Expanding Pre-Hospital Emergency Medicine Teaching through Internationally Livestreamed Academic Forums

Jonathon Dean[2], Benjamin Stretch[2], Abigail Dunn[2], Matthew Mitchard[2], Tara Slade[2], Louise Rosson[2], Adam Chesters[2]

Corresponding author: Dr Jonathon Dean jondean@doctors.org.uk
Institution: 2. Cambridge University Pre-Hospital Care Programme
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Abstract

Introduction: Changing expectations in the accessibility of medical education and concomitant increases in inclusion of technology have led to demand for novel content delivery methods in medical education. Classical paradigms of educational preference based on geographical accessibility are gradually being replaced in a progressively online and connected environment by learners’ preference for convenience, with selection between educational options becoming increasingly based on the quality of the content, and not necessarily its physical proximity. Livestreaming a medical education programme presents a new set of technical, logistical, and ethical considerations. Cambridge University Pre-Hospital Care Programme delivers a regional academic Pre-Hospital Emergency Medicine (PHEM) teaching programme mapped to the GMC recognised sub-specialty of the national PHEM curriculum and this programme has begun to stream the programme’s monthly forums. We describe a literature review on livestreaming in medical education, a summary of our results with livestreaming, and recommendations for organisations interested in similar expansion.

Methods: A systematic literature search was conducted by searching PubMed for terms related to livestreamed medical education. This programme began implementation of livestreaming in April 2017. Feedback was collected using Likert scales specific to livestream accessibility and audiovisual quality.

Results: Four forums were successfully livestreamed between April and August 2017; feedback was increasingly positive as the programme became more familiar with livestreaming and made technical improvements to the stream.

Discussion: This programme provided free, open-access livestreamed PHEM education to students and professionals in diverse fields. We present lessons learned by this organisation in implementation, and evidence that
livestreamed medical education from leading experts is both possible and in demand. This has implications for both synchronous and asynchronous medical education; diffusion of medical education to interested parties need not be limited by geography, specialty, or access.

**Keywords:** livestream; broadcast; technology; accessibility

**Introduction**

Changing expectations in the accessibility of medical education and concomitant increases in inclusion of technology have led to demand for novel content delivery methods in medical education. Classical paradigms of educational preference based on geographical accessibility are gradually being replaced in a progressively online and connected environment by learners’ preference for convenience, with selection between educational options becoming increasingly based on the quality of the content, and not necessarily its physical proximity. The prototypical concept of education as centred around physical institutions, and learners' corresponding limitation of choice of institution to those that can be reached through common transportation options, is becoming obsolete secondary to technological advances; in particular, the model of online education in the form of audiovisual instruction has provided opportunities for widespread dissemination of knowledge not limited by traditional access barriers. Institutions such as the Khan Academy¹ and MIT² have spearheaded the development of freely available asynchronous online education. However, these advancements have not been widely reproduced in medical education, where learning remains relatively institutional, and livestreamed education is rarer still. Although some online medical education exists in asynchronous format, few organisations have successfully and consistently delivered live, freely accessible clinical education, with hurdles ranging from confidentiality concerns to loss of potential funding.

Cambridge University Pre-Hospital Care Programme (CUPHCP) is a regional academic teaching charity³ delivering free, open-access Pre-Hospital Emergency Medicine (PHEM) teaching mapped to the UK’s national PHEM subspecialty curriculum.⁴ The programme was conceived in 2014 and delivers a 20-forum set of monthly 90-minute forums over two years, with lectures delivered by doctors, critical care paramedics, and experts in related areas such as human factors.

Since March 2017, the programme has made use of broadcasting software to livestream these forums to viewers internationally with the aim of delivering free, open-access medical education to all interested parties. Livestreaming a medical teaching programme presents a new set of technical, logistical, and ethical considerations. In this article, we review the current literature surrounding livestreamed medical education, we discuss the programme’s expansion into livestreaming, and we provide guidance for organisations looking to overcome the barriers to implementation.

