Ausbildung von Medizinstudierenden berücksichtigt werden. Dafür bietet sich z.B. die Thematik der Leichenschau an, um die in der täglichen Praxis immer wieder auftretenden Defizite zu reduzieren.

Im Rahmen des Kooperationsprojektes mit dem SkillsLab wurden zwei rechtsmedizinische Prüfungsstationen neu konzipiert und getestet. Diese wurden erstmals 2015 an der medizinischen Fakultät der Martin-Luther-Universität Halle-Wittenberg in die Gesamt-OSCE des neunten Semesters integriert und sind seitdem Bestandteile des Notfallmedizinscheines. In

der ersten OSCE Station werden die Fertigkeiten, die zur Durchführung einer praktischen Leichenschau benötigt werden, überprüft. Dafür wurde im Vorfeld eine Simulationspuppe mit Verletzungen präpariert. Neben der richtigen Auswahl der benötigten Materialien, müssen die Studierenden eine strukturierte Leichenschau durchführen und hinsichtlich der Wunden in Eigen- oder Fremdverschulden klassifizieren. In der zweiten OSCE Station wird das Ausstellen einer Todesbescheinigung bewertet. Dafür erhalten die Studierenden analog der SkillsLab Station eine Fallvignette, die Informationen zur Auffindungssituation und Identifikation des Leichnams sowie Leichenschaubefunde enthält.

Die Ergebnisse der beiden OSCE Stationen wurden anschließend einer detaillierten Analyse unterzogen.

Bei der Vorbereitung und Durchführung der OSCE Stationen war bereits ersichtlich, dass für die Durchführung eines solchen Prüfungsformates, neben einen hohen Organisationsaufwand, vor allem erhebliche personelle ärztliche und materielle Ressourcen erforderlich sind [8,9]. In der Beschäftigung und Auseinandersetzung mit dieser Problematik wurde deshalb der Einsatz computerbasierter Prüfungen diskutiert. Derartige Prüfungsformate wurden bereits sowohl für die Bewertung dermatologischer Fertigkeiten [10], als auch zur Evaluierung zahnmedizinischen Wissens [11] erfolgreich eingesetzt. Beide Studien zeigten zudem, dass dieses Prüfungsformat eine reliable und ressourcensparende Alternative zur konventionellen OSCE darstellt, die vergleichbare Prüfungsergebnisse bei reduzierten Kosten liefert [10,11].

Die Etablierung neuer Prüfungsverfahren unterliegt jedoch auch in der medizinischen Ausbildung strengen Kontrollkriterien. Um eine eventuelle juristische Anfechtbarkeit auszuschließen, muss deshalb immer im Vorfeld geprüft werden, ob die Reliabilität und Validität der Prüfung gewährleitet ist [12].

Nach kritischer Konsultation wurde dementsprechend die OSCE Station „Todesbescheinigung“ für eine Modifizierung als geeignet angesehen und seit 2017 computerbasiert geprüft.

Diskussion

Nach der Einführung der neuen rechtsmedizinischen Lehr-, Lern- und Prüfungsmethoden zur Thematik der Leichenschau war zunächst eine kritische Prüfung dieser Instrumente erforderlich. Bei den Lehr- und Lernmethoden stellte sich die Frage, ob mit diesen Formaten die Kompetenzen für die ärztliche Leichenschau verbessert werden können. Bei den beiden rechtsmedizinischen OSCE Stationen war zu hinterfragen, ob diese Instrumente zur Überprüfung der erworbenen Kompetenzen tatsächlich geeignet sind. Dabei erfolgte neben der Betrachtung der Gesamtergebnisse auch eine detaillierte Auswertung der einzelnen Items.

Im Gesamtergebnis zeigte sich, dass an beiden Stationen von mindestens zwei Dritteln der Studierenden gute bis sehr gute Prüfungsergebnisse erreicht wurden. Durch die Detailauswertung konnten neben mehreren Stärken auch noch bestehende Defizite in den korrespondierenden Lehrveranstaltungen (z.B. Inspektion der Halsregion beim Kleingruppenunterricht) aufgezeigt werden. Damit wurde eine solide Basis für eine Modifikation dieser Unterrichtsform geschaffen. Bei der Auswertung der Prüfungskonzeption und -durchführung zeigte sich eine befriedigende interne Konsistenz, die durch eine Modifizierung der Stationen noch weiter gesteigert werden konnte. Außerdem ergaben sich aus der Evaluation der Prüfer einerseits mehrere Stärken, wie z.B. die gute Verständlichkeit und Nachvollziehbarkeit der Checklisten. Anderseits waren aber auch weitere Verbesserungsmöglichkeiten in der Gestaltung der OSCE Stationen ersichtlich, wie z.B. die Angleichung des Schweregrades bei den einzelnen Rotationsdurchgängen. Insgesamt konnte allerdings aufgezeigt werden, dass durch eine Kombination von Kleingruppenunterricht, SkillsLab Station und einem e-learning Modul umfassende Kompetenzen für eine sachgerechte Durchführung der Leichenschau erworben und auch adäquat durch die beiden OSCE Stationen geprüft werden können [8] . Eine solche kritische Auswertung und Bewertung neu eingeführter Lehr-, Lern- und Prüfungsmethoden ist schließlich auch ein essentieller Bestandteil für die immer wieder notwendige Modifizierung der Lehre und der nachfolgenden Prüfungen.

Der dabei festgestellte hohe Aufwand hinsichtlich organisatorischer, personeller und materieller Ressourcen bei den beiden OSCE Stationen führte dann auch zu einer Weiterentwicklung des Projektes mit der Modifizierung der OSCE Station „Todesbescheinigung“ als computerbasierte Prüfungsstation. Wiederum erfolgte dabei eine detaillierte Auswertung und kritische Bewertung der modifizierten Prüfungsform. Dabei konnten in einem direkten Vergleich zur konventionellen OSCE mit einem ärztlichen Prüfer äquivalente Prüfungsergebnisse verzeichnet werden [13].

Der Einsatz computerbasierter Prüfungen in die OSCE erweist sich zu dem als ökonomischere Alternative [13]. Obwohl im Vorfeld eine einmalige aufwendige Programmierung eines geeigneten Computerprogrammes notwendig ist, rentiert sich dieses Prüfungsformat vor allem bei einer hohen Anzahl von Prüflingen und den wiederkehrenden Einsatz während der OSCE. Personelle Mängel an ärztlichen Prüfern können somit kompensiert bzw. ärztliche und materielle Ressourcen eingespart werden. Trotzdem ist auch während der Prüfung noch eine Unterstützung im Umgang mit den technischen Gegebenheiten erforderlich. Dabei sollte es sich wenn möglich, um technisch versierte studentische Tutoren oder Tutorinnen handeln,

die/der zuvor in das virtuelle Prüfungsprogramm eingewiesen worden ist und gegebenenfalls bei computerbedingten Problemen die Studierenden unterstützen könnte. Dieser Problematik kann mit einer intensiveren Schulung der unterstützenden Tutoren und Tutorinnen und einer Integration des Computerprogrammes in den Kleingruppenunterricht im SkillsLab gelöst werden.

Des Weiteren können durch die detaillierte Auswertung der virtuellen Prüfungsdokumente und durch das Feedback der Tutoren und Tutorinnen technische Fehlerquellen analysiert werden. Dabei sind vor allem Punktverluste bei der Identifikation des Toten durch das Anschauen und Vergleichen des virtuellen Leichenbildes mit dem Lichtbild des Personalausweises ersichtlich. Diese Überprüfung ist neben den Angaben von Angehörigen gemäß Paragraph 31 des Personenstandsgesetzes für eine hinreichende Identifizierung des Leichnams erforderlich [14]. Trotz entsprechender Hinweise von Seiten des Tutors oder der Tutorin die vorgegebenen Hilfstools zu verwenden, erfolgte oftmals lediglich ein Vergleich der Personalausweise mit den Angaben in den Fallvignetten. Die darin enthaltenen Daten waren jedoch auf das Geburtsjahr und den Familiennamen begrenzt und somit nicht ausreichend für eine eindeutige Identifikation. Obwohl auf diese Thematik ausführlich im SkillsLab und in den rechtsmedizinischen Seminaren eingegangen wird, zeigten sich in der Prüfungssituation diesbezüglich erhebliche Defizite.

Dies kann einerseits auf die prüfungsassoziierte Anspannungssituation zurückgeführt werden, die dazu führt, dass die konkreten Aufgabenstellungen zu ungenau gelesen und die Instruktionen der Tutoren oder Tutorinnen nicht ausreichend beachtet werden. Andererseits stimmt die Altersangabe in der Fallvignette nur mit dem Geburtsjahr von einem der zwei zur Auswahl bereit liegenden Personalausweise überein. Diese Information könnten für die Studierenden eine eindeutige Identifizierung logisch erscheinen und die Suche nach weiteren Hinweisen überflüssig wirken lassen. Die volle Punktvergabe erfolgt jedoch nur, wenn neben der Eingabe der korrekten Personalien in den virtuellen Totenschein auch das Leichenbild tatsächlich angeschaut wird. Aufgrund dieser auffällig häufig aufgetretenen Defizite könnte eine Änderung der Angaben im Fallszenario bzw. eine Modifizierung der technischen Umsetzung bei der Überprüfung der Identifikation in Betracht gezogen werden.

Die Punktvergabe könnte beispielsweise bereits mit der Auswahl des richtigen Personalausweises und der Eingabe der Daten erfolgen. Dafür wäre eine Überarbeitung der Angaben in der Fallvignette erforderlich, so dass keine Zuordnung allein auf Grund der Altersangaben mehr möglich ist.

Eine weitere Limitation einer konventionellen OSCE kann trotz standardisierter Aufgabenstellungen und Checklisten eine nicht immer hinreichende objektive Beurteilung der Prüfungsleistungen darstellen. Abhängig von den jeweiligen ärztlichen Prüfern und Prüferinnen kann es durch verschiedene Einflussfaktoren zu Diskrepanzen kommen. Dabei sind neben potentiellen Hilfestellungen auch Interaktionen und Charaktereigenschaften der Studierenden, Prüfer und Prüferinnen, die sich sowohl von Nachteil, als auch von Vorteil auf die Prüfungsleistungen auswirken können, zu erwähnen [15]. Diese Effekte können durch den Einsatz computerbasierter Prüfungen weitestgehend vermieden werden und zu einer objektiveren Einschätzung der Prüfungsleistung führen. Anderseits muss in der kritischen Diskussion berücksichtigt werden, dass nicht alle OSCE Stationen für eine computerbasierte Durchführung geeignet sind. Dies betrifft vor allem Stationen, die sich durch einen hohen praktischen Anteil von Prüfungsleistungen auszeichnen. Dazu dürfte beispielsweise die andere rechtsmedizinische OSCE Station „Praktische Leichenschau“ gehören.

