Policy Document

Information Technology and the Delivery of Medical Education (2023)

Position Statement

AMSA believes that:

1. Information technology, which has been proven to be an effective pedagogic tool for teaching and assessing, should be utilised as a key resource in the delivery of medical education to enhance student's experiences of learning;
2. Integration of new and established information technologies into medical teaching should supplement and not wholly replace clinical education in appropriate circumstances;
3. Universities and students must work together to ensure such new and established technologies are implemented in an equitable and transparent manner, ensuring accessibility of resources to all students whilst respecting data privacy and ethical considerations;
4. Access to technologies for medical student education must consider the barriers created by geographic and socioeconomic statuses;
5. The implementation of technologies must account for the unique requirements of vulnerable populations including students with disabilities;
6. The impact of the increased use of information technology within medical education upon the wellbeing of students must be considered in the implementation of such systems;
7. The implementation of both established and developing technologies is advantageous in it's ability to standardise the curriculum of medical education on a national level;
8. Student and teacher satisfaction with the online learning experience and educational outcomes are pillars in the quality framework of the Online Learning Consortium which require ongoing and robust evaluation.

Policy Points

AMSA calls upon:

1. All Medical Schools and clinical course coordinators to:
    a. Supplement and integrate simulation-based medical education with high quality evidence-based digital tools equally for all students, even at lower fidelity, including but not limited to:
        i. Screen-based virtual reality (VR) programs;
        ii. Augmented reality (AR) programs;
    b. Conduct research and trials into the effectiveness and utility of VR and AR in different settings, such as:

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    i. Objective Structured Clinical Examinations (OSCE's);
    ii. Anatomy classes using AR cadaveric models to display a range of physiologies and pathologies seen in the human body;
    iii. With real patients once approved in OSCEs and anatomy classes;
c. Adopt structured hybrid models of teaching within the medical school curriculum;
d. Assess and re-evaluate the sustainability, reliability, and student satisfaction in hybrid online models of learning;
e. Encourage student-directed learning through online resources and collaborative models through online platforms;
f. Efficiently design technology-driven teaching methods by adhering to 'learner-centred' design principles by considering learner experiences with educational technology as a key factor in a learning environment's development including but not limited to the consideration of;
    i. learners' perception formed during the interaction with a learning environment;
g. Conduct research into effective yet accurate methods to evaluate assessments and examine students' understanding, in the context of modern technology;
h. Incorporate real-time consistent feedback from summative and formative assessment in online and digital tools;
i. Provide training in information technology literacy and usage to all educators and course facilitators who engage with such systems;
j. Acknowledge the advantages of digital examinations such as reduced administrative burden;
k. Explore the possibility of conducting clinical assessments online in the appropriate circumstances;
l. Consider conducting theoretical and clinical examinations online when circumstances prevent physical examinations from occurring;
m. Thoughtfully design and continuously enforce policies against cheating and plagiarism through the integration of anti-plagiarism and proctoring software in an ethical and transparent manner;
n. Incorporate telehealth style assessment and training within the clinical curriculum;
o. Cultivate a positive data security culture through:
    i. Informing students of the purpose and content of student data collection;
    ii. Having a cybersecurity strategy in place to protect students and patients from cybersecurity threats;
    iii. Have a robust pipeline for reporting and handling data security breaches;
    iv. Participate in sector-wide cybersecurity forums and networks to share insights into new cybersecurity incidents and response;

p. Invest in providing students with quality online and computer-based resources, including but not limited to question banks and evidence-based clinical references;
q. Foster Artificial Intelligence literacy in medical students via project-based learning in multidisciplinary settings with an emphasis on:
    i. Developing a working understanding of how a wide variety of Artificial Intelligence systems operate (i.e. Neural Networks, GANs, Language Models);
    ii. Ensuring medical students understand emerging trends in Medical applications of Artificial Intelligence tools;
    iii. Supporting medical students to contribute to medical Artificial Intelligence research and policy;
r. Ensure medical students have adequate experience with mature applications of Artificial Intelligence (AI) in healthcare, including but not limited to:
    i. Image-based (Radiological + Histological) AI tools;
    ii. Medical Chatbot tools;
    iii. Diagnostic AI tools such as algorithms process sensor data from Electrocardiograms and Heart Rate Monitors;
s. Promote interdisciplinary collaboration between medical students, clinicians, and AI experts;
t. Inform medical students of ethical considerations pertaining to the clinical use of AI, in particular relating to AI bias, data privacy, and accountability when AI is used to inform medical decisions;
u. Teach medical students how to communicate the use of AI tools to patients under their care, including explanation of the benefits and limitations of AI at an appropriate level and ensuring patients are comfortable with the technology as tools in assisting diagnosis, treatment and patient education;
v. Ensure that the interface design and navigation of online learning platforms be accessible to students with disabilities and/or allow alternative applications with accessible interfaces to access the same content.
w. Ensure that students with disabilities are involved in decision making upon the design, access and implementation of online learning tools and modalities.

