

OCTOBER 2020 | IeJSME 2020 14 (2)

ISSN 2231-8194

INTERNATIONAL

E-Journal

OF SCIENCE, MEDICINE AND EDUCATION



RT-PCR testing for COVID-19 at the IMU



EDITORIAL BOARD

INTERNATIONAL E-JOURNAL OF SCIENCE, MEDICINE AND EDUCATION (IEJSME)

INTERNATIONAL ADVISORS

PROFESSOR JAMES A DICKINSON

Professor of Medicine, University of Calgary, CANADA

PROFESSOR RON HARDEN

General Secretary,

Association of Medical Education in Europe (AMEE), UNITED KINGDOM

EDITOR-IN-CHIEF

PROFESSOR PATRICIA LIM KIM CHOOI

DEPUTY EDITOR-IN-CHIEF

DR WONG SIEW TUNG

EDITORIAL ASSISTANT

DR LAI PEI KUAN

EDITORIAL BOARD

PROFESSOR MAK JOON WAH

(EMERITUS PROFESSOR, IMU, MALAYSIA)

PROFESSOR TRUDIE ROBERTS

(PROFESSOR [CLINICAL], UNIVERSITY OF LEEDS, UNITED KINGDOM)

PROFESSOR DATUK LOKMAN HAKIM BIN SULAIMAN

(PRO-VICE CHANCELLOR, RESEARCH, IMU, MALAYSIA)

PROFESSOR IAN SYMONDS

(DEAN OF MEDICINE, UNIVERSITY OF ADELAIDE, AUSTRALIA)

PROFESSOR DATO' JAI MOHAN

(PROFESSOR OF HEALTH INFORMATICS & PAEDIATRICS, IMU, MALAYSIA)

PROFESSOR DATO' SIVALINGAM NALLIAH

(CLINICAL SCHOOL, IMU, MALAYSIA)

PROFESSOR GERARD FLAHERTY

(PROFESSOR OF MEDICAL EDUCATION, NATIONAL UNIVERSITY OF IRELAND GALWAY, IRELAND)

PROFESSOR DATO' KANDASAMI PALAYAN

(CLINICAL SCHOOL, IMU, MALAYSIA)

PROFESSOR PAUL CHEN
(MALAYSIA)

DR BALVINDER SINGH GILL
(CENTRE HEAD, MEDICAL RESEARCH RESOURCE CENTRE, INSTITUTE FOR MEDICAL RESEARCH, KUALA LUMPUR, MALAYSIA)

PROFESSOR TENG CHEONG LIENG
(CLINICAL SCHOOL, IMU, MALAYSIA)

DR SHEAMINI SIVASAMPU
(ASSISTANT DIRECTOR, HEALTH STATISTIC UNIT, CLINICAL RESEARCH CENTRE
MINISTRY OF HEALTH MALAYSIA)

PROFESSOR LIM KEAN GHEE
(CLINICAL SCHOOL, IMU, MALAYSIA)

PROFESSOR RAY WILKS
(SENIOR ASSOCIATE [PSYCHOLOGY], RMIT UNIVERSITY, AUSTRALIA)

PROFESSOR DATO' MAIMUNAH BT A HAMID
(ASSOCIATE DEAN, SCHOOL OF MEDICINE, IMU, MALAYSIA)

DR ROZITA HALINA TUN HUSSEIN
(SENIOR DEPUTY DIRECTOR, FINANCING PLANNING, INFORMATICS AND HEALTH ACCOUNTS
MINISTRY OF HEALTH MALAYSIA)

EDITORIAL ADDRESS

PROFESSOR PATRICIA LIM KIM CHOOI
Editor-in-chief
International e-Journal of Science, Medicine and Education
126, Jalan Jalil Perkasa 19, Bukit Jalil, 57000 Kuala Lumpur, MALAYSIA
E-mail: iejsme@imu.edu.my

CONTENTS

EDITORIAL

- COVID-19 – A Malaysian private university’s immediate response to provide testing services** 1
Patricia Kim Chooi Lim, Azizi Ayob, Khai Lone Lim, Shew Fung Wong, Kenny Voon, Lokman Hakim Sulaiman

ORIGINAL ARTICLE

- Development and evaluation of a novel massive open online course in travel medicine for undergraduate healthcare students** 5
Gerard Thomas Flaherty, Lydia Sze Teng Lee, Aida Lina Alias, Hasnain Zafar Baloch, Bryan Chang Wei Lim, Kok Leong Tan, Victor Lim, Lokman Hakim Sulaiman
- Perceived competence of physical examination skills among the registered nurses in a selected private hospital in Malaysia** 26
Wei Fern Siew, Yen Ling Wong, Sheau Wei Lee

COVID-19 – A Malaysian private university's immediate response to provide testing services

Patricia Kim Chooi Lim^{1,2}, Azizi Ayob^{1,2}, Khai Lone Lim¹, Shew Fung Wong^{1,2}, Kenny Voon^{1,2}, Lokman Hakim Sulaiman^{1,2}

Keywords: COVID-19, SARS-CoV-2, pandemic, RT-PCR, diagnostic test

Introduction

On 11 March 2020, when the World Health Organization (WHO) announced the coronavirus disease 2019 (COVID-19) pandemic¹, Malaysia was still in the early phase of the COVID-19 outbreak, with only 161 confirmed cases reported on 13 March 2020.² Initially, the Ministry of Health Malaysia's (MOH) public health measures of containment were effective but since then, the number of cases increased daily and continued in an upward trend; thus the MOH had to change its strategy, moving from containment to mitigation.³ Public health measures during containment include rapid identification of cases, contact tracing, testing of samples, isolation of confirmed and suspected cases, and mobilization of resources where needed.

Malaysia started its pandemic preparedness plan well ahead of time and long before WHO decided to declare the outbreak a pandemic.⁴ Several hospitals were identified to handle COVID-19 patients; a rapid real-time polymerase chain reaction (RT-PCR) test to detect SARS-CoV-2 in patients and contacts was developed, used and distributed to several government hospitals and medical laboratories; and management protocols were developed.

Survey on Laboratory Preparedness

As part of the government's early preparations to handle COVID-19 sample testing, on 23 January 2020, a survey on laboratory facilities to handle diagnostic testing on COVID-19 was conducted by the National

Public Health Laboratory (NPHL) on selected private laboratories including the International Medical University (IMU). Among important information required from the survey are the following:

1. Information on COVID-19 diagnostic testing, virus identification and culture, and other serology testing
2. Willingness of the laboratory to receive samples for COVID-19 testing
3. Identification of laboratory capability and capacity for sample testing per day
4. Willingness of laboratory to participate in a WHO organized proficiency testing programme for coronaviruses
5. Willingness of laboratory to share viruses isolated from specimens produced in-country or internationally, if permission has been granted by referring country with the global laboratory community if requested by the WHO.

Our Research Laboratory responded to this survey and also specifically mentioned that our University has a biosafety officer in-house and our Research Laboratory is equipped with Biosafety Level 2 (BSL 2) facilities and is able to perform detection of coronavirus and novel coronavirus. However, our Research Laboratory has no capability for isolation of novel coronavirus since this requires higher BSL facilities. It is worthwhile to mention that in 2014, our Research Laboratory had previously participated in a 3-yearly survey on assessment of capacity and capability, quality and safety of laboratory services in Malaysia. The assessment was conducted by NPHL for the purpose of establishing the

¹Institute for Research, Development and Innovation, International Medical University
126 Jalan Jalil Perkasa 19, Bukit Jalil, 57000 Kuala Lumpur, Malaysia

²School of Medicine, International Medical University, 126 Jalan Jalil Perkasa 19, Bukit Jalil, 57000 Kuala Lumpur, Malaysia

Address for Correspondence:

Prof Patricia Lim Kim Chooi, Pathology Department, School of Medicine, International Medical University
126 Jalan Jalil Perkasa 19, Bukit Jalil, 57000 Kuala Lumpur, MALAYSIA E-mail: kimchooi_lim@imu.edu.my

laboratory inventory for the country. This laboratory inventory will be used to plan a strategic capability of diagnostic laboratories in preparing for untoward events such as reemerging and emerging diseases. Subsequently after we responded to the COVID-19 survey, our Research Laboratory conducted various discussions and coordination activities with our Institute for Research, Development and Innovation's (IRDI) management and team members in early anticipation of receiving COVID-19 samples. On 6 February 2020 both public and private universities were invited to a COVID-19 laboratory diagnosis training at the NPHL as part of national preparedness and a faculty member from our university was sent for this training.

COVID-19 Sample Testing

On 23 March 2020, the Director of NPHL approached the University's Pro-Vice Chancellor of Research for help to run screening tests for some of its samples as their lab was overwhelmed with the volume of samples it received daily. We were able to respond immediately to this request based on our good practices, staff dedication and preparedness.

However, when we first agreed to assist NPHL in screening, our immediate task was to convert one of our laboratories to become a dedicated testing diagnostic lab. We were fortunate as the University had already established an Advanced Microbiology Collaborative Research Laboratory (AMCRL) in the previous year, initially to take on collaborative research with its international partner universities. This laboratory is well designed and equipped with Biosafety Level-2 (BSL-2) cabinets, with its own air-conditioning system which allows a contained testing for infectious agents including SARS-CoV-2, and access to authorised personnel only.

There were still challenges as this laboratory was a BSL-2 facility and initially, we did not have sufficient personal protective equipment (PPE) to sort and aliquot samples and perform extraction on a daily basis but we will be able to sort this out with NPHL's help. In addition, we needed to move specific equipment e.g. real-time PCR machine, freezer etc. into this dedicated laboratory to reduce the risk of infection. Based on the earlier training provided to our academic staff at NPHL, this staff was tasked to set up working teams comprising of the University's laboratory staff and faculty volunteers. The challenge he faced was to engage Research Laboratory staff and faculty to be volunteers; this was a challenge as they needed to work overtime and even on weekends. But we again were very fortunate to be able to establish our teams immediately due to our Research Laboratory staff and faculty's dedication and deep sense of responsibility and empathy to respond to the nation's call for help and teams were established by 25 March 2020. Of course not all team members were microbiologists or had similar levels of biosafety awareness and training but with further training provided by the NPHL staff on 26 March 2020 to these teams on biosafety and PPE, and data entry into the SIMKA system (web-based portal for COVID-19 test registration process), the University was able to start the testing service at a very short notice. All staff are informed of the risk associated with COVID-19 infection, its symptoms, self-monitoring, reporting procedures and support from the healthcare facility in the event of illness. The University's capability and preparedness to respond to this national need is also due to our good laboratory practices as part of the Research Laboratory has been accredited under ISO 17025:2015 and we are also working towards attaining ISO 45001. The University's Biosafety Committee periodically

conducts training courses to ensure all researchers update their knowledge and adhere to safe laboratory practices. Furthermore, regular team meetings and briefings have been put in place to ensure good communication among all involved. In the initial period of testing, monitoring of the team members' competence was done to ensure the reliability and accuracy of test results.

Compliance to WHO Laboratory Biosafety Manual

Our well trained laboratory staff displayed their talents and innovation in ensuring that the testing was carried out in a very systematic and efficient manner and provided clear instructions to ensure that all team members followed proper Standard Operating Procedures and observed biosafety measures to minimize risk to infection. Donning of PPE is guided with a poster displayed in the laboratory showing the detailed procedure. Upon receiving the samples from NPHL, the samples taken from patients who are suspected or confirmed to be infected with novel SARS-CoV-2 are either safely kept in a dedicated chiller in the AMCRL or processed according to the practices and procedures described under Biosafety Level 2 (BSL-2), as specified in the WHO Laboratory Biosafety Manual (3rd edition). The samples are sorted and identified according to the patient identity in a biosafety cabinet and a small portion (200 µl) of each sample is transferred into a microcentrifuge tube for RNA extraction according to manufacturer's instructions. All the remaining samples are returned to their original packaging or transferred into 2 mL cryovials for storage. The empty sample tubes, wrappers and waste generated during the process are sterilised with alcohol, transferred out of the biosafety

cabinet and placed into an autoclave bag and autoclaved before being discarded. All the used PPE are discarded into a biohazard bag placed just outside the exit of the testing area and decontaminated with autoclaving also.

We received the first batch of samples from NPHL and started testing them on 27 March 2020 and since then, we are providing this service on a daily basis. Our ability to assist in providing this testing service is timely and important as we anticipate that the MOH will need both public and private universities to supplement their own testing services in the coming weeks.⁵ JP Morgan, an investment banking firm, said in a research paper that it expected the peak of infections to reach in mid-April with about 6,300 cases.⁶ Up till April, the MOH has performed about 49,000+ RT-PCR tests with a few hundred more by private labs but this is still far below the ideal.⁷ With MOH's capacity of 10,000 tests per day using an automated high throughput system, there is still a need for all universities and private labs to help to deliver another 8,000 tests a day. Since then, the MOH has been increasing their testing capacity with more laboratories providing CoVID-19 testing.