Weiterhin ist zu bedenken, dass durch die Anwendung dieses computerbasierten Prüfungsformates das ärztliche Feedback im Anschluss an die Prüfung entfällt. Dieses wird von den Studierenden oftmals als hilfreiche Rückmeldung bezüglich ihres Wissensstandes empfunden und zeigt einen positiven Effekt auf den längerfristigen Lernerfolg [16].
Daraus ist zu schlussfolgern, dass auch im computerbasierten OSCE Format die Möglichkeiten der Anwendung einer geeigneten Feedbackform geprüft werden sollte. Die technische Umsetzung hängt vor allem von der konkreten Prüfungsform ab. Diese kann von der einfachen Methode der Markierung der Falschantworten bis hin zu ausführlichen Freitextkommentaren bezüglich der Prüfungsleistung variieren [17]. Die Effizienz eines elektronischen Feedbacks wird dabei stark von dem Ausmaß bzw. Verständlichkeit der schriftlichen Anmerkungen und von einer zeitnahen Übermittlung im Anschluss an die Prüfung beeinflusst [18]. Deshalb ist zu Beginn der Konfiguration eines elektronischen Feedbacks explizit zu eruieren, wie dieses gestaltet werden sollte, um eine annähernd äquivalente Variante gegenüber dem herkömmlichen mündlichen Feedback zu gewährleisten. Als Grundlage für die Generierung eines elektronischen Feedbacks, welches am Anschluss an die Prüfung per Mail den Studierenden zur Verfügung gestellt werden kann, eignet sich die Auswertung der einzelnen OSCE Items. Des Weiteren sollte das persönliche Feedback das Prüfungsergebnis, sowie Verbesserungsvorschläge und hilfreiche Kommentare zu bestehenden Defiziten enthalten.
Die technische Umsetzung dieser individuellen Anforderungen stellt eine enorme Herausforderung dar. Es erfordert im Vorfeld eine strukturelle und gründliche Planung um einerseits die Weitergabe von Prüfungsinhalten zu vermeiden, andererseits aber ein

persönliches konstruktives Feedback zur Verfügung zu stellen. Eine Option wäre, den Studierenden nach Abschluss der gesamten OSCE, das vom Computer korrigierte virtuelle Prüfungsdokument per Mail zuzusenden. Fehlerhafte Angaben könnten eindeutig markiert sein und dem Studierenden dementsprechend zeigen, wo Defizite vorhanden sind. Ohne das Vorliegen einer entsprechenden Musterlösung oder beigefügten Kommentaren ist bei dieser Variante jedoch wahrscheinlich kein entscheidender Lernzuwachs zu erwarten.
Alternativ könnte orientierend an klar definierten Lernzielen ein schriftliches Feedback generiert werden. Schwerpunktmäßig würden sich bei der Thematik „Todesbescheinigung“ die Bestimmung der Todeszeit, die Klassifikation der Todesart und die Todesursache eignen. Sofern bei der Beantwortung dieser spezifischen Items Fehler ersichtlich sind, würden die Studierenden in einem e-Feedback per Mail darüber in Kenntnis gesetzt werden. Abhängig von den vorhandenen Defiziten könnten ergänzend Erläuterungen zur Wahl der Todesart bzw. Todesursache und zur Schätzung der Todeszeit angefügt werden. Ein individuelles Feedback ist mit dieser Verfahrensweise jedoch nur bedingt möglich. Die zeitnahe Rückmeldung zur persönlichen Prüfungsleistung wäre aber ohne die Weitergabe der Prüfungsinhalte gegeben. Somit weisen die verschiedenen Feedbackmöglichkeiten unterschiedliche Stärken und Schwächen in Bezug auf Programmierungsaufwand, Individualität und Wahrscheinlichkeit eines langfristigen Lernerfolges auf. Möglicherweise könnte hier eine Evaluation der Studierenden hinsichtlich der praktischen Umsetzung dieser Feedbackmethoden hilfreich sein.

Neben der Erarbeitung und Erprobung der Feedbackkonzepte sollte auch weiterhin eine kontinuierliche kritische Bewertung sowie Modifizierung bzw. Weiterentwicklung der eingesetzten Lehr-, Lern- und Prüfungsmethoden erfolgen. Dazu gehören auch die Erarbeitung und der Einsatz neuer Fallbeispiele und -konstellationen für den Kleingruppenunterricht, die SkillsLab Station und das e-learning Modul, aber auch für die OSCE Stationen. Damit kann einerseits einer schematisierten Weitergabe von Prüfungsinformationen unter den Studierenden entgegengewirkt werden und anderseits, ein fall- und problemorientierter Lösungsansatz gefördert und trainiert werden.

Eine weitere Anwendungsperspektive der primär für die studentische Ausbildung konzipierten Lehr- und Lernmethoden bietet die Fort- und Weiterbildung von Ärzten und Ärztinnen. Theoretisch kann zwar jeder approbierte Arzt oder Ärztin unabhängig von der Fachrichtung die Leichenschau durchführen und im Allgemeinen besteht auf Verlangen auch eine Verpflichtung dazu. In der täglichen Praxis bestehen in den Kenntnissen, Fähigkeiten und Fertigkeiten in der Leichenschau jedoch erhebliche Defizite, insbesondere bei Ärztinnen und Ärzten die diese

Tätigkeit nur selten durchführen. Dies führt bei den Ärzten und Ärztinnen vermehrt zu Unsicherheiten hinsichtlich ihrer Kompetenzen bei der Durchführung einer Leichenschau [19]. In der Bundesrepublik Deutschland besteht aktuell keine ausreichende gesetzliche Verpflichtung von Ärzten und Ärztinnen zur Fort- und Weiterbildung [20]. Um die Qualität der ärztlichen Leichenschau dennoch zu gewährleisten und stetig zu verbessern, wird neben theoretischen Veranstaltungen, auch die Teilnahme an praktischen Curricula zum Thema Leichenschau angeraten [21]. Die Inanspruchnahme dieser Fort- und Weiterbildungen hängt von der Motivation und Bereitschaft des Einzelnen, aber auch von der Qualität der Angebote ab. Deshalb sollte versucht werden die Rahmenbedingen, unter denen die Qualifizierungen stattfinden und die Umsetzung der Thematik entsprechend anspruchsvoll zu gestalten [20].

Die Entwicklung neuer Technologien im Rahmen moderner didaktischer Lehr-, Lern- und Prüfungsmethoden könnten hierbei von erheblichem Nutzen sein. So wurden z.B. bereits internetbasierte e-learning Module entwickelt, die die komplexe Durchführung einer virtuellen Leichenschau ermöglichen [22]. Die örtliche und zeitliche Variabilität der Benutzung solcher Computerprogramme stellt für klinisch tätige Mediziner mit Schicht- und Bereitschaftsdiensten eine attraktive Form der Weiterbildung dar. Dabei kann auf eine Kombination mit Präsenzveranstaltungen zur Thematik der Leichenschau jedoch nicht verzichtet werden. Hier sollte neben der Vermittlung und Auffrischung theoretischer Kenntnisse vor allem die praktische Anwendung rechtsmedizinischer Fähigkeiten und Fertigkeiten im Vordergrund stehen, wie z.B. Kleingruppenunterricht am realen Leichnam bzw. an Simulationspuppen. Für die zukünftige Entwicklung und Modifizierung neuer Lehr- und Lernmethoden können sicherlich auch Computerprogramme mit Einsatz spezieller 3 D Verfahren hilfreich sein [23].
Derartige Methoden werden bereits für die Rekonstruktion von Tatorten [24] sowie für die bessere Beurteilung von Verletzungen an Verstorbenen [25] genutzt. Eine Integrierung in die rechtsmedizinische Aus-, Fort- und Weiterbildung stellt jedoch eine weitere Herausforderung bezüglich der Umsetzung dar.
Während das Ausfüllen einer Todesbescheinigung durch die Bereitstellung von weiteren Fallkonstellationen im Rahmen von e-Learning Modulen jederzeit geübt werden kann, ist die praktische Durchführung einer Leichenschau oftmals auf Grund diverser Ressourcen limitiert. Durch den Einsatz der virtuellen Realität und der Verwendung von head mounted displays und Controllern, könnte dieser Problematik entgegengewirkt werden. Neben der verbesserten Zugänglichkeit zur Durchführung einer praktischen Leichenschau, könnte somit auch eine Steigerung des Lerneffektes durch Wiederholung der praktischen Fertigkeiten erzielt werden.

Im Zuge der kontinuierlichen Weiterentwicklung der rechtsmedizinischen Ausbildung an der Martin-Luther-Universität Halle-Wittenberg wurde das Projekt „virtuelle Leichenschau“ neu konzipiert und erstmalig im November 2018 den Medizinstudierenden im praktischen Jahr angeboten.

Die Studierenden erhielten hierbei zu Beginn des Seminares eine kurze Beschreibung der Fallsituation. Danach wurden sie durch das Aufsetzen des head mounted displays in die Situation des Notarztes oder Notärztin hineinversetzt und konnten die Komplexität des Ereignisortes nachempfinden. Dafür wurden im Vorfeld reale Tatorte mit einer 360° Kamera erfasst und detailgetreu grafisch nachrekonstruiert. Durch das Roomscale Konzept und geeignete Controller sind authentische Bewegungen und Interaktionen, wie beispielsweise die Durchführung einer Leichenschau, in der digitalen Welt möglich. Somit kann eine detaillierte Untersuchung des Ereignisortes nach Hinweisen zur Todesart und Todesursache vorgenommen, eine strukturierte Leichenschau durchgeführt, sowie die virtuelle Todesbescheinigung an Hand der gesammelten Informationen ausgefüllt werden.

Die detaillierte Rekonstruktion realer Tatorte ermöglicht zudem eine hohe Immersion in der virtuellen Realität. Unterschiedliche Fallszenarien können dadurch nachgebildet werden und Limitationen, wie beispielsweise das Vorhandensein eines Leichnams oder zeitliche bzw. räumliche Einschränkungen, entfallen. Komplexe Lernziele, wie die Durchführung einer strukturierten und zugleich standardisierten Leichenschau und das Attestieren der Todesbescheinigung können durch diese Anwendung miteinander kombiniert werden. Die Studierenden haben dementsprechend die Möglichkeit, im praktischen Jahr ihr bereits vorhandenes rechtsmedizinisches Wissen praxisnah anzuwenden, zu wiederholen und damit auch zu festigen.

Somit stellt die Etablierung und Weiterentwicklung derartiger Lehr-, Lernmethoden einen weiteren wichtigen Schritt zur Optimierung der Qualität der ärztlichen Leichenschau sowohl in der rechtsmedizinischen Ausbildung, als auch in der Fort- und Weiterbildung nach der Approbation dar.

Literaturverzeichnis

1. Regeln zur Durchführung der ärztlichen Leichenschau, gültig bis 2022, https://www.awmf.org/uploads/tx_szleitlinien/054-002l_S1_Regeln-zur-Durchfuehrung-der-aerztlichen-Leichenschau_2018-02_01.pdf, Abrufdatum:22.04.2019
2. Zack F, Kaden A, Riepenhausen S, Rentsch D, Kegler R, Büttner A (2017) Fehler bei der Ausstellung der Todesbescheinigung. Rechtsmedizin 27:516–527.
3. Gleich S, Viehöver S, Stäbler P, Graw M, Kraus S (2017) Falsch bescheinigter natürlicher Tod nach ärztlicher Leichenschau. Rechtsmedizin 27:2–7.
4. Vorschläge der DGRM zur Verbesserung der Leichenschau und zur Aufdeckung von nicht natürlichen Todesfällen, https://www.dgrm.de/fileadmin/PDF/DGRM-Vorschläge_Verbesserung_Leichenschau_2009_2015.pdf, Abrufdatum: 22.04.2019
5. Nikendei C, Jünger J (2006) OSCE - praktische Tipps zur Implementierung einer klinisch-praktischen Prüfung. GMS Zeitschrift für medizinische Ausbildung 23(3):Doc47.
6. Newble D (2004) Techniques for measuring clinical competence: Objective structured clinical examinations. Medical education 38:199–203.
7. Prince KJAH, Boshuizen HPA, van der Vleuten CPM, Scherpbier AJJA (2005) Students' opinions about their preparation for clinical practice. Medical education 39:704–712.
8. Heide S, Lessig R, Hachmann V, Stiller D, Rönsch M, Stoevesandt D, Biolik A, Watzke S, Kellner J (2018) Establishment of two forensic medicine OSCE stations on the subject of external post-mortem examination. International journal of legal medicine 132:311–319.
9. Rau T, Fegert J, Liebhardt H (2011) How high are the personnel costs for OSCE? A financial report on management aspects. GMS Zeitschrift für medizinische Ausbildung 28:Doc13
10. Chaudhary R, Grover C, Bhattacharya SN, Sharma A (2017) Computer assisted Objective structured clinical examination versus Objective structured clinical examination in assessment of Dermatology undergraduate students. Indian journal of dermatology, venereology and leprology 83:448–452.
11. Holyfield LJ, Bolin KA, Rankin KV, Shulman JD, Jones DL, Eden BD (2005) Use of computer technology to modify objective structured clinical examinations. Journal of dental education 69:1133–1136.