**Methods**

**Figure 1 - Literature Review Flowchart**
A systematic literature search was conducted through a MEDLINE search for terms related to livestreamed medical education to establish previous work in expanding existing medical education resources to include livestreaming (Figure 1). The specific search used was:

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((((video recording AND education, medical AND social learning)) OR (webcasts AND medical education)) OR (webinar AND medical education)) OR (live streaming OR live video streaming OR live video-streaming OR live streaming education)
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This search provided a total of 330 results. Results were manually filtered by title and were excluded if they were deemed to be unrelated to medical education, were greater than ten years old, were irrelevant to the specifics of audio-visual livestreaming, or were pertaining to species other than humans.

22 results remained for abstract interrogation and filtered to eight relevant articles that pertained specifically to the practice of introducing livestreamed medical education. One paper was then removed after review of the article’s full text as it was related to text-based internet medical education only. The remaining seven results are summarised in Appendix 1.

Research directly relevant to the audiovisual livestreaming of medical education remains sparse and incompletely diffusible, and specific recommendations for similar expansion of practice within other organisations is limited. It may be the case that organisations attempt livestreaming and are faced with prohibitive obstacles without the benefit of learning from shared experience and attempts are therefore abandoned. The papers identified in our literature review do highlight some benefits and challenges with implementation which will further guide our discussion.

Streaming platforms were researched and tested with the criteria of being widely accessible, cost-effective, and versatile with the results of the literature review in mind. This programme took advantage of existing streaming platforms for broadcasting purposes. Implementation was begun during the programme’s Trauma: Fractures, Splinting, and Spinal Cord forum in April 2017 using a mobile phone’s camera and microphone as the only equipment. After this proof-of-concept forum finished, funding for additional hardware was secured including for a new webcam and a dedicated microphone. Steps were also taken to utilise dedicated streaming software to stream lecture slides legibly and in sync with projected slides to optimise accessibility and learning potential.
Feedback was collected from participants on the livestream using Likert scales to assess the ease of stream access, audiovisual quality and quality of the content. The option was provided for participants to provide free text feedback to highlight specific issues with aspects of the stream.

**Results**

An average of 50 participants responded to livestream feedback requests for each of the four forums that were streamed. The average livestreamed event was viewed over 4,000 times with key engagement moments including questions from viewers relayed on to speakers and live quizzes and polls for both audiences. This organisation is based in Cambridge, UK, but the livestreams attracted participants globally.

**Figure 2 - Livestream Ratings Over Time**

There were increases in all feedback domains with each forum over the four forums (Figure 2). Specifically, the stream-specific accessibility, audio quality, and video quality increased with each forum and this is likely due to improvements in equipment, familiarity, and setup. Key free text feedback regarding access, sound, and video quality were noted and interventions were made as a specific result of previous forums’ feedback, likely responsible for the generally-improving feedback trend.

**Discussion**

Advancements in technology and changing expectations of medical education have generated a demand for easily-accessible, high-yield teaching not limited by chronological or geographical barriers. However, no clear guidance exists for organisations interested in expanding their academic scope to include livestreamed teaching. As
mentioned, institutions such as the Khan Academy\textsuperscript{1} and MIT\textsuperscript{2} have spearheaded the development of freely available online education. However, these advancements were largely asynchronous and medical education can present some unique challenges and access barriers with particular concerns about confidentiality.