Experience and Lessons Learnt

From this experience, early preparedness in terms of laboratory facilities, staff competencies and training would help an organization to face any unprecedented events and new infectious diseases like COVID-19. We have also learnt a valuable lesson on the importance of teamwork, professionalism, good practices and most importantly, willingness and dedication to serve our nation in times of need.

REFERENCES

1. <https://www.euro.who.int/en/health-topics/health-emergencies/coronavirus-covid-19/news/news/2020/3/who-announces-covid-19-outbreak-a-pandemic>
2. <https://www.bernama.com/en/infographics/index.php?v=6218>
3. <https://www.nst.com.my/news/nation/2020/03/575180/14-day-movement-control-order-begins-nationwide-wednesday>
4. https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Malaysia
5. <https://www.nst.com.my/education/2020/04/582522/malaysian-varsities-join-covid-19-testing-battle>
6. <https://www.thestar.com.my/news/nation/2020/03/27/medical-experts-treat-forecast-with-caution>
7. <https://www.thestar.com.my/news/nation/2020/04/27/health-ministry-will-be-able-to-conduct-22000-covid-19-tests-a-day-by-next-week>

Development and evaluation of a novel massive open online course in travel medicine for undergraduate healthcare students

Gerard Thomas Flaherty^{1,2}, Lydia Sze Teng Lee², Aida Lina Alias³, Hasnain Zafar Baloch³, Bryan Chang Wei Lim^{1,2,4}, Kok Leong Tan⁵, Victor Lim⁶, Lokman Hakim Sulaiman^{5,7}

Abstract

Introduction: Massive open online courses (MOOCs) are designed to accommodate large numbers of geographically dispersed learners. Few healthcare students receive exposure in travel medicine. We aimed as partner medical universities to develop a novel introductory MOOC in travel medicine suitable for undergraduate healthcare students, and to evaluate it among a cohort of learners.

Methods: A course development team, comprising a senior travel medicine academic from National University of Ireland Galway, local International Medical University faculty and instructional/graphic designers, was convened in November 2017. The MOOC proposal was subsequently refined. Course construction commenced in December 2017 and involved communication between team members based in Malaysia and Ireland. Lectures were recorded in January-July 2018. Development of learning and assessment material and the pilot phase were completed in December 2019. Course evaluation was based on the results of a questionnaire and qualitative free text comments from users.

Results: The MOOC is being delivered to a multinational cohort on a rolling basis. It is organised into five four-themed units: travel health risk assessment; pre-travel health advice; tropical infectious diseases; specialised travellers; and illness in returned travellers. Pedagogical methods include short video lectures, journal articles, a discussion forum, and self-assessment quizzes. Learners have the option of completing an online test to receive a certificate of achievement. Participant evaluation from the first run of the MOOC has revealed very high levels of satisfaction with content and mode of delivery.

Conclusions: This is the first MOOC in travel medicine and it may provide a model for development of other collaborative international e-learning courses. It will address a significant deficit in undergraduate health professional education.

Keywords: *Travel medicine, global health, MOOC, medical education, e-learning.*

Introduction

Travel medicine has established itself as a legitimate medical discipline since its origins in the 1970s, some thirty years after the first publication of academic literature relating to medical fitness to fly.¹ Although it has achieved limited specialty recognition to date², travel medicine (emporiatics) is practised in most developed countries by physicians, often with an infectious disease, public health or general practice background, by travel health nurses and, in some jurisdictions, by community pharmacists. The International Society of Travel Medicine (ISTM), established in 1991, now has nearly 4,000 members in over 100 countries worldwide. The content-rich biennial Conference of the ISTM (CISTM)³ typically hosts over 1,500 delegates. The ISTM, through its professional education committee, provides a diverse array of educational opportunities to its members in the form of webinars, review courses and online learning resources.⁴

Although relatively poorly funded, travel medicine has become a fertile field of research activity, with four specialist journals publishing original and review articles in the discipline. A citation analysis of travel medicine literature has characterised the most influential publications in the field.⁵ Two travel medicine journals have published comprehensive bibliometric analyses

¹School of Medicine, National University of Ireland Galway, Galway, Ireland

²School of Medicine, International Medical University, Kuala Lumpur, Malaysia

³Department of Learning Resources, International Medical University, Kuala Lumpur, Malaysia

⁴Department of Emergency Medicine, Mercy University Hospital, Cork, Ireland

⁵Department of Community Medicine, School of Medicine, International Medical University, Kuala Lumpur, Malaysia

⁶Department of Pathology, International Medical University, Kuala Lumpur, Malaysia

⁷Institute for Research, Development and Innovation, International Medical University, Kuala Lumpur, Malaysia

Address for Correspondence:

Prof Gerard Thomas Flaherty, MD School of Medicine, National University of Ireland Galway, Galway, Ireland. Email: gerard.flaherty@nuigalway.ie.

of their publications^{6,7}, which have reflected the broad scope of travel medicine practice and scholarship, as well as identifying gaps in research output. Beyond the ISTM, much of travel medicine education is delivered by national and regional travel medicine societies, such as the Travel Medicine Society of Ireland and Asia-Pacific Travel Health Society.

A limited number of postgraduate educational programmes leading to post-nominal credentials in travel medicine currently exist. The ISTM body of knowledge describes the domains and sub-domains of activity within travel medicine.⁸ The Certificate in Travel Health examination offered by the ISTM is based on the ISTM body of knowledge and it recognises excellence in knowledge of travel medicine. It must be renewed on a ten-yearly basis, unless the holder can demonstrate significant ongoing education in travel medicine. Deficiencies in travel medicine education and training exist at the level of primary care, where general practitioners and practice nurses may be called upon to prepare international travellers medically without having received any formal education in the area. Apart from isolated examples of travel medicine-related student selected components as part of innovative university curricula⁹, travel medicine is almost entirely absent from undergraduate medical, pharmacy and nursing programmes. The current COVID-19 pandemic has reminded the academic community of the importance of global biosecurity and traveller behaviour in mitigating the spread of communicable diseases. Prior to the pandemic, international travel had reached impressive levels, with projected increases in passenger arrivals to 1.8 billion by 2030.¹⁰ If the expansion of travel volumes in emerging economies within Asia, the Middle East and Africa¹¹ recovers in a post-COVID era, travel medicine

education will assume even greater significance in developing countries.

The accelerated uptake of online instruction and assessment in the higher education sector during the current pandemic has brought technology-enhanced learning pedagogies into sharper focus. One of the more recent disruptive innovations in online learning has been the Massive Open Online Course (MOOC) which is regarded as a product of the Open Educational Resources movement.¹² A MOOC has been defined as “an online course with the option of free and open registration, a publicly shared curriculum, and open-ended outcomes”.¹³ MOOCs offered by reputable educational institutions provide valuable access to reliable information without the limitations imposed by time, geographical considerations, or educational level. The first American MOOCs were offered by Stanford University in 2011¹⁴, three years after the University of Manitoba launched their course ‘Connectivism and Connective Knowledge’¹⁵, which is believed to be the world’s first MOOC. Since then, many of the world’s leading universities have been converting some of their most prestigious courses to free online MOOCs and university consortia now offer each institution’s MOOCs to their collective students.¹⁶

Medical MOOCs may be designed to fulfil continuing medical education or continuing professional development needs. They may also be integrated into campus-based undergraduate programmes. Other MOOCs have a public health literacy objective or are aimed at patient education.¹⁷ MOOCs are generally made available on commercial platforms without any enrolment fee for learners. Despite the massive numbers of enrolled students on some MOOCs, they are designed

to incorporate several tools to promote inter-learner interaction, including live chats, small group classrooms, discussion boards and project-based learning. The high dropout rate on most MOOCs, with average MOOC completion rates of 4-7%¹⁸, has led to assertions that completion rates should not be used as a measure of the success of individual MOOCs¹⁶, whose learners are drawn from diverse backgrounds and who approach their MOOC with individual learning goals.

Travel medicine requires a sound knowledge of tropical infectious disease epidemiology, clinical presentation and prevention. To date, very few MOOCs of relevance to travel medicine practitioners have been developed. These include MOOCs relating to disease outbreaks¹⁹, Ebola virus disease¹⁸, Zika infection¹⁹, dengue¹⁹, Chikungunya¹⁹ and malaria.²⁰ The Ebola MOOC attracted 7,000 learners from 170 countries and recorded a 10% completion rate.¹⁸ We aimed to design, develop, deliver and evaluate the world's first holistic MOOC in travel medicine as a transnational educational partnership initiative between two leading third-level institutions, based in Malaysia and the Republic of Ireland. The MOOC was targeted at undergraduate healthcare, primarily medical, students in order to address a recognised gap in education provision in universities worldwide.

Methods

Course development

The concept for the MOOC arose from a break-out session at the 2017 Academic Council of the International Medical University (IMU) in Kuala Lumpur, Malaysia. The subject area for the MOOC was based on a longstanding partnership in travel medicine research between the IMU and its partner medical

school in the Republic of Ireland, National University of Ireland Galway. A MOOC Lead (GTF) with 15 years of clinical experience as a travel medicine physician and multiple educational qualifications to doctoral level in travel medicine was appointed at the Academic Council meeting. An interdisciplinary project development team of academics, representing primary care, infectious diseases and public health, and e-learning technologists from IMU was established. The IMU e-Learning Lead (HZB) applied to host the MOOC on the OpenLearning® platform.

Subsequent in-person development meetings were supplemented by multiple emails and conference calls involving a core MOOC faculty of four individuals. The instructional design of the MOOC was based on the team's previous experience as MOOC developers and users and their expert knowledge of travel medicine and e-learning. Published recommendations for high quality MOOC design in the medical education literature were consulted. A syllabus outline was drafted and revised by the project team based on agreed learning objectives, comprising 5 sequential blocks or units of learning, each with 4 related themes, yielding a total of 20 themes.

Lecture recording took place at the sound-proof recording facilities at the IMU and at the NUI Galway Centre for Excellence in Learning and Teaching. A green screen approach was used which enabled the addition of relevant backgrounds for individual lectures without any extraneous distractors. Mayer's principles of multimedia teaching were followed by lecturers in an attempt to capture learners' attention and promote more active engagement with the course material.²¹ Cross-referencing of material in the MOOC with information typically learned during microbiology, public health and clinical medicine modules in core undergraduate medical

curricula aimed to motivate the principal target learner audience of medical students. Most of the lectures were prepared and delivered by the travel medicine expert (GTF) but additional lectures were contributed by IMU-based academics. Open access journal articles written by GTF provided background reading material for users.

Formative self-assessment multiple choice quizzes (10 questions per unit) accompanied each unit and provided feedback to learners on their progress. A discussion forum was set up to encourage interaction between MOOC users and faculty. A certificate of achievement was designed which could be downloaded by users for a nominal administrative fee upon successful completion of a 25-item MCQ assessment based on the entire course material. The course was promoted by both universities to its current medical students via social media. In addition, OpenLearning[®] promoted the course to its extensive network of global learners. The pilot phase of the MOOC was officially launched at the 2019 Academic Council meeting as a live, facilitated course with an anticipated 5 hours of study per week for 5 weeks and was accessed on the OpenLearning[®] website with a secure log-in facility. Learners were enabled to learn in a self-paced manner and track their own progress as they proceeded.

Course evaluation

Qualitative, free text feedback responses were obtained from medical students at the IMU and NUI Galway who volunteered to register for the MOOC during its pilot phase. No changes to course structure or content were required following feedback received after the first run of the MOOC. Recruitment of MOOC users is ongoing, having been disrupted by the COVID-19

pandemic. A 20-item course evaluation survey using a 4-point Likert scale was designed to be completed by registrants who had completed the entire course and wished to take the multiple-choice question assessment in order to receive a certificate of achievement. Demographic information and web log data, including video viewing histories, clickstreams, and participation in course discussion forums, were extracted from learning records on the MOOC platform.

Study ethics

All study data were de-identified by allocating participants with a unique ID number to maintain anonymity and data confidentiality. The protocol for this study was approved by the IMU Joint Committee on Research and Ethics (IMU R239/2019).

Results

Course development

Undergraduate healthcare students, especially medical students, were the primary target audience for the MOOC. The learning outcomes for the course are shown in Table 1. Course planning took approximately 6 months and was facilitated by regular asynchronous email contact and synchronous video conference and Whatsapp[®] group communications between the core members of the project development team based in the collaborating partner institutions. Lecture recording in soundproof recording studios against a green screen took place in January and July 2018. A further six months were required to design and populate the OpenLearning[®] MOOC platform, to pilot the delivery of the course and to identify and address technical issues.