12. Wannemacher K: Computerbasierte Prüfungen. Zwischen Self-Assessment und Abschlussklausuren - In: Seiler Schiedt E (Hrsg), Kälin S (Hrsg), Sengstag C (Hrsg): E-Learning - alltagstaugliche Innovation?, Münster – Waxmann, 2006, S. 163-172.
13. Biolik A, Heide S, Lessig R, Hachmann V, Stoevesandt D, Kellner J, Jäschke C, Watzke S (2018) OSCE "Death Certificate" station – Computer-based versus conventional exam format. Journal of Forensic and Legal Medicine 55:33-38.
14. Tag B: Rechtsmedizinische Aspekte des Arztrechtes. In: Madea B (Hrsg): Rechtsmedizin, Springer Berlin - Heidelberg, 2015, S. 835–853.
15. Chong L, Taylor S, Haywood M, Adelstein B-A, Shulruf B (2017) The sights and insights of examiners in objective structured clinical examinations. Journal of educational evaluation for health professions 14:34.
16. Hodder RV, Rivington RN, Calcutt LE, Hart IR (1989) The effectiveness of immediate feedback during the objective structured clinical examination. Medical education 23:184–188.
17. Striewe M, Goedicke M: Feedback-Möglichkeiten in automatischen Prüfungssystemen. In: Kerres, M; Ojstersek N; Schroeder U; Hoppe U (Hrsg): DeLFI 2010 - 8. Tagung der Fachgruppe E-Learning der Gesellschaft für Informatik e.V., Universität Duisburg-Essen, 2010, S. 85-96.
18. Ashby SE, Snodgrass SH, Rivett DA, Russell T (2016) Factors shaping e-feedback utilization following electronic Objective Structured Clinical Examinations. Nursing & health sciences 18:362–369.
19. Valentini J, Goetz K, Yen K, Szecsenyi J, Dettling A, Joos S, Steinhäuser J, Flum E (2017) Knowledge, competencies and attitudes regarding external post-mortem physical examination: A survey among German post-graduate trainees in general practice. European Journal of General Practice 24:1–6.
20. Böthin E (2013) Ärztliche Fortbildung in Deutschland - Pflicht und Freiwilligkeit. Zeitschrift für Evidenz, Fortbildung und Qualität im Gesundheitswesen 107:327–334
21. Madea B, Bajanowski T, Peschel O, Ritz-Timme S, Rothschild MA, Stiller D, Grass H (2011) Kontinuierliche ärztliche Fortbildung zum Thema Leichenschau. Rechtsmedizin 21:51–54.
22. Schmeling A, Kellinghaus M, Becker JC, Schulz R, Schäfer A, Pfeiffer H (2011) A web-based e-learning programme for training external post-mortem examination in curricular medical education. International journal of legal medicine 125:857–861.

23. Englert CJ: Moderne Methoden der Gerichtsmedizin und Kriminaltechnik. In: Englert CJ (Hrsg) Der CSI-Effekt in Deutschland. Springer Fachmedien Wiesbaden, 2014, S. 71–93.
24. Sieberth T, Dobay A, Affolter R, Ebert LC (2019) Applying virtual reality in forensics - a virtual scene walkthrough. Forensic science, medicine, and pathology 15:41–47.
25. Koller S, Ebert LC, Martinez RM, Sieberth T (2019) Using virtual reality for forensic examinations of injuries. Forensic science international 295:30–35.

Thesen

1. Die Entwicklung von einem e-learning Modul und einer SkillsLab Station begleitend zur bisherigen rechtsmedizinischen Ausbildung ermöglicht die Intensivierung der praktischen Umsetzung der Thematik der Leichenschau im Medizinstudium.
2. Durch die Kombination von Kleingruppenunterricht, einer SkillsLab Station und einem e-learning Modul können grundlegende Fähigkeiten und Fertigkeiten in Bezug auf die Aufgabe der Leichenschau erlangt werden.
3. Die OSCE eignet sich zur Überprüfung rechtsmedizinischer Kompetenzen.
4. Computerbasierte Prüfungsformen stellen eine ökonomischere und standardisierte Alternative zur konventionellen OSCE dar.
5. Durch die Weiterentwicklung der eingeführten Lehr-, Lern- und Prüfungsmethoden und Integrierung neuer Technologien in die Aus- und Fortbildung können rechtsmedizinische Kompetenzen verbessert und damit die Qualität der ärztlichen Leichenschau optimiert werden.

Publikationsteil

Int J Legal Med (2018) 132:311–319
DOI 10.1007/s00414-017-1630-6

ORIGINAL ARTICLE

Establishment of two forensic medicine OSCE stations on the subject of external post-mortem examination

S. Heide[1] · R. Lessig[1] · V. Hachmann[1] · D. Stiller[1] · M. Rönsch[2] · D. Stoevesandt[2] · A. Biolik[2] · S. Watzke[3] · J. Kellner[2]

Received: 2 February 2017 / Accepted: 14 June 2017 / Published online: 21 June 2017

Abstract An improvement in quality of medical external post-mortem examinations among others can be achieved by more intensive training of medical students. Modern learning and teaching methods such as e-learning modules and SkillsLab stations should be used for this. The introduction of corresponding methods of assessment such as the OSCE procedure is necessary to test the success of learning. In Halle (Germany), two OSCE stations on the subject of external post-mortem examinations were introduced in 2016. The 'practical external post-mortem examination' station test skills and abilities students have learned during practical external post-mortem examination in small group classes on a simulation doll. At the 'death certificate' station, an original death certificate must be filled in, testing the knowledge, skills and abilities learned in the SkillsLab station and during e-learning. A total of 148 students took part in the test. At both stations, at least two thirds of the students (69.5 and 81.7%) were able to show good or very good test results. In addition to the strengths, a detailed evaluation of the test results showed that there were still deficits in terms of the corresponding courses (e.g. inspection of the neck region in the small group classes), which will have to be remedied in the future. When analysing the test concept and the test implementation, objectivity was nearly perfect. There was a satisfactory internal consistency and stability over 8 months. Ultimately, in addition to several strengths (such as good understanding and transparency of the checklists) the evaluation of the examiners also showed further potential areas for improvement (e.g. harmonisation of the degree of difficulty for the individual rotations) when designing the OSCE stations. Overall, it was possible to determine that the OSCE testing format is a suitable tool to test external post-mortem examination skills and that conclusions about improvements in teaching can also be drawn from this.

Keywords External post-mortem examination · Forensic medicine · SkillsLab station · OSCE

Introduction

Around the world, the quality of medical external post-mortem examination is the subject of sometimes controversial discussions, in particular countries in which doctors have to carry out this procedure regardless of their specialty [1]. Many studies have been able to show that external post-mortem examinations have recurrent blatant deficiencies [2–9]. The training of medical students involves the communication of the subject of external post-mortem examination mostly within the scope of lectures and practical exercises on cadavers. The learning objectives are usually assessed with multiple-choice exams. There is a question, however, as to whether the skill involved in a medical external post-mortem examination can be sufficiently communicated through these classical teaching and testing formats alone. A French study showed that at the end of their studies only 4.5% of students felt that they were able to carry out an external post-mortem examination competently [10].

✉ S. Heide
steffen.heide@uk-halle.de

[1] Institute for Forensic Medicine, Martin Luther University of Halle-Wittenberg, Franzosenweg 1, 06112 Halle (Saale), Germany

[2] Dorothea Erxleben Learning Centre, Medical Faculty of the Martin Luther University of Halle-Wittenberg, Halle, Germany

[3] Clinic and Polyclinic of Psychiatry, Psychotherapy and Psychosomatic Medicine, Halle University Hospital, Halle, Germany

In light of the increasing significance of modern learning and teaching methods in medicine but also in terms of the broad spectrum of constellations of external post-mortem examinations, further practical measures are needed to ensure a decisive improvement in training [1, 11]. In contrast to clinical fields, the introduction of new teaching and learning methods in the field of forensic medicine primarily focuses on the establishment of e-learning modules [12–14], in individual cases, the use of role plays has also been reported [15]. The subject of external post-mortem examinations plays a key role in the e-learning modules [16, 17]. In addition to an e-learning module of this type, a SkillsLab station on this subject has recently been introduced in Halle (Saale), with the aim of improving the quality of external post-mortem examination [18]. The introduction of corresponding test forms is therefore necessary in order to evaluate the success of such teaching methods. In order to do this, the objective structured clinical examination (OSCE) procedures are available and have been established as a fixed part of practical tests on other subjects at most medical schools for a number of years. With the OSCE, candidates rotate through a course of several test stations. In each station, the student is given a written instruction and a checklist is used to objectively assess clinical and practical tasks. Points are assigned for each station and then added to yield a total point score for the entire course [19].

The aim of this study is to present the concept of OSCE tests on the subject of external post-mortem examination in order to establish this new form of examination for medical students. First examination results will be evaluated in terms of distribution and psychometric properties (internal consistency, inter-rater reliability and stability of the results).

Material and methods

Student training in post-mortem examinations

In Halle, student training in post-mortem examinations is achieved through lectures, practical small group instruction as well as a SkillsLab station and an e-learning module. In the practical part, the students practise a full external post-mortem examination on full cadavers in a crematorium in groups of three to four under medical supervision. In order to do this, the day beforehand, suitable cases are selected by the seminar facilitator and appropriate case vignettes are developed. At the end of the course unit, the students present their cases to one another. The SkillsLab station is compulsory for all students during their rotations. Small groups of four people each have 1 hour to process two cases with the support of a trained student tutor. Information on the history, position on discovery, findings from the external post-mortem examination and information related to the identification and estimation of the time of death is provided using images and texts in a computer-assisted case presentation. The associated ICD numbers for the diagnosis of the cause of death can be researched online. For the estimation of the time of death, the students are given Hennsge's nomograms [20] with relevant instructions. The students then fill in the original death certificate using these facts. This is then signed and sealed in accordance with the applicable provisions. Instructions are given by the tutor, who also provides feedback at the end of the course. As a continuation, students can work on eight further e-learning cases on a protected learning platform. There is no time limit for these, and there are no restrictions in terms of the location in which they can be carried out. The primary learning objective of this student training is the ability of students to independently perform an external post-mortem examination and complete a death certificate.

Sample

The test stations presented below are integrated into the OSCEs for emergency medicine. The students rotate between a test course of ten stations which include for example the clinical and practical activities such as the resuscitation of children, determining a prescription, emergency neurological examinations and insertion of a CVC or pleural drain. The forensic medicine test stations were completed by all 148 students who had to pass the OSCE in the ninth semester. The students were tested in three individual rotations carried out over two successive days. The students were randomly allocated to the rotations using their identification number in the medicine study programme.

OSCE test stations

In a collaborative project between the learning centre of the medical school of Martin Luther University of Halle-Wittenberg and the forensic medicine institute, two OSCE stations on the subject of external post-mortem examinations were introduced for the first time. As part of the first 'practical external post-mortem examination' station the skills and abilities students have learned during practical external post-mortem examination in small group classes were tested on a simulation doll. In the OSCE test, the students initially have to select the necessary work materials, with various distracting items included in the selection (Fig. 1). The students then have to create sufficient lighting conditions in the room, which is initially dark, and remove all of from the simulation dolls clothing. Then the students should check for certain signs of death. Rigour mortis should be evaluated on at least two different joints. The students also have to turn the simulated cadaver and assess the lividity attached to the back as an extensive photo. Next, there is a systematic examination of the body in which the steps carried out also have to be explained (e.g. inspection of the conjunctiva in order to rule out

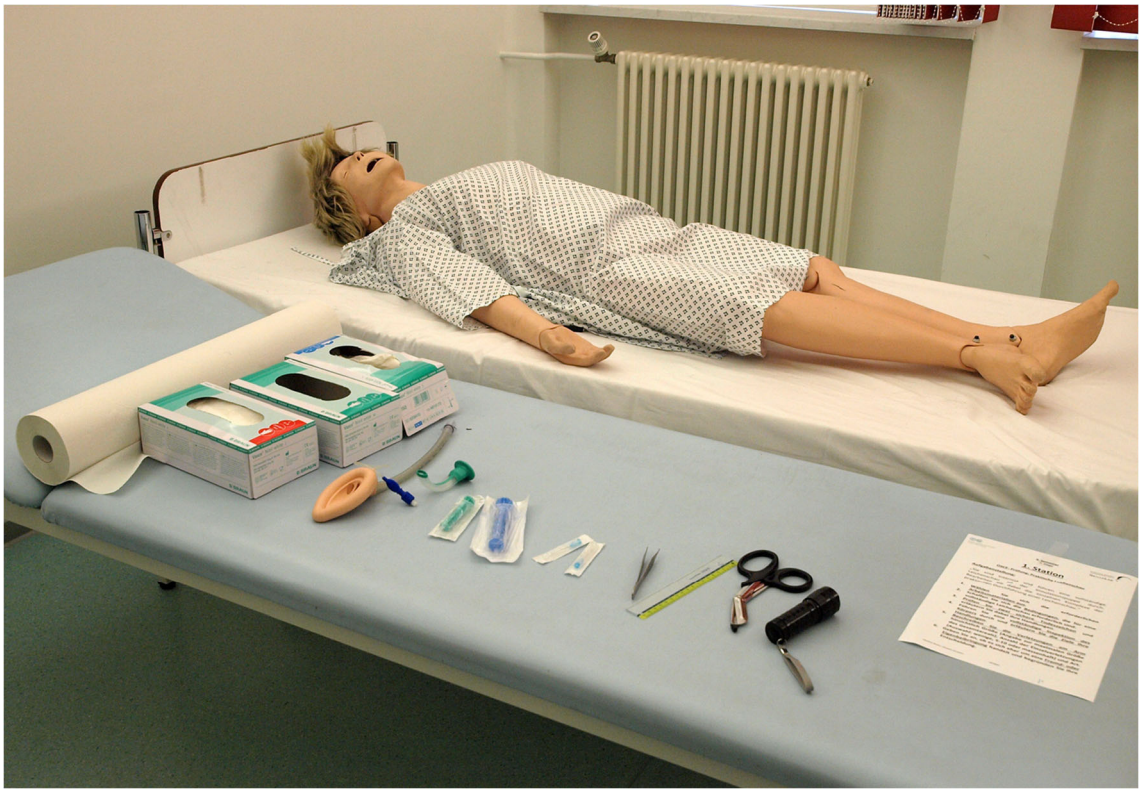


Fig. 1 Structure of the 'practical external post-mortem examination' station with a simulation doll

possible petechial haemorrhages). The students then have to describe and be able to classify an injury applied to the simulation doll using a thin adhesive film. The students are taught about the forensic evaluation and documentation of injuries previously in another seminar unit.