This organisation has been able to identify some specific advantages and incentives of livestreaming. Livestreaming allows leading clinicians to deliver accessible, expert education from their home institution to geographically and chronologically diverse audiences without the logistical, financial, and opportunity costs of attending traditional conference-based educational events. Livestreamed education is convenient for both the provider and the audience, and the videos can be stored in a library for playback at the viewer’s convenience, further increasing the educator’s reach and scope. Our programme also confirms that livestreaming can allow for two-way communication between the audience and the presenter with the assistance of social media; this was previously noted in work by Mayorga et al.\textsuperscript{9} We believe that livestreaming has a major role in the future of medical education and this is supported by data from our literature review. In particular, Collins et al found that 76\% of the audience from their livestreamed International Urology conference would preferentially ‘attend’ a virtual streamed conference rather than attend in person if audience members were to receive the same accreditation.\textsuperscript{5} Sandhu suggests that the convenience of virtual attendance encourages students who might not otherwise have attended to participate, with subjective and objective findings of non-inferiority of streams in terms of content retention.\textsuperscript{11} The ability to freely distribute medical education to interested clinicians globally also allows experts in the field to share experience, advances, and best practice recommendations more quickly and in a more granular fashion, expediting the application of lessons learned.

We have identified some disadvantages to expanding our programme through livestreaming. Purchasing or renting equipment for livestreaming is an additional cost to the education provider. Running a high-quality stream is a labour-intensive process requiring additional equipment, prior planning, and a dedicated member of the committee responsible for running and editing the stream.\textsuperscript{6,7} Perhaps paradoxically, interruptions or poor stream quality tends to lead to greater dissatisfaction with the event than there would be if no stream were offered at all, as expectations for an equivalent or at least comparable audience experience quickly grow. There are concerns that livestreaming lectures will lead to reduced numbers attending in person for convenience reasons and this is in keeping with conclusions drawn from other work.\textsuperscript{5} Finally, livestreaming raises issues around patient confidentiality wherein identifiable case reports may be broadcasted. In our Cardiac Arrest forum, the decision was made in the planning stage to avoid broadcasting the CCTV footage of the cardiac arrest and subsequent resuscitation effort on the stream but instead to only display it to members of the in-house audience. This provides an example of a situation wherein the forums provided a separate experience for those attending in person compared to those watching the stream. An alternative method used by other authors is to password protect access so that only professionals who have registered prior to the event can view the livestream.\textsuperscript{5,7}

Attention to the feedback alongside improvements in our equipment and technique allowed us to improve the average livestream score from 4.5 to 4.75. This was matched by an improvement in audio quality (from 3.25 to 4.5), video quality (from 3.25 to 4.5) and stream accessibility (from 4.1 to 4.8). In order to improve the quality and consistency of our livestream, we made the following key interventions and would recommend these to other organisations:

1. Have the right equipment; a dedicated computer with software, camera, microphone, and reliable internet connection is essential. A certain amount of pre-implementation funding may need to be secured for this purpose. We recommend capturing sound output from the venue’s soundboard directly into the computer if possible, with speakers wearing individual microphones.

2. Have the right people; a named person should be tasked with providing the stream and this person should be
familiar with the equipment and software to be able to troubleshoot during the event. If social media is used to distribute the stream, a second person's role should be to monitor and moderate comments and questions from the audience to maximise engagement and relay questions as required.

3. Have the right software; we recommend use of existing, dedicated software and streaming platforms to ensure the stream is reliable, visible, legible, and audible. We suggest starting the steam early to allow people to log in and adjust sound levels as required.

4. Have the right consent; speakers should be made aware that their talks will, with their permission, be broadcast live to a theoretically unlimited audience that might include those familiar with any cases discussed. Any material with a copyright should be distributed and displayed only with permission and purely for educational purposes. Any discussion must be with the understanding that members of the public may be watching, and it should be considered impossible to remove a streamed video once it has been seen live, as it may be recorded easily by third parties. Any possibility of pending litigation, coroner inquests, or other proceedings should preclude discussion of a topic. A password may be necessary to restrict access if confidential material is to be discussed.

5. Have the right expectations; expanding into regular livestreaming requires significantly increased expenditure and effort if it is something to be performed on a scheduled basis and is to complement or replace physical attendance with reliability. Livestreaming on an ad-hoc basis requires less equipment and fewer resources, but may provide a diminished experience for viewers.