Table 1. MOOC learning outcomes

By the end of the MOOC in travel medicine, learners should be able to:
1. Describe the role of a travel medicine practitioner
2. Comment on current global travel trends
3. Relate the key elements of travel risk assessment
4. Summarise the major travel-related infectious diseases
5. Outline an approach to travel vaccination
6. Provide basic pre-travel health advice
7. Understand the needs of special groups of travellers
8. Discuss issues relating to illness in returned travellers

Keywords were generated by lecturers and used to provide closed captions for the video lectures. The total duration of recorded lecture and demonstration video material was 4.68 hours. Lectures were generally of 5-10 minutes length each. The median lecture duration was 7 minutes 23 seconds. The longest lecture of 60 minutes in duration addressed commercial space tourism and was made available in the MOOC as a supplementary lecture in Unit 4 (specialised travellers). It had been previously recorded as a guest lecture for academic staff and students at IMU prior to development of the MOOC. While full length lectures are not recommended in online courses, this presentation was included because of its significance for both partner universities involved in developing this MOOC. Learners were encouraged to view it as a series of shorter lectures over multiple sessions. Thirty lectures given by four IMU-based academics and one academic from NUI Galway were recorded and video-scripted

using YouTube® software. These were supplemented by two demonstration videos – one recorded at NUI Galway which demonstrated the use of a portable hyperbaric chamber, and the other recorded at Tropical Medical Bureau clinic in Galway, Ireland which demonstrated how to prepare and administer a travel vaccine to a patient. Additionally, a welcome video and navigational course outline page were provided as a means of orienting learners to the MOOC.

The course was structured into five units, each with four sub-themes, representing the continuum of pre-travel, during travel, and post-travel (Table 2). Video lectures accompanied each unit, but additional lectures provided deeper coverage of selected infectious disease topics, including dengue, Japanese encephalitis and COVID-19. The course was designed to be delivered in 5-week blocks, with self-paced learning, such that each unit would take approximately 5 hours to complete. Digital badges were created to represent the completion of each unit. Learners could track their progress through the MOOC using the progress bar at the top of their screen. Relevant, published journal articles written by the MOOC Lead (GTF) expanded on material introduced in the lectures and were referred to in the lecture recordings. At the time of writing, there were web-links to 28 open access articles available in the MOOC (Table 3). The majority of articles were published in *Journal of Travel Medicine* (2019 impact factor 7.089) of which the corresponding author (GTF) is a section editor for non-communicable diseases.

Table 2. Course structure – units and themes

UNIT	THEMES
1. Travel health risk assessment	1.1 Global travel trends 1.2 Pre-travel consultation 1.3 Travel vaccinations 1.4 Transportation issues
2. Pre-travel health advice	2.1 Travellers' diarrhoea 2.2 Insect bite avoidance 2.3 Safety and security 2.4 Environmental hazards
3. Tropical infectious diseases	3.1 Vector borne diseases 3.2 Diseases spread by human contact 3.3 Food and water borne infections 3.4 Environmental infections
4. Specialised travellers	4.1 Medical tourism 4.2 Travellers with chronic illnesses 4.3 Pregnancy and children 4.4 Immunocompromised travellers
5. Illness abroad and in returnees	5.1 Insurance and medical evacuation 5.2 Accessing medical care abroad 5.3 Travel health kits 5.4 Ill returned travellers

Table 3. Course content – lecture topics and article themes

UNIT	VIDEO LECTURE THEMES	JOURNAL ARTICLE TOPICS
Introduction	Welcome to travel medicine	Bibliometric analysis Airport survey Responsible travel Medical electives Recommendations for practice Space tourism Mobile health technology in travel medicine
Travel health risk assessment	Travel epidemiology Travel trends in Asia Pre-travel consultation Travel vaccinations Vaccine preparation Transportation issues	Traveller priorities Travel itinerary uncertainty Personalised risk assessment
Pre-travel health advice	Travellers' diarrhoea Insect bite avoidance Safety and security Environmental hazards Use of a portable hyperbaric chamber	Cliff tourism fatalities Hotel fire safety Drug tourism Selfies and travel Sexual assault and rape during travel Traumatic travels Air pollution Altitude training Carbon monoxide High altitude travel Lake tourism

UNIT	VIDEO LECTURE THEMES	JOURNAL ARTICLE TOPICS
Tropical infectious diseases	<ul style="list-style-type: none"> Vector borne disease Dengue infection Japanese encephalitis Malaria Diseases spread by human contact Food and water borne infections Environmental infections Lymphatic filariasis COVID-19 intermediate host 	Emergency self-treatment of malaria
Specialised travellers	<ul style="list-style-type: none"> Medical tourism Chronic illnesses Pregnancy and children (part 1) Pregnancy and children (part 2) Immunocompromised travellers Medical aspects of space travel 	<ul style="list-style-type: none"> Stem cell tourism Altitude travel with pre-existing conditions Eye disease and travel Obesity and travel Profile of travellers with pre-existing conditions
Illness abroad and in returnees	<ul style="list-style-type: none"> Insurance and medical evacuation Medical care abroad Travel health kits Ill returned travellers 	<ul style="list-style-type: none"> Repatriation of deceased travellers Obtaining a travel history

Interaction between peer learners and between learners and faculty was encouraged through use of the “Meet the team”, “Introduce yourself” and “Share your ideas” functions on the MOOC platform. The MOOC was unveiled at the 2019 IMU Academic Council meeting in Malaysia and a promotional video trailer and sample unit material were presented for feedback from the Council members. Each unit was assessed by a single

best answer multiple choice assessment quiz (best of 5 options) based on material covered in that unit which must be completed before the learner can receive a digital badge for that unit and progress to the following unit. Selected screenshots from the MOOC are provided in Figures 1-3. The course is available to view at

<https://www.openlearning.com/courses/travel-medicine>.

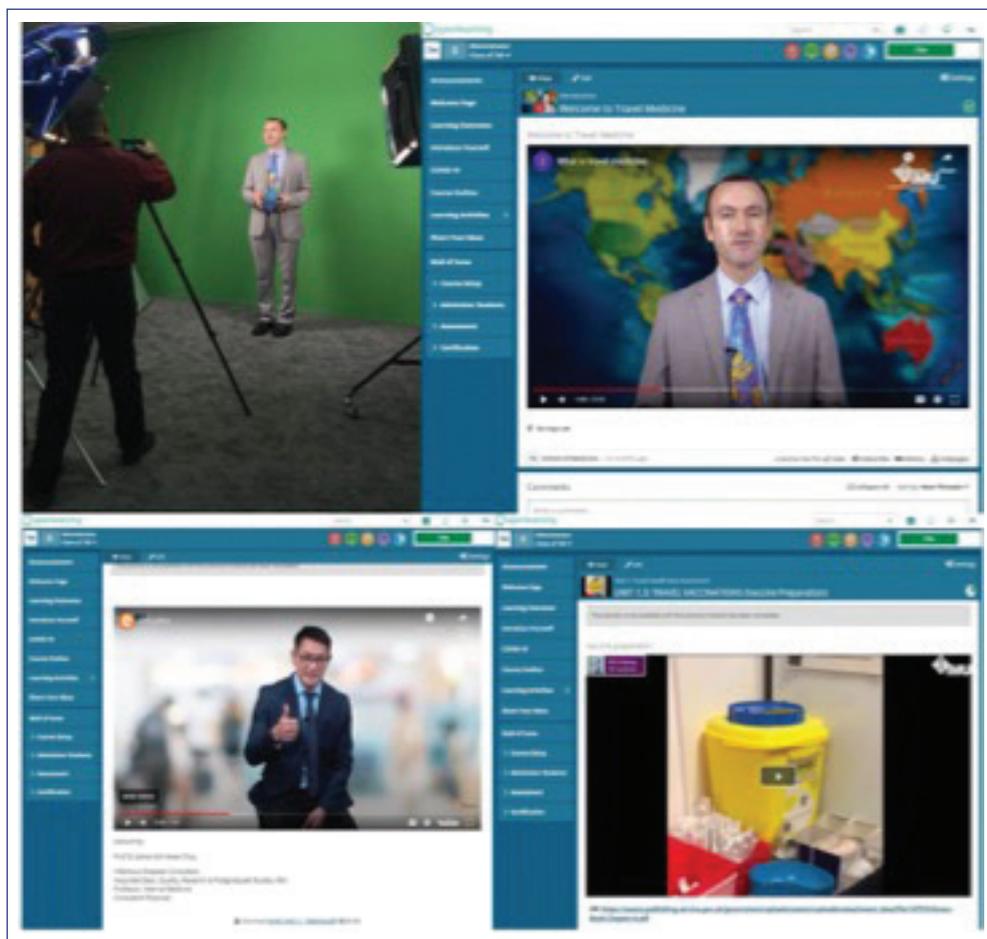


Figure 1: Screenshot from MOOC – video lecture recording



Figure 2: Screenshot from MOOC – course learning and assessment material

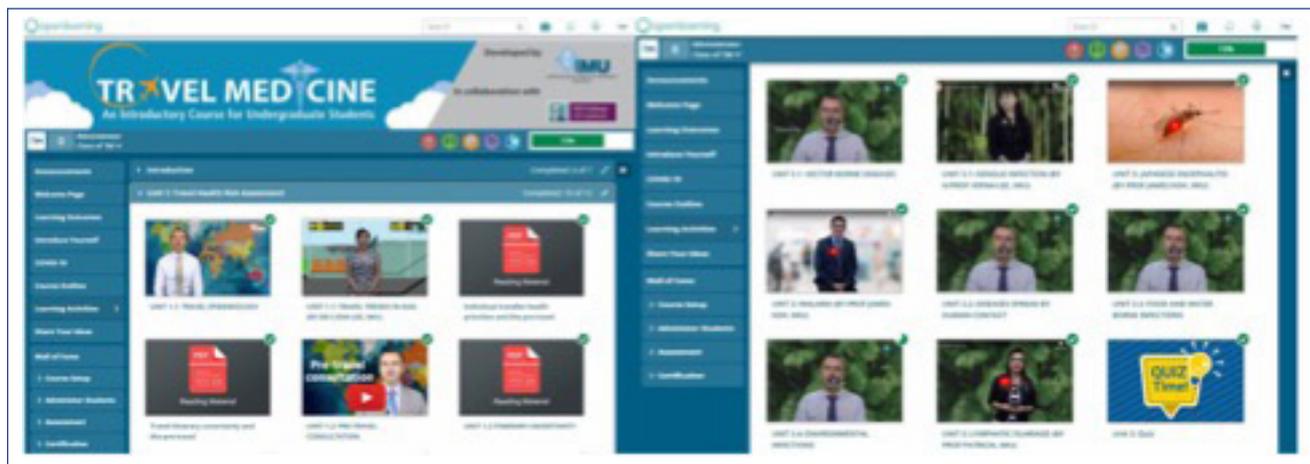


Figure 3: Screenshot from MOOC – selected unit content

Course uptake

At the time of writing, 195 learners had registered for the MOOC. Demographic data are presented for the first 76 learners. The median age of the learner cohort was 21 years. The majority of learners were female (66%, n=50). All but two of the learners were undergraduate medical students; one was a pharmacy student, and one a PhD student. Learners were citizens of 14 countries, with the majority (59%, n=45) being from Malaysia. Ten of the 14 countries represented were in Asia, with 2 in Europe (Ireland and Lithuania), 1 in North America (Canada) and 1 in Africa (Kenya). Various minor technical platform issues which affected the progression between units required troubleshooting by members of the technical e-learning team at IMU. Delays imposed by the COVID-19 pandemic lockdown are likely to have influenced the uptake of the course as medical students were very preoccupied with online learning for their core modules in advance of end of academic year assessments during the period when the MOOC was first made publicly available.

Table 4 presents usage data from the first 87 learners on the MOOC. Learners viewed an average (mean) of 36.9% of all the course learning content (mean of 142.6 views per content page). They completed an average (mean) of 24.5% of the MOOC. Thirteen learners completed the end of course MCQ test and gained their certificate of achievement, yielding a MOOC completion rate of 17%. It is unknown if learners who encountered technical progression barriers abandoned the MOOC prematurely. Some learners used the “post a comment” function to highlight technical challenges and, in most cases, these were promptly resolved. The mean time spent by learners on the MOOC was 175 minutes with an average (mean) of 2.85 minutes per content page. Learners posted an average (mean) of 1.3 comments each on the MOOC platform. The mean score on the final certificate MCQ test was 75%. Figure 4 shows the daily usage profile of learners on the MOOC. Periods of peak activity occurred during the pilot phase in December 2019 and in June and July 2020. The trough of learner activity on the MOOC occurred in March, April and May 2020 and coincided with the period of global societal lockdown in response to the COVID-19 pandemic.