2. The Australian Government to:
    a. Increase funding to rural medical schools to mitigate disparities in technological access;
    b. Develop standards of student privacy and information security;
    c. Increase funding to medical schools to support integration, maintenance and evaluation of technological platforms used in hybrid models of learning;
    d. Equip medical schools with AI-based diagnostic decision-making tools in order to support medical students to understand how AI tools can reduce their diagnostic errors and promote the adoption of AI tools;

e. Contribute to the development of standards for the use of AI in healthcare. This includes developing ethical guidelines, best practices, and standards for interoperability and data exchange in healthcare settings.

3. Medical Deans Australia and New Zealand, and the Australian Medical Council to:
    a. Conduct research upon issues of accessibility for Australian Medical Students with Disabilities;
    b. Conduct research upon cybersecurity awareness and education for medical students;
    c. Develop guidelines upon the implementation of hybrid structured forms of student learning;
    d. Develop standardised guidelines upon the usage of AI technologies, including but not limited to chatbots, within medical education.
4. Developers of IT platforms to:
    a. Continue to improve online proctoring platforms by:
        i. Ensuring transparency with information gathered on students during online examinations;
        ii. Mitigating any discrimination against people due to limitations in technology;
        iii. Ensuring online exams can be run as smoothly as possible;
    b. Seek feedback from students and staff regarding their satisfaction with the platforms;
    c. Develop more Australia-specific study tools and online resources that incorporate up-to-date Australian guidelines.

Background

Introduction

Healthcare is an evolving field, subject to rapidly changing and advancing technology, techniques and practice. Prior to the 2019 COVID-19 pandemic, web-based technologies (WBT) were introduced to facilitate and enhance the learning of curriculums, with integration into pedagogical design. [1,2] Several meta-analyses revealed that WBTs utilised in medical education predominantly consist of a combination of text and multimedia tools such as videos, diagrams, pictures and tutorials.[1,2] These include interactive self-assessment tools such as patient cases, quizzes and digital feedback. Effective digital education models facilitate active learning through engagement with these multimedia resources, peer interaction and performance evaluation for student-directed learning, with educator-directed learning management systems (LMS) for content delivery. [3]

The pandemic necessitated an abrupt transition to online learning, leading to a paradigm shift in the delivery of education. [4] During the pandemic, the use of WBT in the medical curriculum increased rapidly, in response to restrictions placed on content delivery in areas such as laboratory practicals and face-to-face clinical

tutorials. This transition was enhanced by the benefits of technology use, including cost and efficiency. [4] The proven effectiveness of online learning supports the potential of WBT as a significant change to educational delivery [5]. However potential downsides such as the lack of face-to-face interaction and direct patient exposure must be considered. Versions of online learning have been adopted by many health professions degree and training programs worldwide [6]

It must be clarified that emergency remote teaching during the COVID-19 pandemic was a temporary solution, while online learning refers to planned, structured delivery of education, using a digital education model. [7] When combined with face-to-face teaching, this is known as a hybrid model, blended or 'flipped' learning. [8] Hybrid models are preferred as they can provide the same assessment options as traditional methods when combined with face-to-face sessions. [6] Literature suggests a rise in the incidence of blended learning models in medical education, with increased use of information technology to facilitate learning. [9] There is demonstrated effectiveness of blended learning in medical curricula, including postgraduate and subspeciality training in medicine. [10] Evidence suggests benefits of e-learning in medical education occur only when used to support but not replace traditional face-to face teaching as part of a blended model of education delivery. [4,11]