In the second station (death certificate), an original death certificate including the identification and estimation of the time of death has to be filled in. This tests the knowledge, skills and abilities on which the students received training in the SkillsLab station and during the optional e-learning. In the OSCE test, the students each receive a case vignette, on the basis of which they then fill in the original death certificate as they did in the SkillsLab station. In principle, the students are in the role of a clinical physician during the examination. Since on the one hand, all students should complete the entire scope of the examination, and on the other hand, various types of death should be represented among the cases; the students are asked to continue the examination even where there are signs of a possible homicide (Fig. 2).

A standardised half-hour briefing of the trained examiners is carried out before the test. A test time of 8 min is available for the two forensic medicine OSCE stations, then there is a short session (1 min) of feedback provided by the examiner and the students then switch to the next station (1 min). The performance is assessed by means of a structured checklist. The approach is a summative evaluation. A maximum of 30 points is achievable at both stations. Marks are allocated in accordance with the German Medical Licensure Act. At the first station (practical external post-mortem examination), three different test scenarios in the three different rotations were used with various injuries (laceration/contused wound on the top of the head, laceration/contused wound on the back of the head and strangulation marks on the neck). At the second station (death certificate), three different case vignettes were also used (natural death, non-natural death and unexplained death).

Statistical procedures

At first, distribution of test results will be examined using descriptive statistics and Kolmogorov-Smirnov test for evaluation of deviation of the results from a hypothetical normal distribution. Additionally, percentage of students obtaining full marks is calculated for every single item. In a next step, double ratings from two examiners ('death certificate' only) were used for estimation of test objectivity by calculation of intraclass correlation two-way mixed for average measures for the total scale and two-way mixed for single measures for every item [21]. ICC was classified good when over 0.6, and excellent when above 0.75 [22]. Reliability was evaluated using Cronbach's alpha using the classification by [23], rating internal consistencies above 0.7 to be acceptable, above 0.8 as good and above 0.9 as excellent. Additionally, the Spearman rank correlations between each item and the total score (part

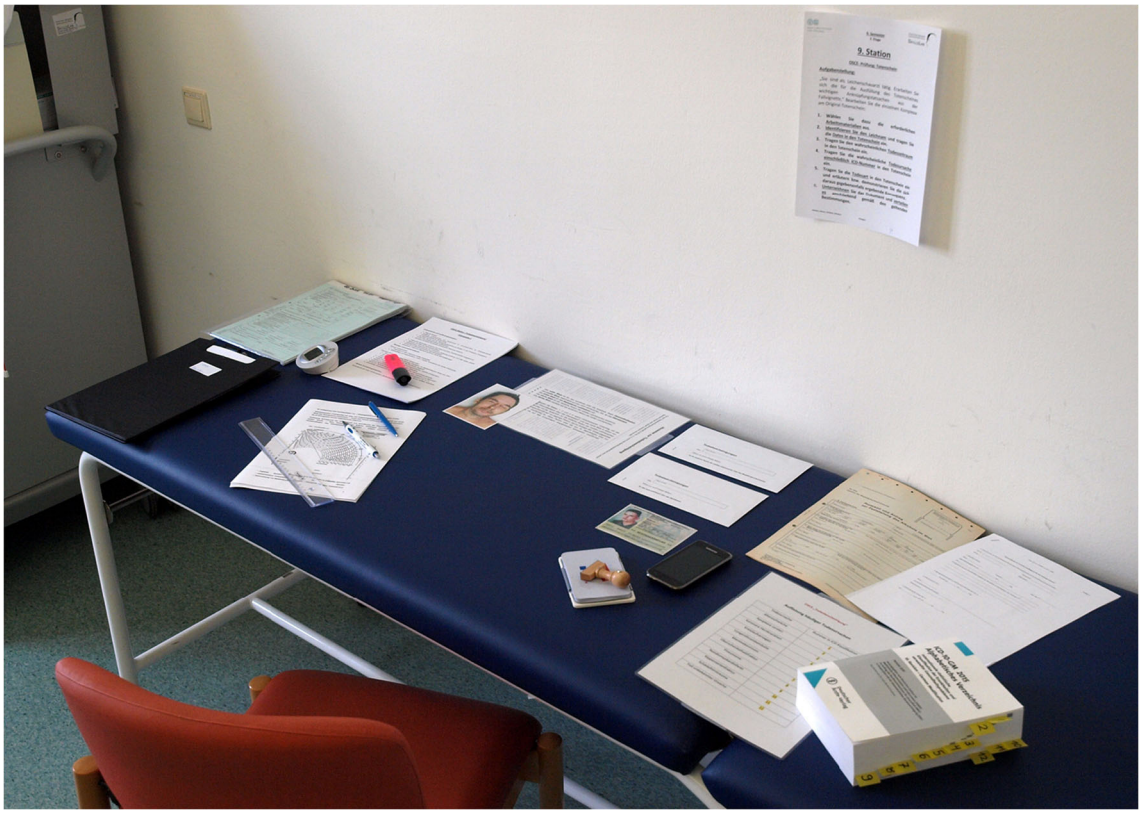


Fig. 2 Structure of the 'death certificate' station

whole corrected) are shown. Stability (retest reliability) of results was evaluated by correlation (Pearson) between repeated test results for an 8-month interval ('death certificate' only). Coefficients over 0.8 are considered to be good and above 0.9 to be high. Finally, both examiners gave a written feedback for the stations in order to check for systematic difficulties in the examination procedure.

Results

At the first station (practical external post-mortem examination), more than two thirds of the students (69.5%) achieved a good or very good test result, and only 4.7% of the students did not achieve the number of points necessary to pass (Table 1). In sum, test scores had a mean of 21.86 (SD = 3.27) with min = 9 and max = 25 points. Distribution of scores was skewed left and significantly diverged from normal (K-S-Z = 2.06; $p > 0.001$). Cronbach's alpha for the station 'practical external post-mortem examination' station showed to be low with alpha = 0.680. Part whole corrected correlation (see Table 2) of some items is below three, indicating low discriminatory power for these items. Especially, items 5 (establishing sufficient lighting conditions) and 8 (inspection of the part of the scalp with hair on it) show insufficient correlation coefficients and if selected would increase alpha to 70.

The detailed evaluation of the individual items (Table 2) showed that in the collating of the work materials (not including the ruler to measure the wound), the test of rigour mortis, the establishment of sufficient lighting conditions, the inspection of the conjunctiva, the oral cavity and the back and the palpation of the arms and legs, the maximum number of points was achieved by at least 90% of students. For the other items, this percentage was between 80.7 and 87.9%. Regarding the neck inspection, only 75% of students achieved full marks. In the two test scenarios in which there were no strangulation marks to assess, this percentage was only between 50.0 and 62.3%.

Table 1 Overall result for the 'practical external post-mortem examination' station ($n = 148$)

Grade	Number of points	Absolute number	Percentage
1	27–30	69	46.6
2	24–26	34	22.9
3	21–23	20	13.5
4	18–20	18	12.2
5	0–17	7	4.7

Table 2 Point rating and detailed results (not including injuries) at the 'practical external post-mortem examination' station

Work requirement	Point rating	Percentage of students obtaining full marks
Putting together work materials (tweezers)	1	90.5
Putting together work materials (lamp)	1	90.5
Putting together work materials (ruler)	1	81.8
Putting on gloves	1	87.9
Establishing sufficient lighting conditions	1	94.6
Checking the lividity (turning and pressing)	2	86.1
Checking the rigour mortis (at least two joints)	2	91.2
Inspection of the part of the scalp with hair on it	2	87.8
Inspection of the conjunctiva	2	91.2
Inspection of the oral cavity	2	92.9
Inspection of the neck	2	75.0
Testing the mobility of the chest	2	80.7
Inspection of the anal and genital region	2	85.5
Palpating and moving the arms and legs	2	91.2
Inspection of the back	2	92.2
Failure to remove clothes	−5	98.7

When evaluating injuries (Table 3), significant deficiencies were identified both in the description of the size, shape and type of injuries and in the classification of the wounds and the justification for this. For example, the laceration/contusion wound on the top of the head was only able to be classified as an impact injury by 26.3% of students while the wound on the back of the head was classified by 54.2% of students as a fall injury. A high percentage of correct answers for both the description and the classification were only able to be identified in the case of the strangulation marks on the neck, between 91.1 and 100%.

At the second station (death certificate), 81.7% of students achieved a good or very good result, with just 2.0% of students failing to achieve the required number of points (Table 4). Test scores had a mean of 25.32 (SD = 2.89) with min = 17 and max = 30 points. Again, distribution of scores was skewed left and significantly diverged from normal (K-S-Z = 2.22; $p > 0.001$).

For $n = 27$, students parallel ratings from two examiners were available. Intraclass correlation was excellent for the total scale (ICC = 0.99). For the single items, intraclass correlation reached from good ICC = 0.71 (item 5) to mostly excellent ICC = 1.00 (items 1, 3, 9, 10, 11, 17, 19, 22).

The reliability coefficient of alpha = 0.757 for this station is between the thresholds of 'acceptable' and 'good'. Part whole corrected correlation (see Table 5) of some items is below 0.3, indicating low discriminatory power for these items. Item 3 (putting together work materials [ruler]) showed a zero correlation, very low correlations were found for item 2 (putting together work materials [Hennsge's nomogram]), 8 (comparison of the data on the case vignette/identity card with the death certificate) and 22 (failure to call the police or the GP). The detailed evaluation of the individual items (Table 5) showed that the selection of the work materials was completed successfully by more than 90%, with the exception of the selection of the telephone. The tasks of identification, estimation of the time of death using Hennsge's nomogram, the indication of the cause of death and the classification of the type of death were completed by 88.5 and 97.9% of students with full marks. The necessary calls to the police (to report a non-natural or unexplained death) and the GP (to obtain a patient history in the event of a natural death) were also only made by a small number of students. The allocation of the correct ICD number and the correct distribution of the copies of the death certificate also showed lower completion rates (82.8 and 80.4%). There were only significant deficiencies (58.1% positive point rating) for the task of stamping all copies of the death certificate.

$N = 16$ randomly chosen students were asked to repeat the examination 'death certificate' 8 months after the first assessment. Correlation between the two assessment points was $r = 0.632$ ($p = 0.009$). This comparison was only made for the second station.