Conclusion

Providing free, open-access prehospital emergency medical education to students and professionals in diverse fields was made even more possible through livestreaming the programme’s academic forums. Feedback provided from participants helped shape future events and the programme’s audience diversity has grown to include not only the typical mix of medical students, paramedic students, paramedics, doctors, and nurses, but also deployed combat medics and on-duty professionals in between calls who would typically not be able to attend the event due to geographical restrictions or occupational commitments. The programme's ability to provide continued professional development points without physical attendance through livestreaming has increased its audience significantly and allowed participants to translate teaching directly into action, and the programme has continued to livestream its teaching.

The dearth of generalizable evidence and the need for organisations to share their experience and practice in livestreaming medical education is highlighted. This programme is pleased to be able to present evidence that livestreamed medical education from leading experts is both possible and in demand. This has implications for both synchronous and asynchronous medical education; diffusion of medical education to interested parties need not be limited by geography, specialty, or access. Regular livestreaming provides opportunities for familiarisation and generation of best practice guidelines for improving an organisation’s experience with streaming, and we share our lessons above to encourage other organisations’ similar expansions into streaming.

Take Home Messages

1. Changing expectations in medical education have generated a demand for teaching not limited by physical access.
2. Demand for livestreamed medical education is high, and little research has been published highlighting key points for successfully streamed medical education.
3. Expanding into livestreamed medical education presents a new set of technical, logistical, and ethical challenges.

4. This programme's expansion into livestreaming faced some challenges that are likely to be experienced by other organisations attempting a similar expansion.

5. We recommend that other organisations and institutions assess their audiences' demand for livestreamed teaching and trial streaming if feasible.

Notes On Contributors

Jonathon Dean - Doctor at Barts Health, previous president and current executive committee member of Cambridge University Pre-Hospital Care Programme.

Benjamin Stretch - Doctor at Barts Health, previous president and current executive committee member of Cambridge University Pre-Hospital Care Programme.

Abigail Dunn - Doctor at NHS Scotland, previous vice-president of Cambridge University Pre-Hospital Care Programme.

Matthew Mitchard - Doctor at Barts Health, previous committee member of Cambridge University Pre-Hospital Care Programme.

Tara Slade - Medical Student at Gonville and Caius College, University of Cambridge and current president of Cambridge University Pre-Hospital Care Programme.

Louise Rosson - Critical Care Paramedic and Air Operations Supervisor with Essex and Herts Air Ambulance Trust, and lead paramedic of Cambridge University Pre-Hospital Care Programme.

Adam Chesters - Consultant in Emergency Medicine and Pre-Hospital Emergency Medicine, and lead clinician of Cambridge University Pre-Hospital Care Programme.

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Bibliography/References

1. Khan Academy. https://www.khanacademy.org/. Accessed November 2017.

2. MIT Open Courseware. https://ocw.mit.edu/index.htm. Massachusetts Institute of Technology. Accessed November 2017.
3. Cambridge University Pre-Hospital Care Programme. [http://camprehosp.com/](http://camprehosp.com/). Accessed November 2017.

4. Sub-speciality Training in Pre-hospital Emergency Medicine: Curriculum and Assessment System. Intercollegiate Board for Training in Pre-hospital Emergency Medicine, Faculty of Pre-Hospital Care. 2015.

5. Collins JW, et al. Application and Integration of Live Streaming from Leading Robotic Centres Can Enhance Surgical Education. Eur Urol, Nov 2015;68(5):747-9.

[https://doi.org/10.1016/j.eururo.2015.07.052](https://doi.org/10.1016/j.eururo.2015.07.052)

6. Wall Parilo, et al. Case study: student perceptions of video streaming nursing class sessions. Nurs Educ 2014;53(3):161-3.

[https://doi.org/10.3928/01484834-20140223-01](https://doi.org/10.3928/01484834-20140223-01)

7. Shiozawa T, et al. Interactive anatomical and surgical live stream lectures improve students' academic performance in applied clinical anatomy. Anat Sci Educ 2017, Jan;10(1):46-52.