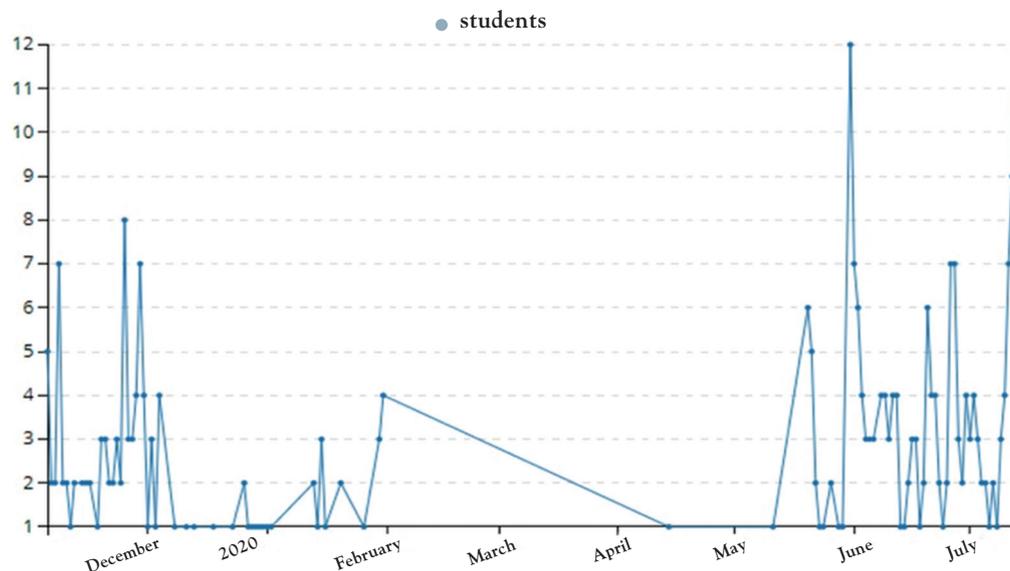


Figure 4: MOOC usage

Table 4. Usage data from initial cohort of MOOC learners (n=86)

MOOC CONTENT PAGE	VIEWS (n)	VIEWS (%)	COMPLETED (%)	COMMENTS POSTED (n)	MEAN TIME ON PAGE (mins)
Course outline	137	63.22	67.82	1	1
Learning outcomes	146	63.22	65.52	0	20
Welcome video	117	59.77	64.37	0	1
Introduce yourself	134	52.87	0	11	1
Introductory articles	633	42.86	34.16	6	9
Unit 1.1 lectures	105	51.72	31.03	0	2
Unit 1.2 lectures	134	47.13	29.89	6	1
Unit 1.3 lectures	193	48.28	29.89	3	2
Unit 1.4 lectures	164	47.13	28.74	1	1
Vaccination video	300	29.89	29.89	17	1
Unit 1 articles	250	47.13	16.48	1	4
Unit 2.1 lectures	112	40.23	22.99	0	1
Unit 2.2 lectures	113	39.08	22.99	6	1
Unit 2.3 lectures	77	36.78	21.84	1	2
Unit 2.4 lectures	90	37.93	21.84	1	2
Hyperbaric chamber video	84	36.78	35.63	1	2
Unit 2 articles	611	34.69	13.98	2	16
Unit 3.1 lectures	130	32.18	18.39	3	2
Unit 3.2 lectures	90	29.89	18.39	4	4
Unit 3.3 lectures	70	31.03	18.39	2	1
Unit 3.4 lectures	72	31.03	18.39	5	2
Unit 3 articles	16	5.75	5.75	0	1
Unit 4.1 lectures	62	29.89	18.39	0	1
Unit 4.2 lectures	71	29.89	18.39	2	1
Unit 4.3 lectures	123	29.89	18.39	4	2
Unit 4.4 lectures	70	29.89	18.39	3	1
Unit 4 articles	198	28.97	17.70	1	5
Unit 5.1 lectures	76	28.74	17.24	3	1
Unit 5.2 lectures	71	28.74	17.24	4	1
Unit 5.3 lectures	70	28.74	17.24	0	1
Unit 5.4 lectures	74	28.74	17.24	6	1
Unit 5 articles	80	28.17	14.37	4	2
Evaluation survey	34	17.24	17.24	1	1

Course evaluation

For the pilot phase of the MOOC rollout, 20 medical student volunteers were invited to register for the MOOC and provide anonymous free text feedback comments. Comments were received from 50% of students (n=10), 4 students from IMU and 6 students from NUI Galway. Qualitative data were coded and subjected to thematic analysis by members of the MOOC development team. Eight themes emerged from the analysis (Table 5).

These related to the perceived educational level of the course material; learners’ attitudes towards the use of video lectures; integration of journal articles; positive effect of self-assessment quizzes on student learning; the motivational effect of the MOOC design; lack of learner interaction with faculty-suggested improvements in course delivery; and user frustration with technical issues involving progression from one unit to the next. Representative, anonymised quotations in Table 5 serve to amplify these individual themes.

Table 5. Themes arising from respondents’ feedback on MOOC (n=10)

THEME	REPRESENTATIVE QUOTATIONS
<p>SUBJECT MATTER WAS RELEVANT AND PITCHED AT THE APPROPRIATE LEVEL</p>	<p>“Clear objectives and learning outcomes are established.”</p> <p>“The topics were quite interesting and teaches [sic.] a lot of basic prevention of diseases spread which we don't really focus on in our medical studies.”</p> <p>“The course sheds just enough light on the topic to give us a broad overview of travel medicine and does not delve too deep into too much detail for our level.”</p> <p>“Video animations are very attractive and draws our attention to key points that the speaker is conveying.”</p> <p>“Particularly liked the way tutor put some questions to think about at the end of the lecture: personally, the more of this the better for me as it forces me to engage and reflect on my learning. This reflection elevates the MOOC to an engaging learning experience, rather than a passive one.”</p>

**LEARNERS WERE POSITIVE
TOWARDS
THE USE OF VIDEO LECTURES**

“I also appreciated the videos as they can be slowed down when taking notes and sped up when going over them a second time. I put on the subtitles to be able to hear and read what was being taught.”

“I was more keen to finish the videos of the topics because they are less than 10 minutes in duration. More interested and more focused with short time videos, I can go through more topics without being distracted or bored.”

“The highlighted words displayed on videos (e.g. disease names, key words) was very efficient for the learning process of the person taking the course.”

“I appreciated the way articles/ textbook excerpts were planted in the video: the combination of aural and visual aids together is very helpful.”

“The videos are of high quality and resolution.”

“The manner in which keywords and terms come up highlighted in video lectures is a very good visual aid.”

**PEER-REVIEWED
JOURNAL ARTICLES WERE WELCOMED
BUT COULD BE
INTEGRATED BETTER**

“Very helpful to have real published articles to guide the Learning Unit content.”

“I would suggest to provide [sic.] a concise summary and a link to the article, if any students are interested for [sic.] some deep reading, they may click on the link and access the paper.”

“Some questions asked about the subjects covered in these papers would be helpful in focusing the student.”

<p>SELF-ASSESSMENT QUIZZES DROVE ACTIVE LEARNING</p>	<p>“Short quizzes at the end of every theme are great for testing knowledge as I find it easier to remember something after being questioned.”</p> <p>“The quiz questions were fair as they addressed during the videos, and if people were interested to read up more on specific topics to broaden their knowledge on the subject matter, research papers were generously provided for their perusal.”</p> <p>“MCQs prevent this non-taxing learning experience from becoming overly passive or non-engaging.”</p> <p>“MCQs could maybe reference which specific unit each question was taken from so that if the quiz reveals a lack of understanding of a particular topic, it would be easy to revise the relevant paper/video lecture afterwards.”</p> <p>“The MCQs are fair and not particularly challenging, you can get all the information you need from the video tutorials.”</p>
<p>LEARNERS WERE MOTIVATED BY THE MOOC DESIGN</p>	<p>“I like the progress bar at the right top corner of the screen as it helped me to track my progress. Sometimes, it even motivated me to go further when I felt like stopping.”</p> <p>“Providing badges after finishing a chapter motivated me to continue.”</p> <p>“The certificate of completion felt very satisfying and rewarding.”</p>
<p>GREATER LEARNER INTERACTION WITH FACULTY WAS ENCOURAGED</p>	<p>“There could be more interactive sessions with the faculty and students rather than displaying prepared materials.”</p> <p>“The “Share Your Ideas” page will go a long way to allow contact between student and teacher, provided it becomes a two-way conversation.”</p>

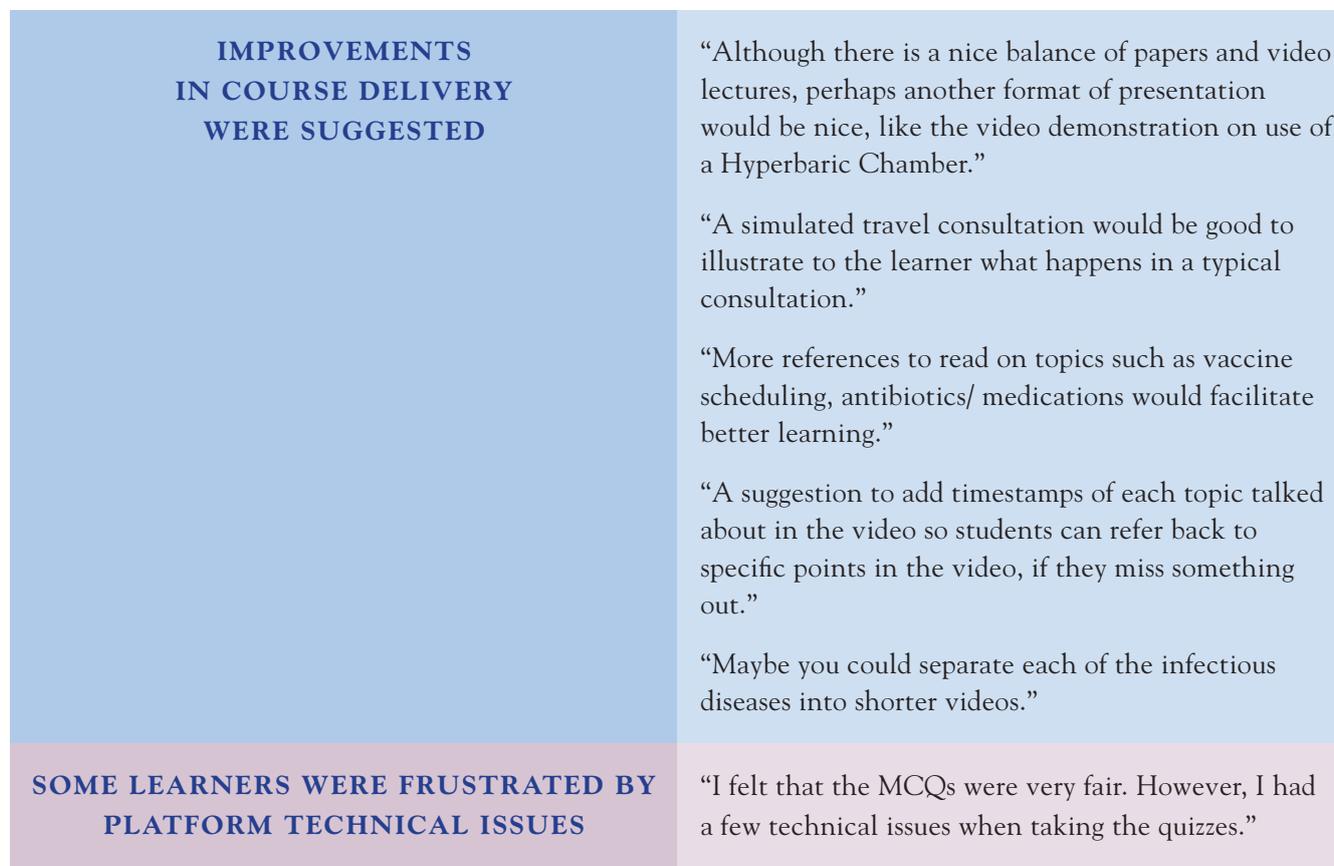


Figure 5 illustrates the high levels of satisfaction expressed in the evaluation survey by the 13 learners who completed all sections of the MOOC. Over half (54%, n=7) of the MOOC completers would strongly recommend the course to other learners and highly valued the certificate of achievement. Just under a half (46%, n=6) of MOOC completers felt strongly encouraged to register for other MOOCs, perceived a strong future career benefit from completing the MOOC, believed

the lectures to be of a very high standard, and strongly agreed that the volume of learning was manageable. Fewer MOOC completers strongly agreed with the statements “I enjoyed interacting with other learners from around the world”, “There was a good variety of learning experiences”, and “The peer-reviewed journal articles were useful”.