Advantages of hybrid models for delivery of medical education

There are several benefits of online learning, hybrid pedagogical models and integration of technology. Online curricula increases accessibility of high-quality health education in most settings, for example in its ability to allow students access to content without geographical or temporal barriers. It enhances teaching and learning outcomes through standardisation of curricular resources and individualising curricular experiences, with use of a structured framework. [6]

In healthcare education, e-Learning has been associated with positive outcomes. [1] Following the COVID-19 pandemic, delivery of pre-recorded non-clinical lectures has demonstrated improvements in curriculum delivery, including increased flexibility and transition to self-directed learning. [12] Blended learning has been shown to increase self-efficacy,engagement, higher-order thinking and clinical skills in the healthcare setting.[13] Advancements in the areas of simulation, Virtual Reality [VR] and Artificial Intelligence [AI] complement the subsequent rise in telehealth, in Australian healthcare, as Australia has invested over $103 million in permanent telehealth services. [14] The pandemic has had a significant impact on rural communities and has exacerbated disparities to vulnerable populations, however telehealth is a solution which has been shown to reduce these inequities. [9,15] Transition of healthcare delivery to virtual services has provided opportunity for

medical schools to enhance teaching around telehealth, which may improve access to healthcare for older populations, people with disabilities and minimise location barriers for rural communities. [9]. Thus, use of technology in blended learning models have potential to contribute to UN Sustainable Development Goals (SDGs), including SDG 4: Equity and High-quality Education for All,and SDG 10: Reduced Inequality.[16]

Thus it can be seen that while online learning presents new challenges in pedagogy and curriculum design, its incorporation with in-person teaching as a part of the hybrid model can present students with novel and advantageous modes of learning. [9]

Reflexivity and feedback

Additionally, the implementation of e-learning enables tracking of student performance, encourages flexibility and self-directed learning driven by the student's own abilities and interest, at their own pace. [18] It has also been shown to minimise geographical barriers, increasing accessibility to education, positively impacting on student wellbeing. [18]

Online learning was perceived by students as most valuable when associated with real-time feedback, self-assessments and extended time for completion. [19,20]

A systematic review of the impact of blended learning in clinical education found improvement in healthcare students' competencies, including reflective thinking [21], self efficacy [22], clinical reasoning and skills such as history taking, examination, documentation and patient management [23,24]. Reflective practice is known to enhance deeper learning of clinical skills and development of clinical reasoning within the health sciences has been supported by use of online technologies such as blogging. [25] Clinical competency through the use of technology to explore evidence based practice in clinical settings have received positive results from students.

Challenges and Navigating Solutions

The Organisation for Economic Co-operation & Development (OECD) identified differences in students' attitudes and skills towards independent learning online when compared to face-to-face learning. These include challenges such as maintaining motivation online and developing digital literacy to navigate online learning platforms As such, there is an imperative to minimise barriers to engagement in online settings wherever possible [26]. It is to be noted though that these limitations and challenges have prompted opportunities for solutions which facilitate student-directed learning through information technology. [27,28]

A central challenge to web-based learning is issues of access. Students from low socioeconomic status (SES) backgrounds as well as those who live in remote geographic locations may be unable to access high-speed internet connections (29) therefore limiting their ability to utilise online learning, tutorials and resources. (30) Those from low socioeconomic backgrounds may also face barriers when accessing equipment such as laptops and tablets which are essential for online learning. Consequently, they may be disadvantaged in completing assignments and online classes. (31) Therefore, students who have not had the same access to digital learning in the past, may be less competent in optimising their digital learning in comparison to their peers. This may have a negative outcome on their medical education. Medical schools themselves have different access to technological resources which is often influenced by economic and social factors which impact the individual schools themselves. Therefore, depending on their institution, medical graduates may demonstrate varied levels of competence with medical technology in areas such as Electronic Medical Record among other infrastructure which may in turn impact on patient health outcomes. (32-33)

Another challenge of access has been for students with disabilities. Though IT use has become increasingly common, there is a broad range in how it is used by people with disabilities. In the context of the medical student cohort of Australia, estimates are that around 2% disclosed a disability of some kind. (34) Even without considering the figure may be under-reported due to ongoing stigma, this represents a sizable population for medical schools to consider when incorporating IT into their education streams. As such, it is necessary to understand the perceived difficulties faced by people with disabilities in order to make the appropriate accommodations and promote equitable access.

