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Darrell J R Evans, Boon Huat Bay, Timothy D Wilson, Claire Smith, Nirusha Lachman, Wojciech Pawlina

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Editorial

Going Virtual to Support Anatomy Education: A STOP GAP in the Midst of the Covid-19 Pandemic

Darrell J.R. Evans[1], Boon Huat Bay[2], Timothy D. Wilson[3], Claire F. Smith[4], Nirusha Lachman[5], Wojciech Pawlina[5,*]

[1]School of Medicine and Public Health, The University of Newcastle, Callaghan, New South Wales, Australia

[2]Department of Anatomy, Yong Loo Lin School of Medicine, National University of Singapore, Singapore

[3]Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry, Western University, London, Ontario, Canada

[4]Department of Medical Education, Brighton and Sussex Medical School, University of Sussex, Brighton, United Kingdom

[5]Department of Clinical Anatomy, Mayo Clinic College of Medicine and Science, Mayo Clinic, Rochester, Minnesota

Running title: A ‘virtual’ stop gap approach for anatomy

*Correspondence to: Dr. Wojciech Pawlina, Department of Anatomy, Mayo Clinic College of Medicine and Science, Mayo Clinic, 200 First Street SW, Rochester, MN 55905. USA. E-mail: pawlina.wojciech@mayo.edu

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"All hands on deck, we need to move everything online as quickly as possible". This is the message that has been ringing out across universities worldwide over the last couple of months as the Covid-19 pandemic has taken hold. Anatomists have responded to this call enthusiastically and creatively, ensuring that their students have resources available to continue and support their learning as they are forced to study remotely and exercise social distancing and where necessary self-isolation. Despite the seriousness of the health situation, this new drive to move to online learning provides the necessary opportunity to assess our future approach to curriculum design and delivery for the anatomical sciences. This pause to reevaluate is necessary as online learning, offers up refreshing and pedagogically innovative approaches to facilitate learning. For many courses and programs however, it is not the long-term silver bullet solution to all learning provision and has consequences that must be considered.

Since the turn of the 21St Century, the world has observed the emergence of coronaviruses that have posed serious public health threats. First, the 2002-2003 severe acute respiratory syndrome coronavirus (SARS-CoV) epidemic, followed by human infections due to the Middle East respiratory syndrome coronavirus (MERS-CoV) which was first reported in 2012 (de Witt et al., 2016; Lai et al., 2020). Like SARS, MERS can result in severe respiratory disease, which is characterized by life-threatening pneumonia and renal failure (Al-Tawfiq et al., 2014). And not surprisingly,

we are now plagued by the current outbreak of a highly infectious disease which is caused by the novel pathogenic SARS-CoV-2. Symptoms associated with the Coronavirus Disease 2019 or Covid-19 include fever, dry cough, myalgia and fatigue (Huang et al., 2020; Wong et al., 2020). In more severe cases, the infection can cause pneumonia, severe acute respiratory syndrome, kidney failure and even fatality. The WHO has declared Covid-19 due to SARS-CoV-2, a pandemic and global health emergency (Velavan and Meyer, 2020). As of 2 April 2020, there were 719,669 confirmed cases with 42,075 deaths worldwide (CSSE, 2020). Covid-19 has served as timely reminder of our vulnerability to biological threats (Palmer, 2020).

In light of the rapidly evolving Covid-19 situation around the world the global impact of this pandemic is reflected through the far reaching geopolitical and economic consequences. Governments have stepped up measures in a bid to contain the virus and curb further spread. The Covid-19 virus has adversely affected global trade and supply chains, caused the value of assets to plunge and impacted multinational businesses (Ayittey et al., 2020). As Covid-19 has affected the economy of China (where Wuhan was the epicenter of the initial outbreak), which is the largest exporter of intermediate manufactured goods, this has spilled over into a global effect (Bloomberg, 2020). Moreover, as countries close borders and go into the lockdown mode to constrain viral transmission, it is foreseeable that more geopolitical ramifications will ensue.