[https://doi.org/10.1002/ase.1623](https://doi.org/10.1002/ase.1623)

8. Vaccani, et al. The effectiveness of webcast compared to live lectures as a teaching tool in medical school. Med Teach 2016 38(1):59-63.

[https://doi.org/10.3109/0142159X.2014.970990](https://doi.org/10.3109/0142159X.2014.970990)

9. Mayorga EP, et al. Webinar software: A tool for developing more effective lectures (online or in-person). Middle East Afr J Ophthalmol 2014;21:123-7.

[https://doi.org/10.4103/0974-9233.129756](https://doi.org/10.4103/0974-9233.129756)

10. Reid MJ, et al. New models for medical education: Web-based conferencing to support HIV training in Sub-Saharan Africa. Telemed J E Health 2012 Sep;18(7):565-9. Epub 2012 Jul 30.

[https://doi.org/10.1089/tmj.2011.0200](https://doi.org/10.1089/tmj.2011.0200)

11. Sandhu, et al. Adding Live-Streaming to Recorded Lectures in a Non-Distributed Pre-Clerkship Medical Education Model. Stud Health Technol Inform 2017;234:292-297.

**Appendices**

**Appendix 1 - Literature Review Results**

| Citation | Audience | Contents | Comments |
|----------|----------|----------|----------|

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| Author(s) | Year | Participants | Subject | Findings |
|----------|------|--------------|---------|----------|
| Collins JW | 2015 | Registered urological professionals | 24 hours of livestreamed urological surgery | The vast majority of respondents would 'attend' the virtual conference rather than attend in person. Access required a password. Problems with high cost of running the stream and limited interaction between the audience and the surgeons. |
| Wall Parilo DM | 2014 | 53 student nurses receiving in-person and streamed lectures | Paediatric and obstetric nursing topics throughout a semester | Students reported greater retention and learning for live streamed lectures. Having a web moderator was deemed to be helpful. Live streaming was found to be far more convenient for the audience |
| Shiozawa T | 2017 | 365 medical and dental students during anatomy classes | Clinical anatomy and dissection classes | Students exposed to the livestreamed lectures performed better than other students in 'clinically applied' multiple choice questions. No significant difference in the 'standard' multiple choice questions between the two cohorts. Access was password protected with an anatomist moderator. |
| Vaccani JP | 2016 | 3rd year medical students at a Canadian university | 3 otolaryngology and head & neck surgery lectures | Noninferiority of recorded webcasts compared to live lectures as teaching tools, as assessed formally by examination. Limited sample size. |
| Mayorga EP | 2014 | Ophthalmology trainees from Hospital Italiano de Buenos Aires | 61 online case-presentation seminars over a one-year period | The audience response system allows two-way communication and active participation. There is no feedback data published on the programme. |
| Author(s), Year | Description | Comments |
|----------------|-------------|----------|
| Reid MJ, 2012¹⁰ | Sub-Saharan medical clinicians. | HIV prevention and treatment teaching. | Noted variability of feed quality. ¾ of attendees found the streamed lecture relevant/useful. The number of attendees per stream increased from 40 to 160 over a ten month period. It is feasible to stream regular educational seminars across the globe and maintain an audience over at least a ten month period. Feedback is largely positive, though limited data is presented. Relevance and audio quality being the only quantitative data included in the paper. |
| Sandhu A, 2017¹¹ | First and second year medical students in a Canadian medical school. | Curriculum delivered in person and livestreamed simultaneously. | Emphasises the convenience of live streaming compared to traditional formats. Recorded and live streamed lectures were perceived to be more valuable than face-to-face attendance. The data suggests that the removal of livestreamed lectures would not increase classroom attendance. Recorded lectures had numerous advantages recorded by surveyed students, in addition to those offered by live streaming. This suggests a combination of the two may be beneficial. |

**Declarations**

*The author has declared that there are no conflicts of interest.*

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