Table 3 Point rating and detailed results of the injuries at the 'practical external post-mortem examination' station

	Point rating	Percentage of the students obtaining full marks		
		Impact injury to the head	Fall injury to the head	Strangulation marks on the neck
Description of the size of the injury	1	63.2	71.4	91.1
Description of the shape of the injury	1	68.4	40.0	92.9
Description of the type of injury	1	71.9	80.0	100
Classification of the injury	1	56	69	100
Justification for the classification of the injury	1	26.3	54.2	100

Table 4 Overall result for the 'death certificate' station (n = 148)

Grade	Number of points	Absolute number	Percentage
1	27–30	85	57.4
2	24–26	36	24.3
3	21–23	14	9.5
4	18–20	10	6.8
5	0–17	3	2

Examiners' feedbacks showed as the following critical evaluation:

- time period measured in the 'death certificate' station too narrow
- some variance in the difficulty interpreting the injuries
- difficulties in the application of the clothing and the wigs
- use of distracting elements that were not necessarily incorrect

The following were listed as positive feedback points:

- Significance of sufficient teaching and testing of the subject of external post-mortem examination
- Understandability and transparency of the checklists
- Organisational structure of the stations
- Selection of realistic case scenarios

Discussion

When introducing new learning and teaching methods in the field of medical external post-mortem examination, the focus is on the establishment of e-learning modules. In addition to commercially available, web-based training opportunities [17] and internally designed models [16, 18], there are currently only individual reports of corresponding testing concepts for the additional learning and teaching methods in the field of forensic medicine, such as the description of objective structured practical examination (OSPE) test formats. Pramod Kumar et al. [24] report on an OSPE with ten stations in which various skills and abilities such as the determination of the cause of death is tested over a period of 5 min in each case. In this investigation from India, the focus was on the student feedback about this type of test, with the precise content of the individual stations and the results of the tests not being described in greater detail. A report on the experiences with an OSPE in forensic medicine in Nepal [25] also showed similar limitations. In contrast to this, the objective structured clinical

Table 5 Point rating and detailed results for the 'death certificate' station

Work requirement	Point rating	Percentage of students obtaining full marks
Putting together work materials (identity card)	1	97.3
Putting together work materials (Hennsge's nomogram)	1	98.6
Putting together work materials (ruler/writing utensil)	1	100
Putting together work materials (ICD classifications)	1	90.5
Putting together work materials (telephone)	1	77
Putting together work materials (stamp)	1	93.2
Comparison of the image on the case vignette with the image on the identity card	2	88.5
Comparison of the data on the case vignette/identity card with the death certificate	2	89.8
Correct transfer of temperatures into the nomogram	2	99.4
Correct entry of the straight connecting lines into the nomogram	1	95.3
Taking into account the body weight and reading the average time of death from the nomogram	2	95.9
Taking into account the 95% tolerance in the time of death interval	1	93.4
Correct entry of the time of death interval onto the death certificate	2	93.2
Correct likely cause of death	1	95.9
Use of the correct field for the cause of death	1	97.9
Research of the correct ICD number and entry	2	82.8
Entry of the correct type of death onto the death certificate	2	96.9
Entry of the date, time, and signature of the person carrying out the external post-mortem examination	2	88.1
Use of the correct field for the signature	1	95.2
Stamping all copies	1	58.1
Correct distribution of the copies	2	80.4
Failure to call the police (two cases) or the GP (one case)	−5	96.6

examination (OSCE) procedure has yet to be used to test external post-mortem examination skills. A test format of this type, however, enables the procedural skills and abilities learned to be assessed directly [19]. This approach results in a higher level in the learning pyramid of Miller [26] to be achieved and a longer-term learning effect than is possible with a written test [27]. In the present investigation, we report for the first time on the establishment and test results of two OSCE stations on external post-mortem examination.

Several organisational and logistic challenges had to be overcome in the design of the stations. For example, it was necessary to ensure that the passing on of detailed information by the students to later rotations was largely avoided between the individual rotations [19]. This is why three different case vignettes were developed for the 'death certificate' station, and three different injuries were developed for the 'practical external post-mortem examination' station. Two test runs also showed further time-related and structural problems. For the 'death certificate' station, it became apparent that the time of 8 min was too short for the complex requirements. Shortening and summarization of the assignments at the station were able to save time. It also transpired that the recommended standardised half-hour briefing session for the examiners immediately before the test [28] represented a significant challenge for examiners not familiar with the subject for the 'death certificate' station due to the high level of complexity (among other things, the estimation of the time of death using Hennsge's nomogram). In the future, where it is possible, this examination should only be conducted by forensically trained doctors or medics who already have experience of this station. In individual cases, however, the use of as yet inexperienced examiners may still be necessary. In these cases, the examiners receive the case vignettes, the task and the checklists 5 days in advance and are recommended to solve at least one case themselves. In addition to this, measures are taken to ensure that the instructions provided on the day of the examination are given by an experienced doctor.

The realisation and evaluation of the OSCE tests indicated that these methods can be a suitable format for the assessment of competencies in post-mortem examinations. This applies to both the knowledge, skills and abilities taught in the small group classes (corresponding test station 'practical external post-mortem examination') and in the SkillsLab or e-learning (corresponding test station 'death certificate').

Psychometrically, both stations show means and standard deviations (as well as distribution of test scores) that are comparable to similar examinations [29]. Means are high, and distribution is skewed left depicting high performance and motivation for achievement of medical students. Due to highly standardised implementation of the examination and recording of the results, objectivity was nearly perfect. Internal consistency of the 'practical external post-mortem examination' is comparatively low, for 'death certificate,' it is acceptable. However, demanding examinations for a complex medical topic to be fully internal consistent can be discussed critically; for it is necessary to reproduce a range of practical skills within the examination rather than to retrieve homogenous and interdependent traits as to be expected in written tests on a certain topic. Furthermore, it is to notice that considering the overall high rates of grad 1 and 2, students and hence the reduced variance acceptable internal consistencies are satisfying. Part whole corrected correlations of the single items with their test scores showed for some items low discriminatory power below 0.3 [30]. Further development of the OSCE should consider these results and match teaching and examination content. Stability of the results over an interval of 8 months was still significant but fairly low. However, practical knowledge on how to solve medical tasks cannot be assumed to be a stable trait. Different influences affect stability of examination results. Students can remember single items of the examination or can get used to the examination procedure. On the other hand, transfer of examination topic into a daily work can lead to alteration of performance.

When comparing the overall results of the two test stations, it is of course necessary to take into account that two different areas within the subject of external post-mortem examination are being addressed. It was possible to determine, however, that in a predominantly identical test collective, the proportion of good and very good test performances at the 'death certificate' station (81.7%) was significantly higher than in the 'practical external post-mortem examination' station at 68.4%. Correspondingly, the proportion of students who did not pass the test was also lower, at 2.0% compared to 5.2%. In the critical discussion of the differences in the overall result of the two stations, however, it should be noted that knowledge, skills and abilities were included in the description and classification of injuries in the 'practical external post-mortem examination' station that had been taught in other course units. However, these were practical exercises on photos and preparations of injuries.

In addition to the evaluation of the overall results, a detailed consideration of the individual items can contribute to identifying the strengths and weaknesses of the corresponding course units and to correcting specific deficiencies. The positive element to be highlighted is the fact that at the 'practical external post-mortem examination' station at least 90% of students achieved full marks for more than half of the items (nine out of 16 items). In contrast to this, the test results for the neck inspection item show that this localisation requires a greater level of attention during the small group classes with cadavers. There were also some high failure rates when describing and classifying the various head injuries. In contrast to this, there were hardly any deficiencies in the group who had to assess strangulation marks on the neck. This could indicate that this group had an advantage over the other groups due to the lack of possible competing interpretations. It may

be possible that this group also benefited in the point rating as the presence of marks on the neck meant that the item of inspection of the neck was almost certain to be positive. The different level of difficulty in the task between the various rotations received critical comments from the examiners in the evaluation and was confirmed in the result of the comparison of mean values. Differences of this type must be balanced out in the planned modification of the station, but observations of this kind can only be identified during the practical implementation of a test. The test results for the description and classification of the injuries indicate that the teaching of this knowledge and these skills and abilities must be improved during practical training. When evaluating the results, it was found that some students passed the examination despite making serious errors. These included a failure to remove the clothes from the body and failure to inform the police where there was evidence of an unexplained or unnatural death. As the station is developed, the plan is to change the point system such that it will no longer be possible to pass the examination if these criteria are not met. The detailed evaluation of the 'death certificate' station showed the positive aspect that at least 90% of students achieved full marks in more than two thirds of the items (15 out of 22). This included the items of estimation of time of death, cause of death, type of death and informing the police. Only 3.4% of students failed to call the police. From experience, these items present the greatest challenge when completing a death certificate. In the core competence of identification of the patient, the percentage of students receiving full marks was also almost 90%. In contrast to this, high failure rates were observed in the research of the correct ICD number and in stamping and distributing the copies of the death certificate. In terms of the possible legal consequences, these deficiencies should be viewed as secondary to the other items. Nevertheless, efforts should be made to improve this situation. It is most likely that this could be achieved by taking these aspects into account when training student tutors for the SkillsLab station.

Overall, the stations showed satisfactory internal consistency. However, this was able to be further increased at the 'practical external post-mortem examination' station by a further homogenisation of the characteristics of the injuries available. The examiners' evaluation showed both the strengths of the test concept of both OSCE stations and the weaknesses with corresponding potential areas for improvement. Without doubt, this includes the need which has already been set out for a change to the description and classification of the injuries. Furthermore, time management at the 'death certificate' station was criticised, although a change was made after the test runs. In the practical implementation of the test, however, it transpired that a test time of 9 min was still too short for this complex OSCE station. On the one hand, this deficiency could be remedied relatively easily by increasing the test time to 10 or 11 min. There are various recommendations for the duration of OSCE stations ranging between 5 min and 15 min [19, 31, 32]. In terms of the overall concept of the OSCE test, however, an isolated increase in test time at an individual station is difficult to implement. A possible solution when modifying the test station could be not estimating the time of death using Henssge's nomogram method as this examination should actually only be carried out by forensic specialists. A significantly quicker and more modern calculation of the estimated time of death based on Henssge's nomogram method could however be integrated into the station in the form of one of the apps and websites (e.g. www.swisswuff.ch) which are now available and in some cases freely accessible. However, the corresponding learning method (SkillsLab station, e-learning) would then have to be changed too. The points of criticism in terms of the selection of distracting items, the clothing and the wigs, could be corrected by means of relatively simple practical changes to the equipment in the stations. The test statistics also showed significant differences in the evaluations of the stations depending on the examiner. This was able to be identified in other investigations too [33]. This shows the need for extensive and more targeted training of the examiners in order to achieve a homogenisation in the test results in the coming years.

In the positive points of the feedback, the non-forensic doctors confirmed the urgent need for practically oriented learning and teaching methods on external post-mortem examination. The good organisational structure and similarity of the stations to practical reality and the clarity and transparency of the checklists were also highlighted [32].

In the overall evaluation, it was possible to determine that through a combination of small group classes, SkillsLab station and e-learning modules comprehensive skills for an external post-mortem examination could sufficiently be taught. OSCE stations are a suitable method to test the achievement of these learning objectives. It is also possible to assume that teaching and testing formats of this type achieve more sustainable learning effect than conventional formats [27]. Of course the establishment, modification and continuation of teaching and testing formats of this kind are associated with a significant degree of effort. Moreover, the establishment of these teaching and testing formats requires adaptation to legal regulations on post-mortem examinations that sometimes vary widely by state. In addition, it is not possible to simulate all conditions that may influence testing during a real post-mortem with the OSCE stations (e.g. external disruptive factors such as relatives or police officials or even unfavourable environmental conditions such as cold). However, the advantages of this testing format include standardisation of the test cases. Also, time and organisational expenses associated with implementation can be significantly reduced compared to testing in a real post-mortem situation. This can make an important contribution to improving the quality of external post-mortem examination. In order to actually achieve this

objective, these learning and testing methods should be used not only in medical education but also in the postgraduate professional education of doctors.

