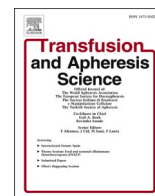




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## Modernizing transfusion medicine education

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Blood transfusion is one of the most common medical procedures [1]. Even though blood transfusion could be life-saving in some circumstances, it also carries significant risks [2]. Inappropriate utilization of blood transfusion is well documented [3] and may stem from poor transfusion knowledge amongst medical professionals. Numerous studies have shown that medical trainees receive limited education in transfusion; furthermore, its content is not always relevant. Not surprisingly, medical trainees score poorly on knowledge assessments in transfusion. For example, in one Canadian study, internal medicine residents undergoing objective standardized clinical examination received a mean score of 6.6 out of 10 on the transfusion medicine station, while 31.5% of examinees failed the station. In contrast to the other stations, the performance at the transfusion station did not improve with increasing postgraduate years [4]. Although there may be numerous reasons behind the consistently observed poor performance, one of them might be how we teach transfusion medicine. In this special issue, we will explore a few novel ways of delivering transfusion medicine education to medical trainees.

Traditionally, transfusion medicine education is delivered by an educator in a classroom to the learners, who passively receive the information and then ask questions. The alternative approach is the “flipped classroom”, where learners acquire foundational information before the class and use class time for interactive activities meant to solidify their knowledge. This approach is thought to enhance problem-solving and critical thinking skills. A recent systematic review has shown that a flipped classroom requires more work on behalf of both educators and learners, but may result in better performance [5]. This approach has been applied to transfusion medicine (personal communication with Dr. J. Kreuter) but its impact is yet to be studied. Other models include problem-based and case-based learning, where students are able to apply their knowledge to address real-world scenarios. In undergraduate medical education, problem-based learning was more effective at improving communication, problem-solving and self-learning skills, while academic performance was not worse or better [6]. In this issue, Lin et al. describe how case-based learning was successfully incorporated into a transfusion medicine course – University of Toronto Transfusion Camp. Simulation-based medical education (SBME) has also emerged as an effective modality to teach health care professionals [7].

It allows the learners to apply their knowledge and skills in a controlled environment. Its utilization in transfusion medicine education is reviewed by Rotin et al. For most of us, SBME conjures an image of a high-tech mannikin in a simulation centre, something that is expensive, over-complicated, and not widely available. However, it also means a low-tech, low-cost table-top exercise or the use of virtual or augmented reality. Virtual reality offers the ability to deliver highly realistic experiential learning in any environment, personalized to the level of training, specialty, and setting. Its utilization in medical education has been associated with improved knowledge and skills as compared to traditional and other digital education [8]. There are surprisingly few studies on using SBME to teach transfusion content to medical trainees and virtual simulation is yet a completely unexplored opportunity.

E-learning, which is learning via electronic media, became popularized in transfusion medicine over the past 20 years. E-learning comes in many formats and may include articles, lectures, modules with and without built-in assessments (ex. Bloody Easy Lite (Ontario), BloodSafe eLearning (Australia), LearnBloodTransfusion (UK), transfusion reactions module (ISBT)), courses (ex. University of Toronto Transfusion Camp), podcasts (ex. Blood Bank Guy), and smartphone applications (ex. iTransfuse) among others. Its advantages are easy access and the ability to disseminate vast amounts of standardized information to numerous trainees. However, its content is usually not personalized and learning is self-directed; with increasing competing demands, e-learning thus runs the risk of turning into a “tick box exercise” [9]. To increase its effective uptake, e-learning should be tailored to the learning needs of its audience and maximize interactive opportunities. Despite its pitfalls, a recent international survey has confirmed its wide adoption to deliver transfusion medicine education worldwide [1]. Lin et al. explore how expansion to multiple sites spanning different time zones and the advent of the COVID-19 pandemic triggered the evolution of Transfusion Camp from in-person to a mixed, and now entirely virtual course. In their article, Wasiluk et al. discuss the development of e-learning modules on transfusion reactions by an international group of experts for a diverse and multi-disciplinary virtual audience. Pendergrast et al. discuss their experience with building the Learn Serology website, designed for post-graduate trainees to teach immunohematology and basics of blood bank compatibility testing. Finally, in his article, Kreuter et al. examine

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the role of social media in transfusion education. With our short attention spans and growing need for immediate gratification, social media is a significant contender as an educational modality; it is able to rapidly deliver on-demand and interactive byte-sized information. Another novel modality is serious gaming; with its promise of personalized and adaptive learning, it has been gaining popularity in medical education, with dozens of randomized controlled trials published to date [10]. In contrast, there has only been one study on the use of a serious game to teach transfusion medicine [11].

So what does the future hold for transfusion medicine education? Similar to other specialties, the growing use of e-learning and “flipped classrooms” will likely lead to the integration of Massive Open Online Courses into transfusion medicine training [12]. Present-day simulation and case/problem-based learning seminars will be replaced by virtual simulation and serious games. It remains to be seen what impact these developments will have on the quality of transfusion medicine knowledge in medical trainees and, most importantly, the quality of transfusion care to patients that they will provide.

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