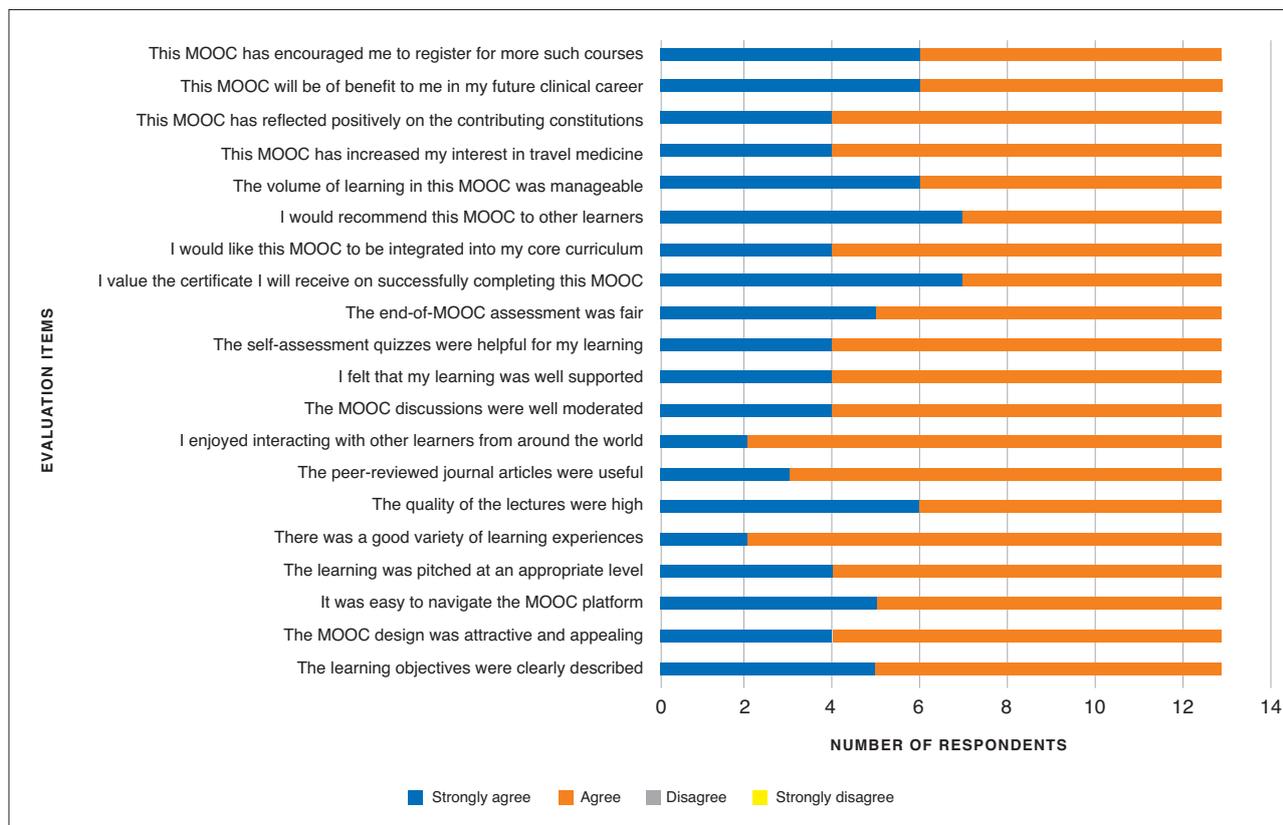


Figure 5: Questionnaire-based course evaluation

Discussion

MOOCs represent a disruptive technology which challenges traditional educational approaches.²² They provide access to information without the constraints imposed by time, cost, geography, or prior educational attainments.²³ By the end of 2018, there were some 11,400 extant MOOCs with 101 million learners worldwide.²⁴ The original social responsibility stimulus for MOOC development may be gradually shifting towards a corporate model where universities use MOOCs to showcase their suite of courses.²⁵ We have designed and delivered the world’s first MOOC in travel medicine to a largely undergraduate cohort of healthcare professions students, the majority of whom

were medical students. The geographic origin of the MOOC registrants reflects the location of the two collaborating educational institutions, in Malaysia and Ireland. While the impetus for developing this MOOC arose from medical education breakout discussions at an Academic Council meeting, this MOOC only involved a single partner medical school, given its particular expertise and international profile in travel medicine. Future trans-national MOOCs should aim to embrace multiple collaborative institutions in order to maximise the quality of the educational product.

The challenges encountered in developing and rolling out a novel MOOC across two institutions separated by eight time zones cannot be overstated.

Regular communication between project development team members was essential in order to maintain momentum and an institutional focus on the MOOC. There was effective engagement of technical support from both universities and pre-recorded lectures were prepared using facilities at both locations. The results from the 2020 cohort of learners to date point to the high levels of learner satisfaction with the content and mode of delivery of the MOOC, particularly the use of short, captioned video lectures, demonstration videos and self-assessment quizzes based on material covered in each unit. The proposal from students to add a consultation video to the MOOC is being actively explored and our next revision of the MOOC content will also include an elaborate case study in travel medicine, which will provide further clinical context to the students' learning.

The main frustration expressed by students related to minor technical progression issues on the MOOC platform. Students used the comments function on the relevant pages to report these difficulties and they were promptly resolved. This underscores the importance of regular and attentive moderation of the MOOC by both an academic lead and e-learning technologist. Most MOOCs, including our own, have fixed course structures, with a pre-determined sequence of video lectures and supplementary learning activities which assume that learners can regulate their own learning.²² Many learners prefer to exercise freedom in accessing the learning material according to their own personal requirements, baseline knowledge and time constraints. The brief time spent by some students viewing videos is typical of MOOC learners, who may choose to revisit material in a distributed fashion across multiple sessions according to their learning needs, rather than

follow a fixed sequence of content. Future MOOCs may employ artificial intelligence algorithms to personalise learning paths, by using so-called 'curious companions' to monitor learners' progress and identify content that is likely to arouse the learner's curiosity.²²

While we originally intended to deliver the MOOCs in fixed five-week blocks, we opted to relax this restriction as the MOOC progressed and our level of familiarity with the platform features increased. We now believe that keeping the MOOC open on a rolling basis better serves the needs of flexible learners who may wish to register for convenience at any given time point, but this does necessitate regular input from an active and responsive moderator, or ideally a group of such moderators who can focus on individual units of the MOOC. In the early stages of the MOOC rollout, this moderation was sporadic, and this may have affected the engagement of learners initially.

The high dropout rate from MOOCs continues to challenge online education providers.¹⁴ Our completion rate to date of 17% exceeds the average of 4-7% which has been reported in the literature¹⁸, but we cannot confirm if technical issues caused some learners to abandon the MOOC early. A MOOC based on an Ebola epidemic reported a 10% completion rate.¹⁸ The high attrition rate of MOOCs reflects the reality that registrants may have specific personal learning objectives which may be met by completing parts of the MOOC or combining information from multiple related MOOCs. The limited number of learners who completed the end-of MOOC quiz and obtained the certificate of achievement could at least partly be explained by the cost, albeit a modest fee, charged for the certificate. Most MOOCs are free to register but levy a nominal charge for obtaining

a certificate in order to cover development costs and administrative input. While we extracted useful learning behaviour metrics from the MOOC platform, we were unable to distinguish learners into previously published categories such as “browsers” and “committed learners”²⁶, but as a larger number of learners engage with and complete our MOOC, such learner analytics may be usefully undertaken.

Ferguson and Clow recommended that institutions provide previews of course material to facilitate more informed decision-making by learners in relation to selecting MOOCs.²⁷ We undertook such promotional efforts at the IMU in Malaysia. IMU is actively considering the integration of this MOOC into its campus-based undergraduate curriculum, perhaps as a student selected component. Developers of an Anatomy MOOC in the UK stressed the importance of ensuring that the learning objectives and academic level of a MOOC are appropriately aligned if it is going to be embedded into an existing course.¹⁷ Translating content into multiple languages will further democratise MOOCs and allow participation of learners from across the globe, thus adding to the cultural diversity of the learner cohort, which is particularly important for a MOOC with a global emphasis such as our MOOC in travel medicine. This has been proposed recently for a series of MOOCs about infectious disease epidemics and pandemics.¹⁹

We were surprised that our MOOC learners did not place as high a value on peer collaboration as on other aspects of the MOOC learning experience. Merrill and colleagues found that the instructional principle of collaboration was least well represented in the MOOC courses examined in their study.²⁸ They postulated that

the difficulties in organising synchronous collaboration among MOOC participants may constitute a barrier to collaboration. Designing educational activities which promote collaborative learning should be a key objective of MOOCs. Our MOOC, with its international focus, is well positioned to achieve this. In creating this first MOOC in travel medicine, we attempted to respect the ten rules²⁹ and twelve tips³⁰ for MOOC design. Rule ten refers to the importance of debriefing and this is proposed for an in-person session at the next Academic Council meeting. Analysis of the learning patterns evident from a larger cohort of participants should provide further insights which will assist in future revisions of the MOOC.

The COVID-19 global pandemic has accelerated progress towards the migration of traditional pedagogical output to an online environment. The 2021 conference of the International Society of Travel Medicine, which was due to take place for the first time in Asia as an in-person event in Kuala Lumpur, will now take the form of a fully virtual meeting. The potential for MOOCs such as ours to have an adjunctive role in the continuing professional development of travel medicine practitioners is significant. Furthermore, our MOOC could, with some modifications, serve as a useful tool for increasing the awareness of the travelling public and travel industry towards the importance of travel health issues.

Study limitations

Our capacity to promote this MOOC in travel medicine and recruit participants in its first phase was constrained by the effects of global pandemic lockdown. We chose a set cut-off point to complete our analysis

of the course uptake and learner behaviour. Whether similar patterns of engagement and completion rates will be observed in future runs of the MOOC remain to be seen. Our MOOC was only available in the English language which may have been a further barrier to its uptake in many countries. We did not employ usability metrics to evaluate the learner experience, but we intend to apply Neilson's heuristics of user interphase design³¹ in our next formal evaluation of a larger number of MOOC learner, in order to identify the strengths and weaknesses of this online course.

Future research opportunities

Future research should explore learner motivations for MOOC participation, the factors which correlate with higher levels of MOOC engagement and completion, and the influence of MOOCs on subsequent educational achievements and career choices.

Conclusions

Travel medicine remains a largely postgraduate discipline although there is growing interest in its introduction at an earlier stage in health professions curricula. This is the first introductory MOOC in travel medicine. It may provide a model for development of other collaborative international e-learning courses. It addresses a significant deficit in undergraduate health professions education and may prove a useful springboard for the development of further MOOCs on related subjects at both introductory and advanced levels.

Acknowledgements: We are grateful to the Academic Council of the IMU for its enthusiastic support of this collaborative educational venture. We sincerely thank Prof James Koh Kwee Choy, Dr. Verna Lee and Prof Patricia Lim Kim Chooi, who contributed video lectures for the course. We also express our sincere gratitude to Ms. Eileen Walsh, e-learning technologist at the School of Medicine, NUI Galway, and technical support staff at both the IMU and the Centre for Excellence in Learning and Teaching at NUI Galway. Thank you also to Ms. Joyce Keaveney, travel health nurse, for her demonstration of travel vaccination technique. Consent was kindly provided from the patient featured in the video.

Authors' contributions: GTF was responsible for conception and design of the study. GTF, BCWL, ALA, HZB and LL contributed to the development of the MOOC. All authors were responsible for interpretation of data arising from the MOOC. The first draft manuscript was prepared by GTF with input from BCWL. The draft was edited for significant intellectual content by all other authors. Each author read and approved the final version of the manuscript.