In some respects, technologies used in learning increases accessibility for some students with disabilities. Online recordings allowed students a sense of self-control to study at their own pace and environment, with the freedom to review key materials later, which was particularly helpful for students with dyslexia. (35) However, within the interface of online environments some key difficulties lie within search and navigational aspects which present increased challenges for people with dyscalculia and language-related diagnoses. (36) Translating to a medical education context, this can present challenges in accessing online lectures, or navigating to important assessment items which directly impacts the education that is able to be delivered to these students. In the field of online exams, certain implementations of proctoring software in online exams have shown discriminatory bias in flagging neurodivergent behaviours as false positives for cheating, further increasing barriers for students with disabilities in medical education. (37) Facing these problems, incorporating either a principle of universal design in the applications and

environments where online content is delivered and assessed, or allowing access to alternative applications with more accessible interfaces here would not only help students with disabilities, but all students as well by virtue of lowering the barriers towards use of IT in medical education. (38)

A central part of face-to-face education is student- facilitated discussions, which provide the opportunity for learners to consolidate and refine their understanding through peer-based learning. The shift to online learning, by its very nature, has this reduced capacity for peer-based learning and student-facilitated discussion as an issue. However these interactions can be emulated through the use of online tools. Online platforms including discussion forums present an opportunity to facilitate student-directed collaborative practice and open communication with limited staff moderation. Ongoing evidence supports the use of online forums in supporting social connectivity and facilitating self-learning amongst students. (27)

Quite pertinently to the medical education context is also the decreased patient interaction. Some studies have found that students may perceive lack of interactions with patients as issues with online learning. (39) Simulation technologies may perhaps mitigate issues regarding decreased patient interaction in scenarios where there are no face-to-face alternatives but further research needs to be conducted on the extent of its effectiveness. (34)

Additionally, the COVID-19 pandemic required both educators and students to develop digital competency skills with new technologies. (41) A systematic review on the implementation of blended learning revealed inadequate IT skills and lack of infrastructure are challenges faced by educators and students. (13) The success of online learning strongly depends on technological literacy, thus there is a need for increased accessibility to faculty training. Investment into maintenance and update of technological platforms and infrastructure is required for high quality provision of online learning. (10)

Consistent monitoring and evaluation are required to assess whether the advantages of real time feedback, self-directed learning and flexibility outweighs potential challenges such as social isolation, staff unfamiliarity or discomfort with technology use.

<u>Evaluation</u>

Each phase of hybrid models must include transparent and reliable monitoring and evaluation of online delivery, with support for continuous improvement during and after implementation. Evidence suggests there must be rigorous and robust evaluation of the implementation of technology, with assessment of usability, sustainability, student experience and satisfaction. (1,28)

Studies have shown that from the students' perspective, improvement of the learning experience in the preclinical curriculum requires: (1) consistent and standardised implementation of blended model across the course (2) timely uploading of online learning resources to increase student access to materials (3) recognition of face-to-face content which cannot be replaced with online delivery (4) clear communication of online and face-to-face class expectations, and estimated time required (5) alignment between online content and face-to-face class activities.

Student and teacher satisfaction with the online learning experience and educational outcomes are pillars in the quality framework of the Online Learning Consortium. (42) These measures are highly predictive of quality and outcome of online delivery. (43) Thus, regular evaluation of online learning and technological platforms is essential for effective provision of high quality, updated medical education.

Web-Based Clinical Education and Technology

Online teaching has long been a medium that transcends geographical and regional boundaries to deliver education - including that of in the pre-clinical and clinical years of medical schools. The COVID-19 pandemic necessitated an abrupt shift to a remote learning environment - with online lectures, tutorials, virtual laboratory sessions, online case-based learning and quizzes becoming the mainstay of continued medical teaching in the unprecedented times. As the world becomes more accustomed to the new normal of the post-COVID era, many of these education delivery methods remain, along with their benefits and disadvantages.

Compared to traditional face-to-face methods of teaching, WBTs better facilitate self-directed learning, where students are able to learn at their own pace and revisit stored or recorded educational material at any time (44). Interactive web-based tutorials were compared against these traditional methods and found to be more effective at inculcating cognitive skills and refining skills in virtual patient interactions (45). The accessibility of WBTs offers unique advantages to certain student subgroups - those from non-English-language backgrounds, students with various disabilities (such as fatigue disorder or dyslexia), students from regional and rural areas where access to live lectures may be difficult, or those quarantining and social distancing (46-47). The use of IT in medicine extends beyond students' interactions with their medical school curriculum and personal study (48), and provides a foundation for using web-based technologies within the hospital system after medical school. Outside the medical school curriculum, applications and Internet resources such as Amboss, Osmosis, online databases and OSCE case studies have been proven to successfully bolster clinical learning (49).