References

1. Anders S, Fischer-Bruegge D, Fabian M, Raupach T, Petersen-Ewert C, Harendza S (2011) Teaching post-mortem external examination in undergraduate medical education—the formal and the informal curriculum. Forensic Sci Int 210(1–3):87–90
2. Ermenc B (1999) Discrepancies between clinical and post-mortem diagnoses of causes of death. Med Sci Law 39(4):287–292
3. Lahti RA, Penttilä A (2001) The validity of death certificates: routine validation of death certification and its effects on mortality statistics. Forensic Sci Int 115(1–2):15–32
4. Karger B, Lorin de la Grandmaison G, Bajanowski T, Brinkmann B (2004) Analysis of 155 consecutive forensic exhumations with emphasis on undetected homicides. Int J Legal Med 118(2):90–94
5. Parai JL, Kreiger N, Tomlinson G, Adlaf EM (2006) The validity of the certification of manner of death by Ontario coroners. Ann Epidemiol 16(11):805–811
6. Ravakhah K (2006) Death certificates are not reliable: revivification of the external post-mortem examination. South Med J 99(7):728–733
7. Winkel BG, Holst AG, Theilade J, Kristensen IB, Thomsen JL, Hougen HP, Bundgaard H, Svendsen JH, Haunsø S, Tfelt-Hansen J (2012) Differences in investigations of sudden unexpected deaths in young people in a nationwide setting. Int J Legal Med 126(2): 223–229
8. Minelli N, Marchetti D (2013) Discrepancies in death certificates, public health registries, and judicial determinations in Italy. J Forensic Sci 58(3):705–710
9. Brinkmann B, Banaschak S, Bratzke H, Cremer U, Drese G, Erfurt C, Giebe W, Lang C, Lange E, Peschel O, Philipp KP, Püschel K, Rieße M, Tutsch-Bauer E, Vock R, Du Chesne A (1997) Fehlleistungen bei der Leichenschau in der Bundesrepublik Deutschland. Arch Kriminol 199(1–12):65–74
10. Franchitto N, Rougé D (2010) Appraisal by year six French medical students of the teaching of forensic medicine and health law. Med Sci Law 50(4):205–210
11. Anders S, Mueller M, Sperhake JP, Petersen-Ewert C, Schiekirka S, Raupach T (2014) External post-mortem examination in undergraduate medical education—what do students really learn? Int J Legal Med 128(6):1031–1038
12. Martínez-Jarreta B, Monsó E, Gascón S, Casalod Y, Abecia E, Kolb S, Reichert J, Radon K (2009) NetWoRM team. E-learning strategies in occupational legal medicine based on problem solving through "CASUS" system. Leg med (Tokyo) 11(Suppl 1):S313–S314
13. Albrecht UV, Folta-Schoofs K, Behrends M, von Jan U (2013) Effects of mobile augmented reality learning compared to textbook learning on medical students: randomized controlled pilot study. J med Internet Res 15(8):e182
14. Magalhães T, Dinis-Oliveira RJ, Santos A (2014) Teaching forensic medicine in the University of Porto. J Forensic Legal Med 25:45–48
15. Noone PH, Raj Sharma S, Khan F, Raviraj KG, Shobhana SS (2013) Use of role play in undergraduate teaching of ethics—an experience. J Forensic Legal Med 20(3):136–138
16. Feiser J, Bellmann D, Krämer T, Hohenberg G, Wendorf A, Wilske J (2009) Teaching legal medicine: Neukonzeption der Lehre im Fach Rechtsmedizin an der Universität des Saarlandes. GMS Medizinische Informatik, Biometrie und Epidemiologie 5(1):1–6
17. Schmeling A, Kellinghaus M, Becker JC, Schulz R, Schäfer A, Pfeiffer H (2011) A web-based e-learning programme for training external post-mortem examination in curricular medical education. Int J Legal Med 125(6):857–861
18. Heide S, Lessig R, Diers V, Rönsch M, Stoevesandt D (2016) Etablierung der Station „Leichenschau“ im SkillsLab und E-Learning. Rechtsmedizin 26 (2): 90–96
19. Nikendei C, Jünger J (2006) OSCE-praktische Tipps zur Implementierung einer klinisch-praktischen Prüfung. GMS Z Med Ausbild 23(3):Doc47
20. Henssge C (1988) Death time estimation in case work. I. The rectal temperature time of death nomogram. Forensic Sci Int 38:209–236
21. Wirtz M, Caspar F (2002) Beurteilerübereinstimmung und Beurteilerreliabilität. Hogrefe, Göttingen
22. Cicchetti D (1994) Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. Psychol Assess 6:284–290
23. George D, Mallery P (2002) SPSS for windows step by step: a simple guide and reference, 11.0 update. 4 ed. Allyn & Bacon, Boston
24. Pramod Kumar GN, Sentitoshi ND, Menezes RG, Kanchan T (2015) Student's perspectives on objective structured practical examination (OSPE) in forensic medicine—a report from India. J Forensic Legal Med 32:39–41
25. Menezes RG, Nayak VC, Binu VS, Kanchan T, Rao PP, Baral P, Lobo SW (2011) Objective structured practical examination (OSPE) in forensic medicine: students' point of view. J Forensic Legal Med 18(8):347–349
26. Miller GE (1990) The assessment of clinical skills/competence/performance. Acad Med 65:563–567
27. Prince KJ, Boshuizen HP, van der Vleuten CP, Scherpbier AJ (2005) Students' opinions about their preparation for clinical practice. Med Educ 39(7):704–712
28. Preusche I, Schmidts M, Wagner-Menghin M (2012) Twelve tips for designing and implementing a structured rater training in OSCEs. Med Teach 34(5):368–372
29. Al-Osail AM, Al-Sheikh MH, Al-Osail EM, Al-Ghamdi MA, Al-Hawas AM, Al-Bahussain AS, Al-Dajani AA (2015) Is Cronbach's alpha sufficient for assessing the reliability of the OSCE for an internal medicine course? Bio Med Central Research Notes 8:582
30. Fisseni HJ (2004) Lehrbuch der psychologischen Diagnostik. Hogrefe, Göttingen
31. Swanson DB, Norman GR, Linn RL (1995) Performance-based assessment: lessons learnt from the health professions. Educ Res 24:5–11
32. Chan J, Humphrey-Murto S, Pugh DM, Su C, Wood T (2014) The objective structured clinical examination: can physician-examiners participate from a distance? Med Educ 48(4):441–450
33. Park SE, Kim A, Kristiansen J, Karimbux NY (2015) The influence of examiner type on dental students' OSCE scores. J Dent Educ 79(1):89–94

Journal of Forensic and Legal Medicine 55 (2018) 33–38

Contents lists available at ScienceDirect

Journal of Forensic and Legal Medicine

journal homepage: www.elsevier.com/locate/yjflm

Objective structured clinical examination "Death Certificate" station – Computer-based versus conventional exam format

A. Biolik[a], S. Heide[b,*], R. Lessig[b], V. Hachmann[b], D. Stoevesandt[a], J. Kellner[a], C. Jäschke[a], S. Watzke[c]

[a] Dorothea Erxleben Learning Centre, Medical Faculty of the Martin Luther University of Halle-Wittenberg, Halle, Germany
[b] Institute for Forensic Medicine, Martin Luther University of Halle-Wittenberg, Franzosenweg 1, 06112, Halle (Saale), Germany
[c] Clinic and Polyclinic of Psychiatry, Psychotherapy and Psychosomatic Medicine, Halle University Hospital, Halle, Germany

ARTICLE INFO

Keywords:
Computer-based OSCE
Death certificate
Learning and assessment in forensic medicine

ABSTRACT

One option for improving the quality of medical post mortem examinations is through intensified training of medical students, especially in countries where such a requirement exists regardless of the area of specialisation. For this reason, new teaching and learning methods on this topic have recently been introduced. These new approaches include e-learning modules or SkillsLab stations; one way to objectify the resultant learning outcomes is by means of the OSCE process. However, despite offering several advantages, this examination format also requires considerable resources, in particular in regards to medical examiners. For this reason, many clinical disciplines have already implemented computer-based OSCE examination formats. This study investigates whether the conventional exam format for the OSCE forensic "Death Certificate" station could be replaced with a computer-based approach in future.

For this study, 123 students completed the OSCE "Death Certificate" station, using both a computer-based and conventional format, half starting with the Computer the other starting with the conventional approach in their OSCE rotation. Assignment of examination cases was random. The examination results for the two stations were compared and both overall results and the individual items of the exam checklist were analysed by means of inferential statistics.

Following statistical analysis of examination cases of varying difficulty levels and correction of the repeated measures effect, the results of both examination formats appear to be comparable. Thus, in the descriptive item analysis, while there were some significant differences between the computer-based and conventional OSCE stations, these differences were not reflected in the overall results after a correction factor was applied (e.g. point deductions for assistance from the medical examiner was possible only at the conventional station).

Thus, we demonstrate that the computer-based OSCE "Death Certificate" station is a cost-efficient and standardised format for examination that yields results comparable to those from a conventional format exam. Moreover, the examination results also indicate the need to optimize both the test itself (adjusting the degree of difficulty of the case vignettes) and the corresponding instructional and learning methods (including, for example, the use of computer programmes to complete the death certificate in small group formats in the SkillsLab).

1. Introduction

The quality of medical post mortem examinations is often the subject of critical discussion, in particular due to recurrent serious errors overlooked homicides.[1–6] One approach to solving this issue is to improve training of medical students, especially in countries where there is a requirement for medical post mortems regardless of the area of specialisation.[7] For this reason, a number of new teaching methods have recently been introduced in the area of medical post mortems. Examples of these new approaches include e-learning modules,[8,9] SkillsLab stations,[10] blended learning concepts[11] or the establishment of training centres using donor bodies.[12] However, outcomes of these teaching methods have also to be objectified in terms of corresponding examination formats. For example, both acquisition of knowledge and practical skills can be evaluated using the OSPE (Objective Structured Practical Examination) or OSCE methods. Nevertheless, to date there

* Corresponding author.
E-mail address: steffen.heide@uk-halle.de (S. Heide).

https://doi.org/10.1016/j.jflm.2018.02.010
Received 8 November 2017; Received in revised form 29 January 2018; Accepted 8 February 2018
Available online 10 February 2018
1752-928X/

are only single reports on the use of these examination formats in the field of forensic medicine,[13–15] despite the fact that the OSCE examination format in particular has already been applied for many years in many clinical disciplines. Recently, two OSCE stations for post mortems ("Death Certificate" and "Practical Post Mortems") were introduced in Halle/Saale (Germany); these stations allow the evaluation of the corresponding teaching methods (SkillsLab station, e-Learning module and small group instruction).[15] However, despite a number of advantages, the OSCE examination format also requires a high level or organisational effort and considerable financial resources in terms of medical examiners, personnel and materials.[16] For this reason, several clinical disciplines have already introduced computer-based OSCE examinations, for which test results are comparable but expenses for personal and materials are significantly lower.[17,18] This therefore raises the question whether the forensic medicine OSCE "Death Certificate" station could also in future be replaced with a computer-based OSCE station. Hence, this study investigates whether comparable results can be achieved using a computer-based approach as compared to the conventional exam format that has been used to date.

2. Methods

2.1. The conventional OSCE "Death Certificate" exam station

This station tests the skills and knowledge that have been acquired by students in a corresponding previously completed mandatory SkillsLab station and optional e-learning module.

The design of the examination involves a detailed definition of tasks and four different case vignettes. These vignettes vary in circumstances of body discovery, anamnesis and external post mortem report, as well as in data for the purpose of identification and estimation of time of death. Cases one, three and four describe situation that point out third-party responsibility and thus, unnatural or undetermined conditions of death. Case two only included information that indicated a natural cause of death.

On the basis of this information, students are then asked to complete an original death certificate. Correct identification requires that post mortem photographs are compared with an identity card. As a confounding factor, students are given a second identity card that differs completely from the correct card with the exception of the last name. Time of death can be estimated using body weight, rectal and environmental temperatures and by taking into account a correction factor using a computer tool designed based on Henssge's method.[19] The ICD classification required in Germany for cause of death is facilitated by providing students with a list of common causes of death and the associated ICD number. In one of the four cases (case 2), which involves a natural cause of death, correct solution of the problem requires a simulated call to a general practitioner. Following this call, further information on anamnesis were provided. The other three cases, which involve either unnatural or undetermined natures of death, necessitate a simulated call to the police in order to clarify a possible homicide.

At the end of the examination, students must sign the document in accordance with legal provisions, stamp all copies and arrange them properly. The students' results are evaluated by a qualified forensic medical examiner using an individualised checklist.

2.2. The computer-based OSCE "Death Certificate" exam station

Equivalent to the conventional OSCE exam format, at this station four case vignettes are used to complete death certificates on a computer (Fig. 1). A student tutor trained in the use of the computer programme assisted the students taking the exam for the purpose of technical support. However, the tutor has no knowledge of the checklist relevant to the assessment, so that there is no opportunity for unwanted support. The program has been designed with all materials and resources (ICD-10 list with the common causes of death, calculation of time of death, post mortem photograph and identity card) are indicated as related links on a computer screen. The simulated calls to the police or a general practitioner are conducted via suitable buttons that are activated by clicking. "Calling" the general practitioner provides additional information about the case medical history. The doctor's stamp and required signature have been programmed as movable digital features that can be moved to the precise position on the death certificate by mouse. Because all copies of the death certificate have been reproduced to be accurate in every detail, a stamp is also required on each page. Ultimately, this can be accomplished by clicking the mouse on each cover page. The examination results are evaluated automatically by means of a checklist that is analogous to the conventional station.

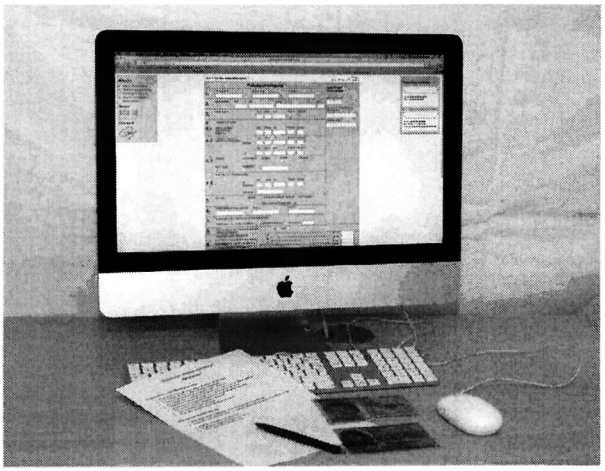


Fig. 1. Setup of the computer-based OSCE "Death Certificate" station.