Conflict of interest: None declared

Funding: None received

REFERENCES

- Hellberg H. Matkailulääketiede-uusi lääketieteen haara [Travel medicine-a new discipline]. *Duodecim*. 1977;93(23):1485-1486.
- Piyaphanee W, Chanthavanich P. Residency training in travel medicine-a 3-year journey to become a specialist. *J Travel Med*. 2016;23(5):10.1093/jtm/taw041.
- Coyle DJ, Flaherty GT. An educational journey in travel medicine: content analysis of CISTM conferences, 1988-2017. *J Travel Med*. 2019 May 10;26(3). pii: tay121. doi: 10.1093/jtm/tay121.
- International Society of Travel Medicine. 2020. Online learning program. Available at: <https://www.istm.org/onlinelearningprogram> (last accessed 7 August 2020).
- G Flaherty, D Browne. Citation analysis of travel medicine literature: a descriptive review of the most influential publications. *International Journal of Travel Medicine and Global Health* 2016; 4(4):122-131.
- Flaherty GT, Lim Yap K. Bibliometric analysis and curriculum mapping of travel medicine research. *J Travel Med*. 2017 Sep 1;24(5). doi: 10.1093/jtm/tax024.
- Oh KE, Flaherty GT. Travel medicine research in the new millennium: A bibliometric analysis of articles published in *Travel Medicine and Infectious Disease*, 2003-2019. *Travel Med Infect Dis*. 2020 Jan - Feb;33:101549. doi: 10.1016/j.tmaid.2019.101549.
- Kozarsky P. The Body of Knowledge for the practice of travel medicine - 2006. *J Travel Med*. 2006;13(5):251-254.
- Flaherty G, Thong Zi Yi C, Browne R. The missing link: introducing travel medicine into the undergraduate medical curriculum. *J Travel Med*. 2016 Jul 4;23(5). doi: 10.1093/jtm/taw038.
- World Tourism Organization. *Tourism Towards 2030/Global Overview*. Madrid; 2011.
- Glaesser D, Kester J, Paulose H, Alizadeh A, Valentin B. Global travel patterns: an overview. *J Travel Med*. 2017;24(4):10.1093/jtm/tax007.
- Zhao F, Fu Y, Zhang QJ, Zhou Y, Ge PF, Huang HX, He Y. The comparison of teaching efficiency between massive open online courses and traditional courses in medicine education: a systematic review and meta-analysis. *Ann Transl Med*. 2018 Dec;6(23):458. doi: 10.21037/atm.2018.11.32.
- McAulay A, Tewart B, Siemens G. *The MOOC model for digital practice*. 2010. Charlottetown: University of Prince Edward Island. Available at: http://www.elearnspace.org/Articles/MOOC_Final.pdf (last accessed 7 August 2020).
- Tseng SF, Tsao YW, Yu LC, Chan CL, Lai KR. Who will pass? Analyzing learner behaviors in MOOCs. *Res Pract Technol Enhanc Learn*. 2016;11(1):8. doi: 10.1186/s41039-016-0033-5.
- Downes S. Places to Go: Connectivism & connective knowledge. *Innovate: Journal of Online Education* 2008;5(1):1-6.
- Hendriks RA, de Jong PGM, Admiraal WF, Reinders MEJ. Instructional design quality in medical Massive Open Online Courses for integration into campus education. *Med Teach*. 2020 Feb;42(2):156-163. doi: 10.1080/0142159X.2019.1665634.
- Swinnerton BJ, Morris NP, Hotchkiss S, Pickering JD. The integration of an anatomy massive open online course (MOOC) into a medical anatomy curriculum. *Anat Sci Educ*. 2017 Jan;10(1):53-67. doi: 10.1002/ase.1625.
- Evans DP, Luffy SM, Parisi S, Del Rio C. The development of a massive open online course during the 2014-15 Ebola virus disease epidemic. *Ann Epidemiol*. 2017 Sep;27(9):611-615. doi: 10.1016/j.annepidem.2017.07.137.
- Bendezu-Quispe G, Torres-Roman JS, Salinas-Ochoa B, Hernández-Vásquez A. Utility of massive open online courses (MOOCs) concerning outbreaks of emerging and reemerging diseases. Version 2. *F1000Res*. 2017 Sep 18;6:1699. doi: 10.12688/f1000research.12639.2.
- Chabriere E, Parola P. Malaria: Massive open online courses MOOC. *Travel Med Infect Dis*. 2016 Nov-Dec;14(6):636. doi: 10.1016/j.tmaid.2016.10.012.
- Mayer RE. *The Cambridge Handbook of Multimedia Learning*, 2nd edn. Cambridge University Press, Cambridge, 2014.
- Yu H, Miao C, Leung C, White TJ. Towards AI-powered personalization in MOOC learning. *NPJ Sci Learn*. 2017 Dec 14;2:15. doi: 10.1038/s41539-017-0016-3.
- Goldberg LR, Crocombe LA. Advances in medical education and practice: role of massive open online courses. *Adv Med Educ Pract*. 2017 Aug 21;8:603-609. doi: 10.2147/AMEPS115321.
- Shah D. By the Numbers: MOOCs in 2018. Available at: <https://www.class-central.com/report/mooc-stats-2018/> (last accessed 7 August 2020).
- Wakefield A, Cartney P, Christie J, Smyth R, Cooke A, Jones T, King E, White H, Kennedy J. Do MOOCs encourage corporate social responsibility or are they simply a marketing opportunity? *Nurse Educ Pract*. 2018 Nov;33:37-41. doi: 10.1016/j.nepr.2018.08.020.
- Koller K, Ng A, Do C, Chen Z. 2013. Retention and intention in massive open online courses. In depth. Available at: <http://www.education.edu/ero/article/retention-and-intention-massive-open-online-courses-depth-0>. (last accessed 7 August 2020).
- Ferguson R, Clow D. 2015. Examining engagement: analysing learner subpopulations in massive open online courses (MOOCs). In 5th International Learning Analytics and Knowledge Conference (LAK15), 16-20 March 2015. Poughkeepsie.
- Merrill MD. First principles of instruction. *Educ Technol Res Dev*. 2002;50(3):43-59.
- Manalack DT, Yuriev E. Ten Simple Rules for Developing a MOOC. *PLoS Comput Biol*. 2016 Oct 20;12(10):e1005061. doi: 10.1371/journal.pcbi.1005061.
- Pickering JD, Henningsohn L, DeRuiter MC, de Jong PGM, Reinders MEJ. Twelve tips for developing and delivering a massive open online course in medical education. *Med Teach*. 2017 Jul;39(7):691-696. doi: 10.1080/0142159X.2017.1322189.
- Nielsen J. 10 usability heuristics for user interface design. Available at: <https://www.nngroup.com/articles/ten-usability-heuristics/> (last accessed 2 September 2020).

Perceived competence of physical examination skills among the registered nurses in a selected private hospital in Malaysia

Wei Fern Siew¹, Yen Ling Wong², Sheau Wei Lee²

Abstract

Background: Physical examination in nursing practice is a systematic process of checking patients from head to toe using inspection, palpation, percussion, and auscultation techniques. This is part of a process to assist nurses in determining nursing diagnoses for patients' care needs. A trained nurse with competent assessment skills can monitor treatment outcome and rapidly detect early signs of deterioration in patients.

Objective: The purpose of this study was to determine the perceived personal competence, the frequency of use of physical examination techniques, the factors that influenced physical examination practices and to identify training needs on physical examination skills among the registered nurses (RNs) in a selected private hospital in Malaysia.

Methods: This is a cross-sectional descriptive study. A self-reporting questionnaire was adapted with permission and pilot tested to ensure its suitability for use in this local study. A total of 154 registered nurses (RNs) from various clinical areas responded to this survey.

Results: The regularly used physical examination techniques by the RNs were mostly inspection and vital signs assessment. The frequency of physical examination skills used was higher among RNs with 4-5 years of working experience. Lack of time, role boundaries/scope of practice and ward culture were some of the factors identified that influenced nurses' physical examination practices. Physical examinations of the cardiovascular, neurological and respiratory systems were the top three skills asserted as training needs by the RNs.

Conclusions: Inspection technique and vital signs checking are commonly practiced at ease by the RNs, but they perceived that they were least competent with palpation, percussion and auscultation techniques. Physical examination training is vital to ensure that the RNs keep their skills current in their nursing practice.

Keywords: Health assessment, perceived competency, influencing factors, training needs.

Introduction

Nursing is indeed a challenging vocation. With the increasing complexity of diseases, advancing population ageing, cost constraint in Malaysia's health care system, and the current situation of doctor-to-population ratio of 1:633 in Malaysia (Social Statistic Bulletin Malaysia, 2016), there is a need for nurses to expand their role to provide quality care to meet the needs of patients. One of the nursing role expansions is to be able to perform comprehensive health assessment because nurses are often the first line who meet the patients, comfort and educate them, thus nurses can contribute immensely in early detection of clinical deterioration of patients.

Physical examination was introduced into the nursing curricula in Canada and Australia in the 1900s. The purpose of this introduction is to support advanced practice in nursing. This introduction causes debates from the west to east, centring on the 'added value' into the RNs' repertoire. Some even argued that this introduction of physical examination skills was a major change in nurses' roles and had implication for the philosophy of nursing (Lesa & Dixon, 2007). Furthermore, the physical assessment skills were never included in the pre-registration nursing programme

¹Community Medicine Department, School of Medicine, International Medical University
No. 126, Jalan Jalil Perkasa 19, Bukit Jalil, 57000, Kuala Lumpur, MALAYSIA

²Division of Nursing, School of Health Sciences, International Medical University
No. 126, Jalan Jalil Perkasa 19, Bukit Jalil, 57000 Kuala Lumpur, MALAYSIA

Address for Correspondence:

Dr Wei Fern Siew, Community Medicine Department, School of Medicine, International Medical University
No. 126, Jalan Jalil Perkasa 19, Bukit Jalil, 57000, Kuala Lumpur, MALAYSIA E-mail: weifern_siew@imu.edu.my

(West, 2006). Therefore, several studies were conducted and argued over the necessity of the nursing role expansion. Eventually, the findings of studies showed and emphasised the needs of the nursing role expansion in this aspect.

Health assessment is a fundamental aspect of the professional nursing role. It is a process to gather information about the health status of patients through complete health history taking and physical examination. It can be done annually on an outpatient basis, on new admission to a hospital or more frequently in intensive care (Jensen, 2015). Whereas, physical examination is a systematic checking from head to toe by using inspection, palpation, percussion, and auscultation techniques to collect objective data as part of a step in determining nursing diagnoses for patients' care needs (Zambas, 2010; Briks et al., 2013; Pejmankhah, 2014). Furthermore, Jensen (2015) emphasised that an accurate and comprehensive nursing assessment is the foundation for holistic and individualised nursing care.

In the nursing process, nursing assessment is the first step to obtain a baseline data for patients. The data collected through a thorough health assessment serves as the baseline in nursing process and provides the framework for the subsequent plan of care for the patient during hospitalisation (Dillon, 2007; Heeyoung et al., 2012; Fennessey, 2016). Douglas et al. (2014) and Massey et al. (2016) also emphasised that patient safety during hospitalisation rely on nurses' ability to detect the early signs of deterioration. As early as 2007, Lesa & Dixon highlighted numerous studies conducted to evaluate the outcome of utilisation of physical examination skills by nurses in their clinical areas across the world which have reflected positive results. They reported that the use of physical examination skills initiates early assessment

that helps to make sound judgements; increase the nurses' capacity to make a good decision about their patients and complications from the patient's illness were determined earlier.

Therefore, health assessment is one of the most important components of contemporary nursing practice (Anderson et al., 2013). It is a crucial skill as the more comprehensive the assessment, the better the results will be obtained, and it increases the quality of patient care. In other words, the quality of patient care is related to the nurses' abilities in performing the physical examination (Adib-Hajbagheri & Safa, 2013).

Strong emphasis was placed on education preparation and assessment courses have become mandatory in nursing programme (Giddens & Eddy, 2009). Additionally, the physical examination was also considered as an essential competency for RNs, but the utilisation of physical examination skills is rarely visible in daily practice (Zambas, 2010). Several studies on the ability of the nurses to practice physical examination skills in their daily practice was conducted (Secrest et al., 2005; Giddens, 2007; Briks et al., 2012; Heeyoung et al., 2012; Akao et al., 2013; Adib-Hajbagheri et al., 2013; Pejmankhah, 2014; Massey et al., 2016). Researchers examined the utilisation of the physical examination skills among those nurses who was taught in undergraduate baccalaureate nursing programmes in America. The results reflected that only 29% of 120 skills which were taught by the educators were used daily or weekly, and 37% of the skills were never used by the nurses at all. Giddens (2007) also surveyed on the utilisation of 126 physical examination skills among the RNs and found that there were only 30 skills reported to be routinely performed. The remaining skills were performed occasionally or not performed at

all. Subsequently, a larger online survey conducted to explore the use of 121 physical examination skills by Australia nurses with 1518 completed questionnaire, found that only 34% of skills were routinely used in practice, 35.5% of skills were not used at all and 31% of skills were used rarely (Birks et al., 2013).

Adib-Hajbaghery and Safa (2013) investigated 200 nurses in one of the Iran's Hospital. Based on the findings, it was shown that nurses used their health assessment skills less than the desired level. Most of the participants of the study reported that they were not proficient in urogenital and nervous system assessments. Pejmankhah (2014) also studied some 104 Iranian nurses and found that nurses were only competent in taking history and interview. Despite broad agreement that physical examination is an essential competency for RNs which facilitates positive patient's care outcomes, there is limited study in Malaysia on this aspect. This study was timely to determine the competency of physical examination skills among these RNs in clinical practice.

Methodology

Google Scholar, PubMed and Web of Science databases were searched for publications of relevant studies between 2000 to 2017, using the following search terms: health assessment, perceived competency, influencing factors, training needs.

Sample and Setting

This was a cross sectional descriptive study with the objectives to determine the perceived personal competence, the frequency of use of physical examination techniques, the factors that influenced physical examination practices and to identify training needs

on physical examination skills among the registered nurses in a selected private hospital in Malaysia. The population of this study consisted a total of 361 RNs. Nursing administration team and those RNs with less than six months of working experience were excluded from this study.

A convenient sampling technique was applied to recruit the RNs from the Accident and Emergency Department (A&E), High Dependency Unit (HDU) and Intensive Care Unit (ICU), Maternity Ward, Medical and Surgical Wards. The sampling size was calculated with Raosoft software, basing on a margin error of 5% and confidence level of 95%. The calculated sample size required was 187, with an added attrition rate of 10%.