The education sector has not been immune to this health pandemic with more than 1.5 billion students attending schools and universities affected by nationwide closures in 188 countries as of 2 April 2020 (UNESCO, 2020). As dense communities are known to be particularly at risk of Covid-19 (Velavan and Meyer, 2020), social distancing rules and full lock-downs have been implemented to try to curb the risk of community spread and limit the exponential rate of infection that has devastating effects on the ability of national health services to cope with those affected. For universities and colleges this has meant the complete closure of campuses or at least a severe reduction in the number and type of face-to-face learning sessions offered to students. As a consequence, educators are rapidly adapting their learning provision by moving as much online as possible so that students can continue to learn and engage, albeit remotely.

Any move to online learning where the main facilitator is the use of the internet, requires effective integration of e-learning platforms, technologies and pedagogies that should enable educators to offer new more effective and impactful learning opportunities. E-learning has thus been touted as one of the most important developments in graduate and postgraduate medical education delivery (Harden, 2006). Anatomists have played pivotal roles in the promotion of computer-based educational innovations (Trelease, 2016) and an array of e-learning resources have been used to augment conventional anatomical teaching methods (Estai and Bunt, 2016) and shown to enhance student learning (Lochner et al., 2016). The inclusion of such innovative approaches is therefore unsurprising to many in the anatomical sciences field as one of tasks of the anatomist in

medical education has been to design and shape the learning environment (Pawlina and Drake, 2017). Moreover, most of the students belong to the Millennial generation who are active in using social media such as YouTube (Barry et al., 2016) and are adept in the use of technology-enhanced learning resources (Pickering and Swinnerton, 2019). Additionally, this journal has demonstrated since its inception that anatomical sciences pedagogy is constantly evolving, with technological advances playing an increasingly definitive role.

Recent discussions on social media and anatomy association forums indicates that the anatomical community has responded to the Covid-19 crisis, and come together energetically to think about how to quickly change the delivery of anatomy teaching, share a range of learning assets, resources and approaches, and importantly support each other (especially for good mental health). This positive response is reassuring and demonstrates the ongoing importance of nurturing a strong academic community and how this connectedness can keep anatomy education invigorated and encourage educators to challenge and adapt their practice and while striving for new innovations and impactful advances. Such rapid transitioning of learning materials and approaches to online platforms demonstrates agility and responsiveness and is socially responsible in the current circumstances, however, also highlights significant concerns, particularly those related to quality and effectiveness.

To avoid a poor-quality learning experience, online learning needs to be created within a curriculum design framework that focusses on effective pedagogical principles and is

further supplemented by an understanding of what makes online learning work for students (Martin and Bolliger 2018). This means (1) knowing how to engage students in an online environment providing them with intuitive interaction, (2) enabling social learning connections with educators and their peers, (3) promoting active facilitation and learning support (including feedback) through synchronous and asynchronous channels (Chen et al., 2005) and (4) utilizing appropriate smart technologies and digital learning assets that enhance the experience. Thinking differently about how and what to deliver is critical as there is a distinct danger that some educators will simply transition existing resources to an online environment without thinking about how learners will engage and interact with it. One example would be uploading 50-minute lecture recordings for students as a core basis for learning. Such an approach does not engage most online learners and delivered in an online environment is particularly ineffective in disseminating knowledge and promoting deeper learning. Reports appear to show that students watching lecture recordings can also become easily distracted by other activities such as engaging with social media (Zureick et al., 2018) and unlike in a live lecture this is not easily addressed by the educator. Instead such a lecture session should be re-designed (not transitioned) to provide a series of short 5-7 minute videos that are engaging in their format and focus on one or two concepts or themes, and which are interspersed with other learning objects such as a mini-quiz, a case study, interactive technology or activity task such as a live discussion. This re-design is all aimed at maintaining as much active engagement as possible and aligns well with established multimedia learning theories (Mayer and Moreno, 2003).

Anatomy has, perhaps, a unique challenge in moving to online delivery. Large numbers of anatomy programs use a range of face-to-face physical-based activities (Heylings 2002; Craig et al., 2010; McBride and Drake 2018; Pan et al., 2020; Rockarts et al., 2020) that are not so easy to adapt into a session delivered using technologies such as Microsoft Teams or Zoom. These include cadaveric dissection sessions, living/surface anatomy and clinically focused sessions using hands-on equipment such as ultrasound. For many the recently enacted lockdown procedures mean that facilities are unavailable to use for creating new learning resources e.g. dissection videos, compounding the challenge for educators of moving learning online. Educators new to delivering online anatomy education will need to balance the amount of content delivered against the quality of the learning materials offered as the quality of the experience affects generative processing and ultimately learner motivation to be in that environment with us (Wilson, 2015).