2.3. The sample group

The lessons on the forensics topic of post mortem examinations, which include lectures, small group instruction using donor bodies, a SkillsLab station and the e-learning module, took place in the 8th semester and the OSCE was to be completed in the subsequent 9th semester. The forensics stations were integrated within the interdisciplinary OSCE for emergency medicine. In this format, students rotate through a course of 11 stations in which skills such as paediatric resuscitation or airway management techniques are assessed. A total of 123 students completed both the computer-based and the conventional format of the OSCE "Death Certificate" station. Assignment of students to the various examination cases, which differed in terms of condition of the body upon discovery, nature and time of death, was random. Every student was examined with one computerized and one conventional OSCE. Approximately half of the sample completed the conventional OSCE station first; the other half completed the computer-based OSCE station first. In each individual examination course, two different cases (out of four case vignettes) were examined. Frequency of every case vignette within the examinations was approximatively equal – as well using the conventional and the computer-based examination format.

Similarly, allocation to the examination sequence was also random, although an approximately equal distribution of students was made (to either conventional format first or computer-based format first). Moreover, an effort was made to maintain a constant interval between the conventional and computer-based OSCE station within the examination rotation. Each examination was limited to 9 min. Subsequent feedback was not obtained for either examination in order to minimise any learning effects.

2.4. Statistical analysis

The results were analysed using IBM SPSS 20.0. The examination results were first tested for effects of any potentially confounding factors (repetition of the exam, level of difficulty of the four case vignettes) using analyses of variance. Both the overall results and the individual items were compared using mixed linear models (compound symmetry) that controlled for these confounding factors. The reliability of both examination formats was tested using Cronbach's alpha, in which classification according to George and Mallery[20] assigns internal consistency as acceptable for a value greater than 0.7, good for a value greater than 0.8 and excellent for a value greater than 0.9. In correlation of individual items with the (corrected) overall point score values > 0.3 were considered good, while items with correlations < 0.1 could not appropriately differentiate between either "good" or "poor" exam results and consequently required review.[21]

3. Results

As a first step, the examination results were analysed for differences between the four case vignettes that were presented. First, all rotations of the examination (conventional and computer-based OSCE "Death Certificate" station for all 123 students) were analysed, regardless of examination sequence or format. Hence, there were 246 examination results. This test revealed significant differences in the overall point total (out of a maximum possible 30 points). However, variances between cases were significantly different (Levene-Test). Thus, results were compared using Brown-Forsythe-Test for unequal variances.

Post hoc analyses revealed that case vignettes 1 and 3 produced better results than cases 2 and 4 (Table 1).

A second step tested for an effect due to repetition of the exam. The randomly assigned sequence of exam formats was approximately equally distributed between first or second examination. N = 58 students completed the conventional OSCE station in the first rotation and 65 students completed the computer-based OSCE station first (χ^2[df = 1] = 0.797; p = 0.373). As expected, the exam results differed significantly between exam rotations (univariate analysis of variance for repeated testing). Independent of the exam format, the first exam yielded in an average of 22.67 points (SD = 5.94), whereas the second exam result averaged 24.79 points (SD = 5.16) (F[df = 1] = 8.865; p = 0.003). Because of these significant differences in exam results both among the four different case vignettes and the significant effect of repeating the exam, these were considered as co-factors in the subsequent analyses.

Controlling statistically for exam sequence and case vignette, a mixed linear model (compound symmetry) produced estimated marginal means for the overall exam results of M = 24.03 (SE = 0.54) for the conventional OSCE station format and M = 23.01 (SE = 0.58) for the computer-based OSCE station format. This nominal difference was not statistically significant (F[df = 1] = 1.45; p = 0.230). The partial correlation between the exam results (conventional vs. computer based) controlled for case vignette and exam sequence was $r_p = 0.410$ (p < 0.001).

Overall, the internal consistencies were α = 0.513 for the conventional OSCE station and α = 0.813 for the computer-based OSCE station. However, alphas differed between cases. Whereas cases 2 (α = .785) and 4 (α = .681) showed satisfying internal consistencies, in cases 1 (α = .543) and 3 (α = .440) consistencies were low.

Finally, the descriptive item-characteristics for each task requirement were calculated for both exam formats and were also compared using inferential statistics (Table 2).

The analysis of the individual items indicated significant differences in corrected item-total correlation between then conventional and the computer-based OSCE. There were consistently higher values in the computer-based format; only items with little or no variation had correlations below 0.3. In contrast, several individual items showed weak corrected item-total correlations in the conventional OSCE format.

In terms of item means, results were higher in conventional OSCE. Comparison of the photographs for the purpose of identification (item 1), Entering the date, time and signature of the post mortem (item 10) and use of the correct field and stamping and arranging the copies correctly (Item11-14) showed significant differences between the two exam formats.

In contrast, items 3 and 4 (correctly transferring the temperatures and the body weight into the computer tool) were correctly executed by virtually all students in both exam formats, although there were strongly limited dispersion parameters resulting from these items. Item 19 involved point deductions (to a maximum of 5 points) for assistance by the medical examiner, which was available only at the conventional OSCE station and not for the computer-based format. This item was used as a correction factor in the consideration of this relevant difference between the exam formats. With the use of this correction factor, there were no additional significant differences in the overall result between the two exam formats, as already described with the marginal means.

4. Discussion

The implementation of the OSCE exam format demands not only a high level or organisational effort but also above all considerable resources in terms of medical personnel.[15,16] It is clear that the typical standardised half-hour of instruction for examiners immediately prior to the examination is a considerable challenge for the "Death Certificate" station due to the high degree of complexity for an examiner outside of his area of specialty.[15] Thus, the examination requires either significant time investment to train non-specialist examiners or the secondment of forensic specialists throughout a full two successive days of the examination. In addition, manual evaluation of the exam demands a considerable temporal investment and may also involve evaluation errors. Beyond the scope of this study, comparison of examination differences between examiners have to be addressed in conventional examination formats.

Finally, the conventional exam format requires an original death certificate for each student. These considerable expenses in terms of personnel, time and materials are also a challenge faced in other clinical disciplines and already several subject areas that are suitable have successfully implemented computer-based OSCE stations. For example, Chaudhary et al.[17] used this exam format to assess competencies in

Table 1
Examination results separated according to the four different case vignettes (n = 246).

	OSCE "Death Certificate" (n = 246); M ± SD				Inferential statistics	
	Case 1 (n = 53)	Case 2 (n = 53)	Case 3 (n = 70)	Case 4 (n = 70)	F; p Levene [df = 3; 242]; p	Post hoc[b]
Overall result	25.47 ± 4.48	21.68 ± 7.61	27.56 ± 2.82	22.94 ± 6.15	Levene = 20.65; p < 0.001F[df = 3, 158.8][a] = 13.78; p < 0.001	(1 & 3) > (2 & 4)

[a] Brown-Forsythe-Test.
[b] post hoc analysis with α = 0.05 (Bonferroni correction).

Table 2
Itemised task requirements and descriptive item parameters.

	Task requirement (max. points)	OSCE Death Certificate (n = 123)				F[df = 1][b]; p
		Corrected item-total correlation		M[a] ± SE		
		Conventional	Computer-based	Conventional	Computer-based	
Item 1	Match the case vignette picture with the identity card picture (2)	.344	.395	2.01 ± 0.07	1.41 ± 0.07	25.21; p < 0.001
Item 2	Transfer the data from the identity card to the death certificate (5)	.211	.273	4.91 ± 0.05	4.75 ± 0.05	5.54; p = 0.020
Item 3	Correctly transfer of the temperatures into the computer tool (2)	.000	.243	2.00 ± 0.01	1.99 ± 0.01	0.14; p = 0.713
Item 4	Correctly transfer of the body weight into the computer tool (1)	.000	.000	1.00 ± 0.00	1.00 ± 0.00	–
Item 5	Correctly input the time of death interval on the death certificate (4)	.146	.335	3.49 ± 0.12	3.14 ± 0.13	4.00; p = 0.047
Item 6	Correctly input the place of death (1)	.014	-.042	0.95 ± 0.02	0.95 ± 0.03	0.01; p = 0.939
Item 7	Correct probable cause of death (2)	.277	.547	1.58 ± 0.08	1.50 ± 0.09	0.33; p = 0.567
Item 8	Research and input correct ICD number (2)	.402	.544	1.38 ± 0.09	1.47 ± 0.09	0.44; p = 0.508
Item 9	Input the correct nature of death on the death certificate(3)	.192	.362	2.54 ± 0.10	2.58 ± 0.11	0.04; p = 0.843
Item10	Input the date, time and signature for the post mortem examination (3)	.061	.548	2.37 ± 0.08	2.76 ± 0.09	6.69; p = 0.011
Item 11	Use of the correct field for the signature (1)	-.077	.582	0.99 ± 0.04	0.76 ± 0.04	14.77; p < 0.001
Item 12	Stamp all copies (2)	.013	.460	1.90 ± 0.06	1.34 ± 0.07	27.04; p < 0.001
Item 13	Correctly arrange copies 1–3 (1)	-.059	.476	0.89 ± 0.04	0.71 ± 0.04	7.91; p = 0.006
Item 14	Correctly arrange the 4th copy (1)	.027	.428	0.93 ± 0.04	0.71 ± 0.04	12.41; p = 0.001
Item 15	Incorrectly call police (3 cases) or the general practitioner (1 case) (−5)[c]	.130	.493	−1.43 ± 0.23	−1.85 ± 0.24	1.42; p = 0.235
Item 16	Use of the "exact time of death" field (−2)[c]	.135	.291	−0.06 ± 0.03	0.00 ± 0.03	1.68; p = 0.197
Item 17	Incorrectly stamp in the "post mortem" field (−1)[c]	.045	.292	0.00 ± 0.03	−0.14 ± 0.03	11.19; p = 0.001
Item 18	Place the 5th copy in an envelope (−1)[c]	.000	.435	−0.04 ± 0.02	0.00 ± 0.02	2.55; p = 0.114
Item 19	Assistance from the examiner (−5)[c]	.168	–	−1.43 ± 0.22	–	–

[a] Estimated marginal mean corrected for exam sequence and case vignette.
[b] Mixed linear model (compound symmetry) with effects for case vignette (fixed) and exam sequence (random; not reported; see above) and exam format (fixed) F[df = 1]; p.
[c] Maximum possible point deductions.

dermatology and Holyfield et al.[18] reported on the introduction of computer-assisted OSCEs to evaluate knowledge in the field of dentistry. Both studies described that this exam format represented a reliable and resource-efficient alternative to the conventional OSCE format that produced comparable exam results at lower costs. Based on these results, the question arose as to whether this exam format could also be viable alternative in forensic medicine. The first challenge was to determine if the subject area and the nature of the OSCE exam station are appropriate for this exam format. First, this was assessed for both established forensic OSCE stations, "Practical Post Mortems" and "Death Certificate".[15] For the "Practical Post Mortems" station, competencies that students have acquired in small group practical sessions on post mortems are assessed using a simulation dummy. Nevertheless, the focus at this station is on practical skills, so replacement of the medical examiner is not an option in this case. In contrast, the significantly formalistic "Death Certificate" station offered an ideal opportunity for this type of alternative exam format. The next step involved determining whether a computer-based OSCE "Death Certificate" station could produce similar exam results as the conventional OSCE station that had been used to date.

As part of the evaluation presented here, the relevant study section was almost entirely assessed using the sample of the target group of medical students that were included in the analyses. The size of the study group is deemed appropriate for answering the questions and allowed for even small to moderate effects of $f \geq 0.15$ to be evaluated at a power of 0.95.[24] Thus, the absence of differences in the means between the two exam formats and hence the equivalence of the exam results is not the result of weak study power arising from a small sample size. However, there was evidence that the case vignettes differed in their level of difficulty and this difference led to significant differences in exam results. The results were somewhat poorer for cases 2 and 4, which retrospectively can be attributed to the particular case constellations. Case 2 involved the only example of a natural cause of death within the examination rotation. Several students neglected to call the general practitioner in this case, meaning that they received no further details of the case history (e.g. known severe cardiac conditions). This shortcoming may be attributable to the clear focus teaching in forensic medicine places on identifying non-natural cases of death. For Case 4, the evidence pointing to a non-natural or unexplained cause of death was considerably less obvious than for cases 1 or 3. Consequently, an adjustment of the degree of difficulty of the case vignettes and modification of the course content in light of the prevalence of natural causes of death are both considered necessary.