Instrument

The instrument of this study was adapted from existing survey tools developed by Heeyoung et.al (2012) and Birks et al. (2012) based on Giddens' (2007) 121 sets of physical examination tool. Permission to use Birks et al's tool for this study was granted, whereas the researchers duly acknowledged Heeyoung et al's tool, as both tools were adapted to ensure relevance to the local setting. The questionnaire was subjected to content validation by a panel of three nursing leaders, namely the Acting Director of Nursing and two nursing managers of the private hospital. A pilot study was also carried out among 30 RNs from another private hospital with almost similar settings as with this hospital under study. The internal consistency for the 38-item core skills was good, with a Cronbach alpha level of 0.91.

The questionnaire of this study comprised of five sections: 1) demographic characteristics; 2) Perceived

Personal Competence in Physical Examination which comprised of numeric rating scale (NRS) of 1 to 4 from not competent 'I do not know how to do this skill' to competent; 3) Frequency of use of Physical Examination Scale which also comprised of NRS of 1 to 5 from 'I know how to do this technique, but have never done this in my clinical practice' to 'I perform this technique frequently in my clinical practice' (every 2-5 times I work); 4) Training Needs, where the RNs were instructed to rank all 14 sectional systems based on the human anatomy in numerical order from 1 being the most important to 14 being the least important skills they needed training; and 5) Factors influencing the utilisation of physical examination in clinical areas where RNs were allowed to tick more than one of the nine factors listed. The RNs' confidentiality was ensured, with written consents obtained from each of them.

Data Collection

Ethical approval was obtained from the International Medical University Joint-Committee on Research and Ethics. Institutional permission was also obtained from the chief executive officer of the private hospital. The RNs consented to participate in this survey after the purpose, procedure, implications, maintenance of privacy and anonymity of this study were clearly explained to them. They were approached by the researchers after their shift duties from Monday to Friday. The survey generally took 20 to 25 minutes to complete.

Statistical Analysis

The data collected were analysed with Statistical software IBM SPSS statistics, version 25.0. Descriptive statistics of mean, standard deviation, percentages and frequencies were used to illustrate the data.

Results

The returned response rate was 73% (154 returned out of 210 sets of questionnaires distributed) with reasons that some of the nurses were away on leave and some were not keen to participate, especially those working in high workload units / wards such as surgical ward, A&E, HDU and ICU.

The RNs were predominantly female (n = 134, 87%). Majority of the RNs were in the age range of 20 to 30 years (n = 116, 75.5%), and 118 (76.6%) held a Diploma in Nursing. Most of the nurses worked in the general medical-surgical wards (n = 107, 69.5%), whereas 30 (19.48%) RNs were from specialty wards (ICU, HDU & A&E) and 17 (11.04%) were from the Maternity Ward.

Perceived personal competence of physical examination skills

The numeric rating scales were totalled into scores for the analysis of this section. The RNs perceived that assessing vital signs was their most competent skills (M = 3.92 to 3.86, SD = 0.28 to 0.36). Whilst inspecting jugular vein distension (M = 2.89, SD = 0.80), percussing abdomen for abdominal tones (M = 3.03, SD = 0.84), and inspecting the spine (M = 3.12, SD = 0.81) were rated as three least competent skills among the RNs. (Table 1)

Table 1: Perceived personal competency of physical examination skills among the RNs (N = 154)

PHYSICAL EXAMINATION SKILLS		PERCEIVED PERSONAL COMPETENCY	
		M	SD
1	Inspect general appearance	3.74	0.50
2	Assess mental status and level of consciousness	3.71	0.50
3	Inspect overall skin colour	3.71	0.50
4	Inspect gait and movement	3.75	0.48
5	Inspect external eyes	3.59	0.57
6	Assess speech	3.66	0.51
7	Assess gross hearing (base on conversation)	3.56	0.63
8	Inspect pupils if equal, round, reacting to light and accommodation	3.56	0.60
9	Inspect oral cavity	3.51	0.66
10	Palpate extremities for temperature	3.67	0.54
11	Palpate distal pulse for circulation	3.66	0.54
12	Palpate and inspect capillary refill	3.74	0.50
13	Inspect chest shape and movement	3.55	0.63
14	Assess breathing effort	3.62	0.59
15	Auscultate lung sound	3.29	0.71
16	Inspect jugular vein distension	*2.89	0.80
17	Auscultate heart sound	3.16	0.76
18	Inspect abdomen	3.49	0.62
19	Auscultate abdomen for bowel sound	3.49	0.65
20	Percuss abdomen for abdominal tones	*3.03	0.84
21	Palpate abdomen for mass, tenderness and distension	3.18	0.80
22	Inspect and palpate extremities for oedema	3.62	0.60
23	Inspect extremities for skin colour and hair growth	3.57	0.65
24	Palpate extremities for tenderness	3.54	0.64
25	Inspect wound and skin lesion	3.63	0.58
26	Inspect muscle and extremities for size and symmetry	3.38	0.70
27	Assess muscle strength	3.49	0.65

28	Observe range of motion of joints	3.48	0.63
29	Inspect the spine	*3.12	0.80
30	Inspect perianal region	3.30	0.74
31	Inspect urine and stool	3.53	0.64
32	Clinical breast examination	3.14	0.88
33	Assess vital signs:		
	Temperature	3.92	0.28
	Pulse	3.90	0.30
	Respiration	3.90	0.32
	Blood pressure	3.91	0.29
	Oxygen saturation	3.89	0.31
	Pain	3.86	0.36

M = Mean, **SD** = Standard Deviation

Frequency of Use of Physical Examination Skills by RNs

Researchers further clustered the frequency of physical examination skills according to median scores. There were 16 (42%) of the 38-item core skills which were rated in median 5, indicating skills were performed every time when the RNs were at work (Table 2). These skills were mostly applying inspection technique and vital signs assessment which measure body temperature, pulse, blood pressure, oxygen saturation and evaluate pain score (Table 2).

The median scores of 4 recorded a total of 18 (47%) of the 38-item core skills where RNs performed between two to five times while at work. There were four (11%) of the 38-item core skills where RNs rarely perform at all, with only a few times in a year. These skills were inspecting jugular vein distension, percussing abdomen for abdominal tones, inspecting the spine and clinically examining the breasts, which yielded similar result as the three least competent skills among the RNs.

Table 2. Frequency of physical examination skills used

MEDIAN = 5 <i>I perform this technique regularly in my clinical practice (every time I work)</i>	MEDIAN = 4 <i>I perform this technique frequently in my clinical practice (every 2-5 times I work)</i>	MEDIAN = 3 <i>I perform this technique occasionally in my clinical practice (a few times a year)</i>	MEDIAN = 2 <i>I perform this technique rarely in my clinical practice (a few times in my career)</i>	MEDIAN = 1 <i>I know how to do this technique, but have never done this in my clinical practice</i>
(42%)	(47%)	(11%)	(0%)	(0%)
1. Inspect general appearance	1. Inspect pupils	1. Inspect jugular vein distension	None	None
2. Assess mental status and level of consciousness	2. Inspect oral cavity	2. Percuss abdomen for abdominal tones		
3. Inspect overall skin colour	3. Palpate distal pulse	3. Inspect the spine		
4. Inspect gait and movement	4. Palpate and inspect capillary refill	4. Clinical breast examination		
5. Inspect external eye	5. Inspect chest shape and movement			
6. Assess speech	6. Auscultate lung sound			
7. Assess gross hearing	7. Auscultate heart sound			
8. Palpate extremities	8. Inspect abdomen			
9. Assess breathing effort	9. Auscultate abdomen for bowel sound			
10. Inspect wound and skin lesion	10. Palpate abdomen for mass, tenderness and distension			
11. Assess temperature	11. Inspect extremities for skin colour and hair growth			
12. Assess pulse	12. Inspect and palpate extremities oedema			
13. Assess respiration	13. Palpate extremities for tenderness			

14. Assess blood pressure	14. Inspect muscle and extremities for size symmetry			
15. Assess oxygen saturation	15. Assess muscle strength			
16. Assess pain	16. Observe range of motion-joints			
	17. Inspect perianal region			
	18. Inspect urine and stool			

Training needs of physical examination skills

Based on the data in Figure 1, the training needs were high for cardiovascular system examination skills (n=67, 43.5%), followed by neurological system (n= 50, 32.5%) and thorax/respiratory system (n= 15, 9.7%).

Whereas 26.6% (n = 41) listed integumentary system as the least important training needs required by the RNs. Genitalia/ anus/ rectum/ prostate system for male patients was rated at second in the list at 25.3% (n = 39) and genitalia and reproductive system for female was listed third least important, 8.4% (n = 13).

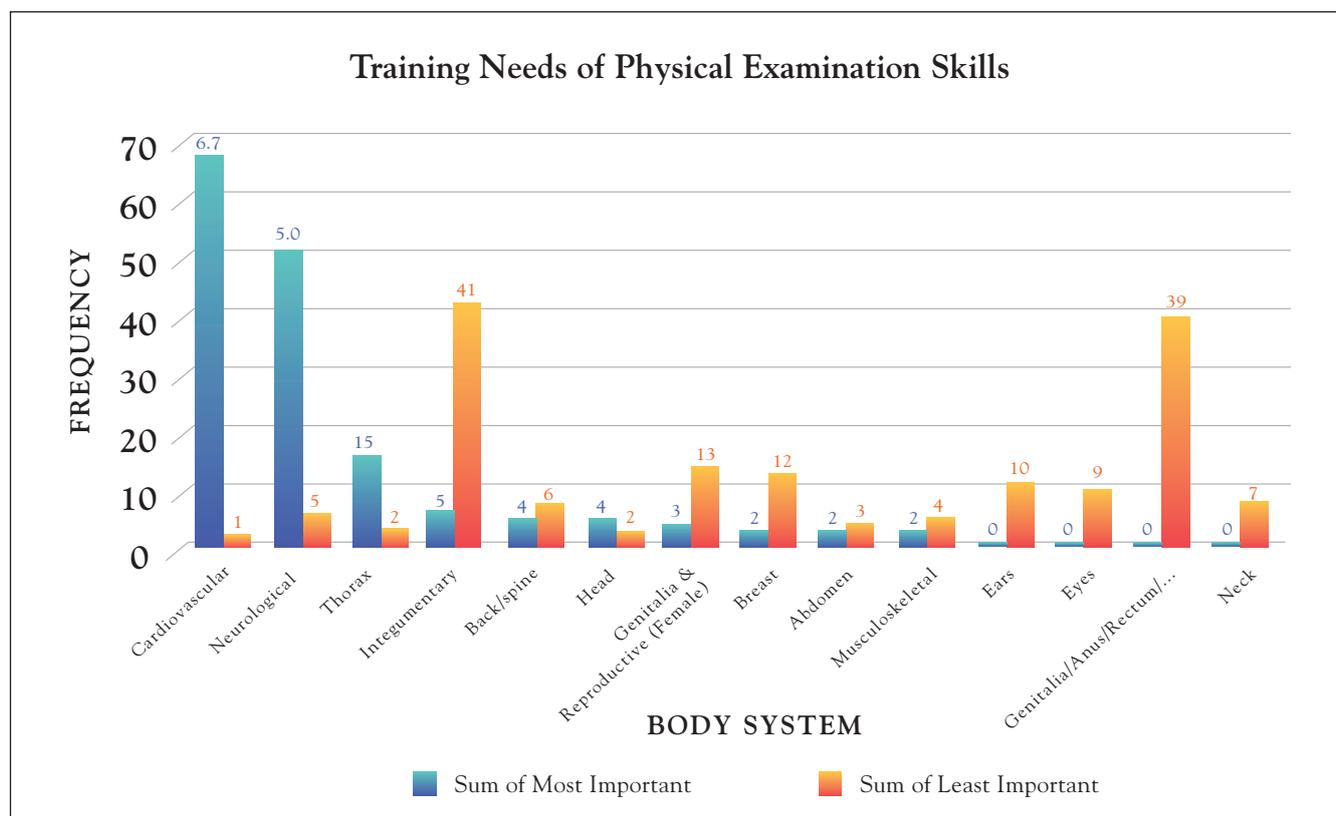


Figure 1. Training needs of physical examination skills

Influencing factors to physical examination practice

Figure 2 presents the seven factors that influence the RNs' physical examination practice in clinical areas. 'Lack of time' (n = 123, 80%) was identified as the major factor hindering the practice of physical examination. 'Role boundaries/scope of practice' (n = 45, 29%) came in second and 'Ward culture' (n = 43, 28%) listed third.

About 6% (n = 4) of the RNs selected 'others' and the compiled answers given were burdened by paperwork, high patient-nurse ratio, high workload, incompetent skills, carrying out billing procedures on patients' consumables usage and procedures.