That being said, WBTs have a multitude of limitations. The ability to rewatch lectures at one's own pace may impede productivity and further aid procrastination (50). "Cultural resistance" from tutors and faculty has been touted as a barrier to WBTs - where technical issues and poor technical education in educators inevitably results in poorly-facilitated learning experiences (51). Staff-centred training sessions within medical schools may aid in preventing this from being a barrier to effective knowledge delivery. The quality of lectures, live or recorded is paramount to the student engagement and outcomes, and certainly live lectures have been reported to remain more engaging for students, but this does not negate the added benefits of WBTs (52-53). Particularly in the context of clinical education, practical skills and hands-on experience are indispensable facets of medical school that cannot be replaced with WBT (50).

As such, while WBTs have a host of advantages to offer, they are best used as adjunct methods to traditional clinical teaching. Establishing a blended learning environment - that is, incorporating and balancing the strengths of virtual and face-to-face teaching - allows students to maximise the benefits of both and enjoy a fruitful medical education in this digital age (50).

Simulations

The ongoing lack of clinical training opportunities in community-based settings—aged care in particular—only worsened during the COVID-19 pandemic (54, 55). The advantage of technologies that can provide virtual simulation is the opportunity for clinical schools to provide students with the exposure to particular clinical experiences that may not be possible in the real-world setting due to barriers such as pandemics. For example, few medical students will observe serious complications when attending real births during their training; however, it is possible to provide a simulation program guaranteeing this exposure (56,62). Engaging in virtual reality during clinical learning also reduces the risk of mistakes during practice and can increase confidence (60).

Virtual Reality (VR) refers to a form of simulation in which the user is completely immersed within the virtual world. (62) The two main types of VR are immersive and screen-based. Immersive VR (iVR) requires more infrastructure, posing a possible issue for smaller campuses (62). Furthermore, a VR programme itself is currently costly and it is difficult to ascertain the exact cost per school, however as the use of VR in medical education becomes more commonplace and in demand, the supply of such technologies will increase, and prices will subsequently drop. Companies such as Medical Realities have worked with universities to provide a platform for students to practise OSCEs and provide trials for universities to experience VR (63). VR has

been proven to give students a better perception and thus improve their memory and learning (61). It has been shown that iVR engages learners more, and they acquire better cognitive, psychomotor and affective skills (57, 58). The most frequently used systems in medical training, however, are screen-based VR simulators. The nontechnical skills addressed in this VR simulation mainly include teamwork, communication, and situational awareness (64).

OSCEs could provide the perfect situation to evaluate the usefulness of VR and lead standardised patient interviews in a completely virtual environment to address many clinical education needs. It will allow clinical coordinators to test students' abilities to react in various clinical scenarios that would otherwise be too complicated or require too much man-power to replicate and organise. The use of VR in an OSCE could also decrease the cost of supplying students with mass packs of medical equipment and the man-power required to prepare. Ultimately, it may be more cost efficient to invest in a VR training program that increases the objectivity of their assessment processes(59).

With increased use of VR in assessment, and without wholly replacing face-to-face contact in clinical training, it will be possible to gain data on whether using VR during OSCEs has assisted students in real-life clinical scenarios of the same calibre.

Augmented Reality (AR) is a form of simulation in which virtual modalities are superimposed and integrated with a user's environment, unlike VR in which the entire environment is virtual. Augmented reality (AR) has been proposed as an alternative to combat the cost of VR. Human cadavers and physical models, for example, can only represent a limited number of pathologies, and the true range of individual variation is often poorly encapsulated within any given medical school. In contrast, multiple pathologies and subtle anatomical variations can be easily added to virtual representations via AR programs such as HoloHuman. These programs are also widely accessible on mobile devices, such as tablets, providing a medium for students to access cadaveric models outside of an anatomy lab. Due to its flexibility in integrating physical and virtual environments, and lower cost AR-based programs are increasingly used in education compared to VR (61).