Creating a supportive environment for learners, especially for a subject that is three-dimensional in naiure, and often learned experientially, requires a different approach when moving to a fully online mode of delivery. Provision of purely asynchronous learning resources with an “off you go” message to learners doesn’t provide either an engaging or enabling learning experience and omits the fundamental educational principle of interaction which facilitates effective learning (Dreon et al., 2019). For a face-to-face delivery this may occur through active-based learning pedagogies or an informal conversation in the anatomy laboratory. When it comes to online environments however, there is a need to be overtly deliberate by incorporating active learning

approaches, opportunities for students to engage and interact with each other and the educator/tutor, and where possible incorporation of some synchronous sessions such as a webinar or a question and answer session. The use of polling features integrated into many systems may enable the tutor to still gauge levels of understanding and give the learner immediate feedback. Overall, online learning requires educators to create a guided and curated learning journey for their students that is specifically designed for online and focuses on enabling connected learning where purely didactic approaches may not be the first choice. Such an approach will be particularly required to support students who might normally be struggling with their learning or those that don't have high engagement levels in the traditional learning and teaching environment. Disengagement with learning or the feeling of isolation as a learner can be heightened in the online world (Gillett-Swan, 2017) where social presence is diminished. Educators must be cognizant that many students in online courses report feelings of social disconnectedness, missing familiar teacher immediacy, and likewise missing interpersonal interactions and social cues they more typically have in "traditional" learning environments (Slagter van Tryon and Bishop, 2009). Moreover, many of the aforementioned components of an engaging learning environment are what many anatomical educators take for granted in our face to face scenarios.

Effective online learning requires all this effort and pedagogical focus to ensure the best learning opportunities that enable student success are provided. If anatomists get this wrong then student learning will suffer as a result, the student experience will be poorer and professional reputation will begin to deteriorate. It is already clear that students are

questioning whether online learning should cost the same as face-to-face classes with students in the UK already campaigning for tuition fee refunds (Turner and Rowan, 2020). Although the question of cost differentials between online and face-to-face provision should be debated, poor quality online approaches and resources should not be the driver of this discussion. Obviously, the need to get materials and resources up online quickly will mean some compromises are inevitable in these first offerings, however following sound pedagogical principles wherever possible must still be the goal with the opportunity to subsequently evaluate what's been offered and to re-plan and adapt as required. The increased interest in moving to online has also opened up the door to numerous companies offering platforms, learning objects and online design help. Utilizing such help might expedite some of the transition, however, it is likely to be expensive with appropriate due diligence and oversight necessary to ensure what is being produced is pedagogically sound, of high quality and meets curriculum needs. In using such companies, colleagues will also have to balance the potential efficiency of using an external provider against building in-house capability and capacity and the ongoing sustainability that brings. Some companies are offering access to some of their resources either free or at reduced rates for a period of time. Although this is welcomed, it will be important for anatomists to curate these resources into their curricula and identify how their availability might be sustained into the future otherwise a re-setting of student expectations will be required further down the line, when resources are no longer available. A more effective way to accelerate a transition to online could be to actively include teaching assistants (TAs) in the learning design, facilitation and support required. Some TAs may already be feeling isolated, unsure of their role when face-to-

face teaching has been temporarily removed and educators may be caught up in the moment of rushing to getting content online that they forget their partners in education, the TAs. Therefore, TAs could be commandeered to help in developing new learning objects, transitioning materials, testing course elements as well as playing an important role as online tutors and facilitators, adapting their current skills sets to support learners remotely. The implementation of synchronous learning support will benefit the learning experience and promote engagement (Racheva, 2018).