The descriptive item analysis indicated that students achieved equivalent results at both stations for a number of task items. However, despite identical assessment checklists, analysis of the exam results also demonstrated that there were significant differences in results for some task items between the conventional and the computer-based OSCE station. The computer-based station yielded better results only for entry of the date, time and signature for the post mortem, while several other task items were completed with poorer results compared to the conventional OSCE station. Points were awarded at the conventional station for identification based on a visual comparison between the provided post mortem photograph and two identity cards and then the transfer of the information to the death certificate. In contrast, students at the computer-based OSCE station were awarded full points only if the post mortem photograph stored within the computer tool was opened for viewing. Every student received instructions on use of the computer programme from the tutor at the start of this station as well as the information that the available tools had to be used. Nevertheless, it is entirely possible that in an exam situation and with this being the first use of the computer programme, these instructions were not always heeded. The consequent transfer of incorrect identity information to the death certificate would be the likely error of this erroneous identification. One option to solve this problem could be to have the comparison of the post mortem photograph with the identity cards take place analogously to the conventional OSCE station. That is, the assessment as to whether the identification has been made correctly would be reflected in additional points awarded if the correct identity has been entered on the death certificate. It is likely that stamping and arranging the copies of the death certificate and envelope also yielded poorer results as a result of the fact that students were not accustomed to using the computer tools.

Students whose first language is not German or who have little experience using computer programmes may be at a particular disadvantage at the computer-based OSCE "Death Certificate" station.

Evidence of this factor was seen in several free-form comments in the standardised evaluation form that tutors distributed at the end of the overall OSCE process. In the conventional setting, these limitations in language ability or technical skills are offset by the assistance from the examiner, more so than in the computer-based format. This aspect warrants notice in particular with respect to the observed differences in internal consistencies for both exam formats. The good internal consistency in the computer-based station points to a higher degree of standardisation, objectivity and consequently reliability of the exam compared to the conventional format. In contrast, students at the computer-based OSCE station were awarded full points only if they clicked on the post mortem photograph stored in a different computer folder and thereby opening it for viewing. Every student received instructions on use of the computer programme from the tutor at the start of this station as well as that there was additional information available in the computer folder that was to be used.

Further, the calculation of corrected item-total correlation for each of the exam formats revealed differences. In the computer-based OSCE, coefficients > 0.3 were obtained for the majority of the task item, indicating a high degree of correlation of the individual items with the overall result.[21] These items thus appear to have a strong ability to differentiate in terms of the overall exam results. In contrast, for the conventional OSCE, only a few values were > 0.3, such as identification of the body and correct entry of the ICD number associated with the cause of death. However, these task items also showed significantly higher value in the computer-based OSCE. Equally lower values were obtained for correctly transferring the temperatures and body weight into the programme tool to determine time of death and for inputting the place of death. Although the awarding of points here was only for correctly transferring the information from the case vignette and indicates no substantial assessment of the exam results, these task items should be retained as essential components of the examination. Incorrect transfer would inevitably lead to large deviations in calculating the approximate time of death and would thus have far-reaching consequences.[25]

In summary, the descriptive analysis of the individual task items 1–18 demonstrated either equivalent or largely better results by the students in the conventional OSCE station. Taking into account the correction factor item 19 (potential point deductions for assistance from the medical examiner only at the conventional station), an overall assessment indicates approximate equivalence between the two exam formats. Moreover, the analysis based on the selectivity values shows that the individual items at the computer-based OSCE station could differentiate significantly better between students who performed better or worse than could the conventional OSCE.

Hence, we demonstrated that the computer-based OSCE "Death Certificate" station, despite the complex programming required in advance, represents a cost-efficient alternative to the conventional OSCE station. Thus, the time-intensive incorporation of medical examiners either specialising in forensics or requiring significant investment in training can be dispensed with, so that implementation of the exam requires only instruction and the presence of student tutors. Further, material resources (original death certificates) are not needed. Ultimately, this exam format offers the opportunity for greater standardisation, objectivity and reliability of the examination, independent of medical examiners. One disadvantage of this format is the lack of feedback for students that is customary in the conventional format and which can contribute to longer-term learning success.[22,23] It is worthwhile considering whether computer-generated feedback based on exam performance is an option. To ensure a learning effect, however, this feedback must be communicated in detail and within 2 days of the OSCE process.[26] This electronic feedback could therefore be generated after completion of the entire emergency medicine OSCE and sent to students using the personal information provided by them at the beginning of the examination. Moreover, the format for teaching, learning and evaluating that is currently being used represents a potential disadvantage for students with language barriers or limited technical skills. However, this disadvantage can be at least partially offset by modifying student training. The idea is to incorporate the computer programme that is for now used only to complete the death certificate in the exam situation into the small group instruction in the SkillsLab and e-learning module. This would give students the opportunity to familiarize themselves with the programme and its particular tools before the OSCE examination. This modification would also take advantage of the opportunity to improve the teaching and learning methods with targeted evaluation of the exam results.

Conflicts of interest

None.

References

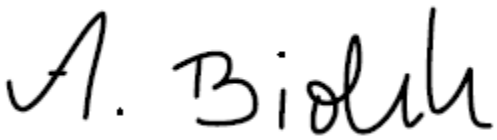
1. Lahti R, Penttilä A. The validity of death certificates: routine validation of death certification and its effects on mortality statistics. *Forensic Sci Int.* 2001;115(1-2):15–32. http://dx.doi.org/10.1016/S0379-0738(00)00300-5.
2. Karger B, La Lorin de Grandmaison G, Bajanowski T, Brinkmann B. Analysis of 155 consecutive forensic exhumations with emphasis on undetected homicides. *Int J Leg Med.* 2004;118(2):90–94. http://dx.doi.org/10.1007/s00414-003-0426-z.
3. Parai JL, Kreiger N, Tomlinson G, Adlaf EM. The validity of the certification of manner of death by Ontario coroners. *Ann Epidemiol.* 2006;16(11):805–811. http://dx.doi.org/10.1016/j.annepidem.2006.01.006.
4. Ravakhah K. Death certificates are not reliable: revivification of the autopsy. *South Med J.* 2006;99(7):728–733. http://dx.doi.org/10.1097/01.smj.0000224337.77074.57.
5. Winkel BG, Holst AG, Theilade J, et al. Differences in investigations of sudden unexpected deaths in young people in a nationwide setting. *Int J Leg Med.* 2012;126(2):223–229. http://dx.doi.org/10.1007/s00414-011-0602-5.
6. Minelli N, Marchetti D. Discrepancies in death certificates, public health registries, and judicial determinations in Italy. *J Forensic Sci.* 2013;58(3):705–710. http://dx.doi.org/10.1111/1556-4029.12114.
7. Anders S, Fischer-Bruegge D, Fabian M, Raupach T, Petersen-Ewert C, Harendza S. Teaching post-mortem external examination in undergraduate medical education–the formal and the informal curriculum. *Forensic Sci Int.* 2011;210(1-3):87–90. http://dx.doi.org/10.1016/j.forsciint.2011.02.008.
8. Feiser J, Bellmann D, Krämer T, Hohenberg G, Wendorf A, Wilske J. TELEMED – teaching Legal Medicine: Neukonzeption der Lehre im Fach Rechtsmedizin an der Universität des Saarlandes. *GMS Med Inform Biom Epidemiol.* 2009;5(1)http://dx.doi.org/10.3205/mibe000088 Doc09; ISSN 1860–9171.
9. Schmeling A, Kellinghaus M, Becker JC, Schulz R, Schäfer A, Pfeiffer H. A web-based e-learning programme for training external post-mortem examination in curricular medical education. *Int J Leg Med.* 2011;125(6):857–861. http://dx.doi.org/10.1007/s00414-011-0613-2.
10. Heide S, Lessig R, Diers V, Rönsch M, Stoevesandt D. Etablierung der Station Leichenschau in SkillsLab und E-Learning. *Rechtsmedizin.* 2016;26(2):90–96. http://dx.doi.org/10.1007/s00194-015-0070-1.
11. Alonso-Sardón M, Iglesias-de-Sena H, Sáez-Lorenzo M, Chamorro Fernández AJ, Salvat-Puig J, Mirón-Canelo JA. B-learning training in the certification of causes of death. *J Forensic Leg Med.* 2015;29:1–5. http://dx.doi.org/10.1016/j.jflm.2014.10.003.
12. Püschel K. Lehre und Forschung an Verstorbenen. *Rechtsmedizin.* 2016;26(2):115–119. http://dx.doi.org/10.1007/s00194-016-0087-0.
13. Pramod Kumar GN, Sentitoshi, Nath D, Menezes RG, Kanchan T. Student's perspectives on objective structured practical examination (OSPE) in Forensic Medicine - a report from India. *J Forensic Leg Med.* 2015;32:39–41. http://dx.doi.org/10.1016/j.jflm.2015.02.013.
14. Menezes RG, Nayak VC, Binu VS, et al. Objective structured practical examination (OSPE) in Forensic Medicine: students' point of view. *J Forensic Leg Med.* 2011;18(8):347–349. http://dx.doi.org/10.1016/j.jflm.2011.06.011.
15. Heidé S, Lessig R, Hachmann V, et al. Establishment of two forensic medicine OSCE stations on the subject of external post-mortem examination. *Int J Leg Med.* 2017. http://dx.doi.org/10.1007/s00414-017-1630-6.
16. Rau T, Fegert J, Liebhardt H. How high are the personnel costs for OSCE? A financial report on management aspects. *GMS Z Med Ausbild.* 2011;28(1)http://dx.doi.org/10.3205/zma000725 Doc13.
17. Chaudhary R, Grover C, Bhattacharya SN, Sharma A. Computer assisted Objective structured clinical examination versus Objective structured clinical examination in assessment of Dermatology undergraduate students. *Indian J Dermatol Venereol Leprol.* 2017;83(4):448–452. http://dx.doi.org/10.4103/ijdvl.IJDVL_587_16.
18. Holyfield LJ, Bolin KA, Rankin KV, Shulman JD, Jones DL, Eden BD. Use of computer technology to modify objective structured clinical examinations. *J Dent Educ.* 2005;69(10):1133–1136.
19. Henssge C. Death time estimation in case work. I. The rectal temperature time of death nomogram. *Forensic Sci Int.* 1988;38(3-4):209–236.
20. George D, Mallery P. *SPSS for Windows Step by Step: A Simple Guide and Reference, 11.0 Update.* fourth ed. Boston: A & B; 2003.

21. Möltner A, Schellberg D, Jünger J. Grundlegende quantitative Analysen medizinischer Prüfungen. *GMS Z Med Ausbild.* 2006;23(3) Doc53.
22. Nikendei C, Jünger J. OSCE - praktische Tipps zur Implementierung einer klinisch-praktischen Prüfung. *GMS Z Med Ausbild.* 2006;23(3) Doc47.
23. Newble D. Techniques for measuring clinical competence: objective structured clinical examinations. *Med Educ.* 2004;38(2):199–203. http://dx.doi.org/10.1111/j.1365-2923.2004.01755.x.
24. Faul F, Erdfelder E, Buchner A, Lang A-G. Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behav Res Meth.* 2009;41(4):1149–1160. http://dx.doi.org/10.3758/BRM.41.4.1149.
25. Hubig M, Muggenthaler H, Mall G. Influence of measurement errors on temperature-based death time determination. *Int J Leg Med.* 2011;125(4):503–517. http://dx.doi.org/10.1007/s00414-010-0453-5.
26. Ashby SE, Snodgrass SH, Rivett DA, Russell T. Factors shaping e-feedback utilization following electronic Objective Structured Clinical Examinations. *Nurs Health Sci.* 2016;18(3):362–369. http://dx.doi.org/10.1111/nhs.12279.

Erklärung über frühere Promotionsversuche

Ich erkläre, dass ich mich an keiner anderen Hochschule einem Promotionsverfahren unterzogen bzw. eine Promotion begonnen habe.

Halle, den 28.09.2019

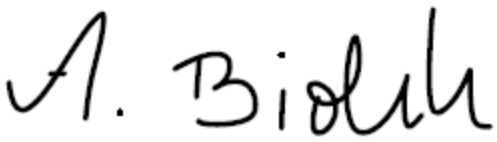


Alexandra Biolik

Erklärung zum Wahrheitsgehalt der Angaben

Ich erkläre, die Angaben wahrheitsgemäß gemacht und die wissenschaftliche Arbeit an keiner anderen wissenschaftlichen Einrichtung zur Erlangung eines akademischen Grades eingereicht zu haben.

Halle, den 28.09.2019

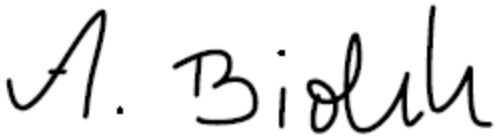


Alexandra Biolik

Eidesstattliche Erklärung

Ich erkläre an Eides statt, dass ich die Arbeit selbstständig und ohne fremde Hilfe verfasst habe. Alle Regeln der guten wissenschaftlichen Praxis wurden eingehalten; es wurden keine anderen als die von mir angegebenen Quellen und Hilfsmittel benutzt und die den benutzten Werken wörtlich oder inhaltlich entnommenen Stellen als solche kenntlich gemacht.

Halle, den 28.09.2019



Alexandra Biolik