Simulation is already an integral part of mainstream medical and healthcare education and technology will likely play an even greater and more important role in the near future(58, 62).

Medical Examinations and Assessments

The rapid shift to remote learning caused by the pandemic meant that universities also had to conduct assessments online (65). Although some institutions already had established online platforms, many had to make significant changes to the delivery of assessments and explore existing platforms (66). Universities have out of necessity adopted online examinations. Conducting assessments online meant students had more flexibility in terms of adjusting their exams for personal needs. Additionally, the administrative burden of printing papers and organising venues for exams was eliminated with the help of e-exam platforms. Considering many medical schools still have some exams in the multiple-choice-question (MCQ) format, having the exams online allowed universities to mark quicker and provide students with feedback faster (67).

Hence, many universities continue to integrate e-exams into their curriculums for both formative and non-formative methods of assessment (65). Furthermore, a study conducted by medical education leaders at a large UK medical school concluded that conducting clinical examinations such as OSCEs online is feasible and may also bring advantages and enhancements; for example, examiners who took part in the study commented that hitches were easier to report online as compared to face-to-face (68). Therefore, assessment methods should be re-evaluated as the age of digitisation approaches (59).

That being said, there are many limitations to online assessments, especially with regard to privacy, cheating and unfairness.

In order to comply with social distancing rules brought about by the pandemic, many universities adopted online proctored exams which allow students to sit for examinations remotely while still being monitored digitally with the aim of preventing cheating (69). However, there are concerns as to how much control the proctoring platforms have over students (70). Students at the University of British Columbia argued that proctoring platforms could invade privacy as they capture students' biometrics and behavioural data which puts them at risk of data breaches (70,71). More importantly, they also mentioned that students found the faceless online proctors very invasive and anxiety-inducing. This may disproportionately affect the examination performance of students with anxiety or sexual trauma. Additionally, the accuracy of online proctors has been criticised (72). There have been reports of racial injustice as some platforms do not identify darker-skinned people as accurately as lighter-skinned people (71,72). In the United Kingdom, some students resorted to wearing adult diapers to avoid their assessment being terminated (71). Hence, many argue that online-proctored examinations are a breach of the duty of care universities owe students (71).

A report done by Swansea University suggests that online exam cheating has drastically increased since COVID-19 and the rise of remote learning (73). This raises serious concerns regarding the abilities of medical students and the implications on patient care as students may still pass their examinations despite not being competent for clinical practice (74). It also increases the chances of students missing out on opportunities solely from being outcompeted by someone who cheated during an examination.

Additionally, concerns have been raised over the prospects of cheating in online exams due to technologies and tools that assist students in doing so. Remote desktop and screen-sharing tools, in addition to traditional methods which are exacerbated due to a lack of control over the examination settings, increase the likelihood of academic dishonesty. (79) Proctoring tools and keystroke recognition are implemented to mitigate this, however face privacy concerns. (76)

Clearly, online examinations have some advantages over face-to-face examinations, especially with regard to logistics and flexibility for students. However, much needs to be done to ensure that online examination platforms treat all students fairly and are sufficient to assess student competency. While examinations were especially affected by the COVID-19 pandemic, issues regarding academic integrity and plagiarism in take home assignments have always been of great concern.

Pilot trials had been undertaken in Australia medical schools to utilise IT to gather feedback and learning analytics of referencing errors in student assessments with some limited benefits, though restricted by a lack of understanding between staff and students in using these tools to their maximum extent. (77) In a similar regard, current plagiarism checkers that are widely used in universities have not been deemed sufficient for coverage of a wide variety of sources, identifying student techniques to disguise plagiarism (via word replacement or paraphrasing), and multi-source compilation, hence requiring further research and development for effective use between staff and students. (78)

Cybersecurity and Privacy

With the increased use of IT in medical education comes a question of preserving student privacy due to the pervasive nature of technology in gathering and storing detailed personal information of students which may be left vulnerable to leaks by third party interference. The introduction of videoconferencing software for use in lectures as an example has caused concerns of privacy amongst student bodies due to innate vulnerabilities and a lack of transparency in where the information is securely stored. (75) Inadvertent capture of sensitive information has been shown to occur with no guarantees for the safety of the information from potential cyber-attacks. (73) Additional concerns arise from an opaque implementation of user join

review, leading to potential third-party individuals with ill-intent to join and disrupt private meetings. (76) Considering these tools can be used for virtual simulated training or discussing sensitive patient clinical information, the potential for violating patient confidentiality is also present.