One particular challenge for anatomy educators in transitioning to the online world is how to approach assessment and the need to develop assessments that continue to meet quality, access and assurance requirements. For many this could mean a default emphasis on multiple-choice style assessments for ease and reliability, but which may restrict the opportunity to assess anatomical knowledge and understanding most appropriately. This maybe adequate for a temporary move to online and to meet issues associated with the current situation, however a sustained online approach would require more innovative thinking and technical facilitation. The desire to adapt assessment practice has already been somewhat curbed by concerns over cheating in assessment which has been recognized as a growing issue by many colleagues and is heightened when considering online assessment where the ability to check the student's identification and/or proctor the assessment, for example, is challenging. Some institutions have already advanced in this area either in offering in-person e-assessments or online synchronous or a-synchronous assessments. In addition, many learning management systems have inbuilt approaches to assessment,

question/answer randomizations, digital drop boxes and other attributes that can help to limit some potential cheating opportunities. Colleagues should investigate what might already be possible in their institutions and be in the knowledge that the current situation is likely to have the effect of a rapid advancement in online assessment. Although there are recognized difficulties, there are also opportunities for assessment, which include the chance to review the efficacy of current assessment approaches for the 21st Century and the changing workforce, develop an emphasis on implementing increased formative assessment as well as thinking creatively and assessing in different ways, perhaps using some online synchronous approaches.

Implementation of effective and successful online learning and inclusion of digitally enabled resources can provide a range of other positive outcomes including developing a learning environment that caters for students with a different pace of learning and those that require multiple learning channels, as well as facilitating opportunities for deeper learning (Ozer et al., 2017; Guy et al., 2018). The new generation of students are largely digitally literate and easily interact with web-based approaches (Durosaro et al., 2008) and so should be able to transition to online learning (Internet infrastructure depending) without too much angst, although these students will be very aware of what ‘good’ looks like, further emphasizing the need to produce a quality online experience. Personalization of learning and the ability to have increasing flexibility is becoming more of the norm and therefore a move to supporting learning anatomy anywhere and at any time, particularly for non-traditional learners is appealing. Such flexibility of learning allows some students to adapt their learning around other requirements including those

that are financial (e.g. needing to work to support their study) or social (e.g. needing to act as a career). The question of equality of learning through online however must also be cognizant of the access to good internet connectivity (Gbolahan Balogun, 2019) and availability of computer hardware. Appropriate bandwidth is required so students can optimally engage with the learning resources made available, which for anatomy can be extensive data heavy. Where this isn't possible such as in rural locations or in some countries, students will receive a poorer experience and therefore anatomist should think about how they might bring in other strategies to mitigate this.

Achieving quality online learning courses also brings its own dangers with a perception that if anatomy can be delivered in a fully online environment with successful results, why not use this as a default approach and cut the face-to-face experience along with the associated expenses. Some university administrators may look upon this possibility with excitement for a number of reasons, but a cut to face-to-face time for instance will not facilitate opening up a timetable as the learning load for the student will not have changed (Dreon et al., 2019). In addition, administrators should not view online learning as a cheap option as the purposeful development of an online curriculum and the associated learning and technical support that is needed demonstrates that an ongoing commitment to appropriate funding and staffing is required. The choice of whether to move to fully online is a pedagogical one and inextricably linked to other factors such as the goals of the program, the discipline and the students. Mindful decision makers will need to recognize that the current situation has not been about a drive to move

anatomy learning delivery online, rather the need to support learners that have suddenly found themselves to be students that must learn remotely.

The emphasis on remote learning rather than online learning should be remembered and is one of the key reasons that the current transition must be viewed as temporary or a stop-gap solution and not a non-returnable transition as students will return in person and no longer be remote. Reproducing the physical and tactile-based experiences that characterize traditional face-to-face approaches to teaching anatomy and which emphasize social and teamwork interactions are not currently possible or ideal in an online environment and therefore validate a continued focus on the physical anatomy lab as the major continuing component of the anatomy curriculum. Anyone that teaches anatomy to students in healthcare and science-based programs also knows that the face-to-face experience provides much more than an opportunity to deliver anatomical knowledge and understanding with opportunities for students to learn non-traditional, discipline independent skills (NTDIS) and demonstrate the hidden curriculum (Evans et al., 2018; Kumar Ghosh and Kumar, 2019). The experience of moving approaches to online and developing new resources isn't wasted effort when we revert to face-to-face delivery and instead should be used as an enhancing experience whereby anatomists have used the opportunity to reflect on what and how they teach, whether the curriculum needs to evolve and how digital and online technologies might promote effective change. The immediate and required temporary transition has enabled educators to produce new learning resources that will continue to augment and enhance the learning experience when there is a return to a primarily face-to-face

approach, provide alternative learning materials for students that are unable to make face-to-face sessions, or facilitate the re-imagining of a course or program to have much more of a multi-modal delivery format.

In addition, there will be opportunities to use the learning objects created in other teaching scenarios and adapt these new online courses to cater for other programs not currently provided for or where anatomy is not compulsory, providing outreach activity or even the development of taster materials. With the blanket impact of Covid-19 measures, health care professionals have also been left to fill voids resulting from cancellations of regular clinical activities with many residency programs, particularly in the United States seeking opportunities to keep physician-trainees and faculty engaged in creditable academic and clinical skills enhancement activities. The impact of anatomy and other foundational science education has long been a point of discussion amongst educators (Older, 2004; Fincher et al., 2009) as the understanding of basic science content is essential to clinical practice (Woods, 2007; Finnerty et al., 2010). The value of anatomical knowledge in filling practice gaps, improving clinical confidence and reinforcing procedural skills is indisputable (Lachman et al., 2018). In this forced "down-time", adopting an online technology-based "point of care" model for delivery of advanced anatomy education as an outreach initiative reinforces the role of basic sciences in continuing professional development and practice improvement (Pawlina and Drake, 2017). Such initiatives keep residents and physicians intellectually engaged, promotes clinical interaction and collaboration between anatomists and physicians, enhances knowledge of anatomy by opening up discussion for changing

perspectives and paradigms, and strengthens clinical and scientific relevance of subject material for both anatomists and physicians.

The response of higher education to the Covid-19 crisis, including the anatomical community has been rapid to ensure students are provided with continued opportunities to learn remotely. Such an emphasis on teaching and learning should be welcomed and the enthusiasm and creativity being demonstrated encouraged and nurtured. However, it is clear that this situation has also revealed for some an inevitable reliance on traditional thinking and a reluctance to see what digital technologies and the internet might bring to the student learning experience and help advance pedagogy and existing approaches. Although a shift to online must be supported at this time, reflective of either a quick shift of thinking or pressure applied from university bosses, ensuring that we don't ignore good pedagogical principles is also a must so that we provide a high quality and effective online learning environment for students. When the situation begins to return to normal and increased face-to-face sessions are again possible, we should be able to reflect that we benefitted from the opportunity to test and review our curriculum content and approaches. We should have gained from the design and implementation of e-learning tools and learning objects that will continue to support the learning experience of our students and use such innovation to improve and inform our existing face-to-face approaches. The success of the response to Covid-19 will be determined by a range of factors, primarily and rightly the learning outcomes of students, but success should also be measured in terms of whether we have continued to secure

anatomy as being adaptive, innovative and at the forefront of evidence-based pedagogy.

Darrell J.R. Evans, Ph.D., F.R.S.B., F.R.M.S., F.H.E.A., F.A.S., F.A.A.A.
School of Medicine and Public Health,
The University of Newcastle,
Callaghan, NSW, Australia

Boon Huat Bay, Ph.D.
Yong Loo Lin School of Medicine,
National University of Singapore,
Singapore

Timothy D. Wilson, Ph.D.
Schulich School of Medicine and Dentistry,
Western University,
London, ON, Canada

Claire F. Smith, B.Sc., P.G.C.E., Ph.D., S.F.H.E.A., F.A.S., F.L.F., N.T.F.,
Brighton and Sussex Medical School,
University of Sussex,

Brighton, United Kingdom.

Nirusha Lachman, Ph.D.

Mayo Clinic College of Medicine and Science,

Mayo Clinic,

Rochester, Minnesota

Wojciech Pawlina, M.D., F.A.A.A.

Mayo Clinic College of Medicine and Science,

Mayo Clinic,

Rochester, Minnesota

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