Health service providers have been the leading target of malicious cybersecurity incidents in Australia. (80) Cybersecurity attacks against healthcare services may lead to delayed procedures and tests for large groups of patients [81], increased health expenditure [82], reduced trust from the public [83], and increased patient mortality. (80-85)

Health workers are the major target for cybersecurity attacks. According to a PriceWaterhouseCoopers report, 89% of initial hospital compromises occur through emails, and 57% of cyberattacks begin with trusted insiders. (86) Achieving a cyber-literate and cyber-conscious workforce through education is a major strategy for healthcare organisations to prevent cybersecurity attacks. (86-88).

Working amongst the front-line health providers, medical students are allowed access to a multitude of patient and hospital information with little experience and guidance regarding cybersecurity. However, we were unable to identify any cybersecurity research targeting medical students or other healthcare workers in training in Australia. Existing publications support the view that cybersecurity education has been lacking in University education programs globally. (89-92)

Australian government guidelines for universities emphasised on the need of a cybersecurity strategy that involves addressing cybersecurity as a whole-of-organisation “human” issue. (87) The recommended solution puts strong emphasis on fostering cultural change hence inducing a strong demand for cybersecurity education for medical students.

Artificial Intelligence

Artificial Intelligence (AI) is rapidly transforming the healthcare industry, enabling doctors and medical practitioners to deliver more efficient, accurate, and personalised care to patients. With advances in machine learning, natural language processing, and image recognition, AI tools are being used in numerous medical applications, from diagnosis and treatment to drug discovery and patient monitoring (93-96).

Currently, AI in healthcare is being used to analyse vast amounts of data from electronic health records, medical imaging, and other sources to identify patterns and predict outcomes (97). For example, AI-powered algorithms can help diagnose diseases, such as cancer, by analysing radiology images, or predict patient outcomes based on historical data. Correspondingly, as these AI tools continue to

advance, it is important for medical students to become familiar with these technologies. Globally, some medical schools are starting to incorporate AI into their curricula, exploring the role of AI in healthcare and how it can be used to improve patient outcomes. These courses teach students how to analyse data, build predictive models, and develop algorithms that can assist with diagnosis and treatment (98). Given that clinicians themselves have often been resistant to explore AI research, this is a productive development in broadening the adoption of AI in healthcare systems (98). Broadly, these potential cases demonstrate the advantages of building AI literacy in medical students, which could be translated to Australian medical students with the potential for similar benefits.

Within the recent cultural and technological milieu, ChatGPT has perhaps presented the greatest interest in the field of medical education. ChatGPT is a chatbot introduced by the AI company 'Open AI' within 2022, which has a user interface embedded to allow the general public to interact with it directly. It illustrated its capacity for impact within medical education when Kung et al. discovered that ChatGPT performed at the threshold level for three of the United States Medical Licensing Exams (USMLE) for medical students (99). The ability for artificial intelligence to succeed in notoriously difficult medical examinations presents novel and interesting questions upon the role that AI will have in education, clinical decision making and in patient treatment. In an interesting application of the software, a study utilised ChatGPT itself about the role of generative language models in medical education, on which it replied that it can assist with patient simulation, personalised learning experience, enhancing medical textbooks and generating summaries of research. It is not just in medical education, but in the wider field of medicine that ChatGPT raises interesting questions and concerns, in its ability to carry out clinical decision making, translational research and analysis of diagnostic modalities (100). The fear, common to many industries, of complete automatisation and replacement with technology has been slowly growing within medicine but the general consensus sees AI as an adjuvant technology that will replace more mundane, more repetitive tasks for clinicians and will assist patients overall. This may be particularly prevalent in specialties such as diagnostic radiology and pathology. However, it is to be noted that the recency and relative dearth of research upon this area calls for caution about future speculation despite the rapid developments in this area (100,101).

In conclusion, AI is changing the landscape of healthcare, and its potential to improve patient outcomes is enormous. As AI tools become more sophisticated, it is crucial that medical students become familiar with these technologies, so they can leverage them to improve patient care. By integrating AI into medical curricula, healthcare organisations can create a workforce of AI-literate doctors who can use these tools to deliver more efficient, accurate, and personalised care to patients.

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