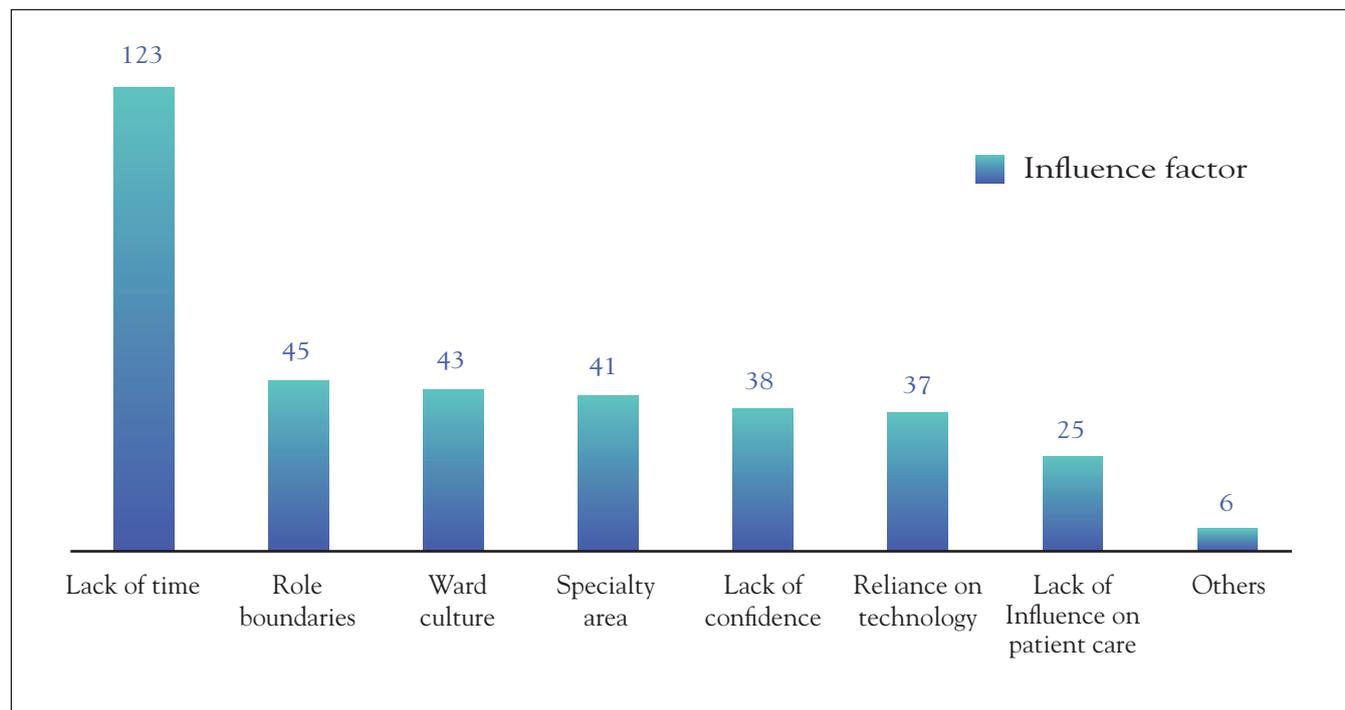


Figure 2. Factors influencing physical examination

Discussion

The findings of this study showed that the RNs perceived personal competence of physical examination skills fell within the scale of 'somewhat competent'. This result corresponded with Heeyoung et al. (2012) study where the Korean nurses responded the similar competency scale. An accurate and complete health assessment is the foundation for appropriate holistic and individualised nursing care (Jensen, 2015). In Adib-Hajbaghery and Safa's (2013) study, the level of nurses' proficiency in health assessment skill was not satisfactory too. In addition, the two studies in the Asian region by Heeyoung et al. (2012) and Akao et al. (2013) also argued that majority of nurses were incompetent in

their physical examination skills, especially skills that were rarely performed and specific.

The RNs in this study routinely used physical examination skills only at 42%. This closely resembles the result of previous studies describing a relatively small set of physical examination skills that were used (Giddens, 2007), 34% of skills routinely used (Birks et al., 2012), and used of health assessment skills less than desired level (Adib-Hajbaghery & Safa, 2013). Majority of the physical examination skills performed routinely in this study (16 out of 38-item core skills) were mainly inspection, general observations and checking of vital signs of patients. These results were consistent with the findings of Osborne et al. (2015) and Massey et

al. (2016), where vital signs and observations were identified as important components in early detection of deterioration signs. This was perhaps what the RNs in this study relied on, as the complex responsibilities of physical examination should fall under the doctors' role.

Moreover, nurses are always rushing through assessments and unable to carry out in-depth physical examination due to the common factors of lack of time, high workload and patient-nurse ratio in the wards (Birks, 2012) which, in this study presented similar findings. This study also showed that the frequency of use of physical examination techniques was higher among the RNs with 4-5 years of working experience. This finding can be attributed to level of professional experience as stated in Benner's from novice to expert theory. Lack of time and role boundaries or scopes of practice were identified as the main factors influencing physical examination practice among the RNs in clinical areas. Similar responses have been observed in other studies. Birks et al. (2012) found that time is the key factor that determines the quality of physical examination by nurses. For example, in a high turnover ward, nurses may not have the time to perform comprehensive physical examination upon admission or transfer in and may only complete inspection of general appearance and obtain vital signs from their patients. Time is the most significant factor influencing nursing practice and the depth of physical examination (Giddens, 2007; Birks et al., 2012).

Second key factor influencing nurses' physical examination practices was role boundaries in this study. Nurses perceived some physical examination skills are to be carried out by doctors, and often their nursing assessment findings were not considered in prescribing treatment for patients' care. Osborne et al., (2014) are

of the opinion that RNs' perception of their role in physical examination is largely shaped by professional boundaries. It appears that a better understanding of the purpose of nursing and medical assessment is essential to enhance professional role and patient's outcome.

A total of 28% (n = 18) of the RNs indicated 'ward culture' as the third influencing factors that affect nurses' physical examination practice. According to Bandura's (1997) Social Learning Theory, Bandura suggests that people learn from one another, via observing, imitating, and modeling. Therefore, it explains nurses' behaviour in learning, behavioral, and environmental influences in the practice of physical examination. If nurses are discouraged to perform their skills to full scope of practice, the lesser use of the skill will lead to a faster decline in competency. The remaining factors which include specialty area, lack of confidence, reliance on technology equipment, and lack of influence on patient care were interpreted and supported by previous research (Giddens, 2007; MsElhinney, 2010; Birks et al., 2012; Osborne et al., 2014; Zambas, 2016).

The ability of nurses to overcome numerous factors that may hinder the practice of physical examination should be viewed as a major concern in nursing profession. Physical examination is one of the essential nursing activities to ensure patient safety and outcome of treatment. Nurses are required to maintain their competence in performing regular physical examination on each patient in order to detect positive or negative clinical changes during the period of hospitalisation. The findings of this study gave a general idea of the utilisation of the RNs' physical examination skills and the factors influencing their practices.

Among the training needs agreed upon by the RNs on body systems' physical examination, the ones that were in the top three list were cardiovascular system (n = 67, 43.5%), followed by neurological system (n = 50, 32.5%) and thorax/respiratory system (n = 15, 9.7%). This result was consistent with the study by Heeyoung et al. (2012) where training needs on these three systems were rated high by the Korean nurses. The results again highlighted that nurses in non-western country lack the confidence in performing the examination on these body systems as compared to nurses in western countries. Another possible factor that could attribute to this might also be because a majority of the RNs were from medical and surgical wards, thus, RNs may perceive these as infrequent use of examination skills which warrant further training.

The training needs for male and female urogenital system was not favoured by the RNs, which may probably be due to the social-cultural factors in Malaysia. Interviews and examination on patient's urogenital areas and sexual behaviour are challenging and embarrassing for both patients and nurses. Nurses maybe of the opinion that this skill is best left for the doctors to perform.

Overall, the findings reflected that the training needs of the RNs were somehow related to their level of proficiency in physical examination skills and the clinical areas where they worked.

Implication of the study

Findings from this study showed that physical examination training is vital for the RNs in order to ensure that they keep their skills in tune. Reevaluating the current physical examination content syllabus in the

nursing programme curriculum needs to be considered. Regular in-service training or refresher course on physical examination with simulation training catered for experienced and inexperienced RNs may help to bridge this practice gap.

The greatest barrier influencing the practice of these skills was time factor. Nursing administrators ought to implement measurements to eliminate tasks that occupy RNs time away from patients' care, such as reasonable patient-nurse ratio, and assigning patients according to acuity and competency of the RNs as well as to review system processes in order to reduce unnecessary or redundant paper work.

Refined competency in physical examination enhances RNs clinical reasoning and judgement in their nursing practice. With this, coupled with good work system processes would be of great benefit to patients care.

Limitations

A few limitations were observed. The sample size of the study was relatively small (n = 154) and the data was collected from one private hospital, therefore the generalisability is restricted. A larger randomised sample of RNs across the city or country from both public and private healthcare is recommended for future studies.

Acknowledgements

We would like to thank the CEO of the private hospital for allowing us to carry out this study in its premise and the International Medical University (IMU) for funding this study [BN I-2017 (PR-21)]. This study would not have been possible without their continuing support in nursing education.

REFERENCES

- Adib-Hajbaghery, M., & Safa, A. (2013). Nurses' Evaluation of Their Use and Mastery in Health Assessment Skills: Selected Iran's Hospitals. *Articles of Nursing and Midwifery Studies*, 2 (3), 39-43.
- Akao, S., Tanabe, K., Dorjsuren, B., & Higuhi, M. (2013). Physical assessment ability of nurses and midwives on maternal care in Mongolia. *Journal of Mongolian Nurse Association* 5(3), 475-480.
- Anderson, B., Nix, E., Norman, B., & McPike, H. D. (2013). An evidence based approach to undergraduate physical assessment practicum course development. *Journal of Nurse Education in Practice*, vol. 14, 242-246.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W H Freeman/Times Books/ Henry Holt & Co. Retrieved from https://books.google.com/books?id=ZL7qN4jullUC&dq=editions%3AitTbpOYuAYgC&source=gbs_book_other_versions
- Briks, M., Cant, R., James, A., Chung, C., & Davis, J. (2012). The Use of Physical Assessment skills by RNs in Australia: Issues for nursing education. *Journal of Collegian*, 20(1), 27-33.
- Dillon, P. (2007). *Health assessment: a critical thinking case studies approach*. (2nd ed.). Philadelphia: F.A. Davis
- Douglas, C., Osborne, S., Reid, C., Batch, M., Hollingdrake, O., Gardner, G., et al. (2014). What factors influence nurses' assessment practice? Development of the barrier to nurses' use of Physical assessment scale. *Journal of Advanced Nursing*, 70 (11), 2683-2694. <https://doi.org/10.1111/jan.12408>
- Fennessey, A.G. (2016). The Relationship of Burnout, Work Environment, and Knowledge to Self-Reported Performance of Physical Assessment by RNs. *Journal of MedSurg Nursing*, 25(5), 346-350.
- Giddens, J.F., & Eddy, L. (2009). A survey of physical assessment skills taught in undergraduate in nursing programs: are we teaching too much? *Journal of Nursing Education* 48 (1), 24-29.
- Giddens, J.F. (2007). A survey of physical assessment skills performed by RNs: lessons for nursing education. *Journal of Nursing Education* 46 (2), 83-87.
- Heeyoung, O., Jiyeon, L., & Eun Kyung, K. (2012). Perceived Competency, Frequency, Training Needs in Physical Assessment among RNs. *Journal of Korean Society of Adult Nursing*, 24(6), 627-634.
- Jensen, S. (2015). *Nursing health assessment: A best practice approach* (2nd ed.). Philadelphia: Lippincott Wolters Kluwer.
- Lesz, R., & Dixon, A. (2007). Physical assessment: implications for nurse educators and nursing practice. *Journal of International Nursing Review* 54(2), 166 – 172.
- Massey, D., Chaboyer, W. & Anderson, V. (2016). What factors influence ward nurses' recognition of and response to patient deterioration? An integrative review of the literature. *Nursing open*. <https://doi.org/10.1002/nop2.53>
- McElhinney, E. (2010). Factors which influence nurse practitioners ability to carry out physical examination skills in the clinical area after degree level module – an electronic Delphi study. *Journal of Clinical Nursing*, 19(21-22), 3177-3187. <https://doi.org/10.1111/j.1365-2702.2010.03304.x>
- Osborne, S., Douglas, C., Reid, C., Jones, L. & Garner, G. (2015). The primacy of vital sign – acute care nurses' and midwives' use of physical assessment skills: a cross sectional study. *International Journal of Nursing Studies*, 52 (5), 951-962.
- Pejmankhah, S. (2014). Evaluate nurses' self-assessment and educational needs in term of physical examination of patients in hospitals of Birjand University of Medical Sciences. *Procedia-Social and Behavioral Sciences*, 141, 597-601.
- Petersen, E., (2013). Retrieved from <http://smallbusiness.chron.com/selfefficacy-theory-workplace-10330.html>
- Secrest, J.A., Norwood, B.R., & DuMont, P.M. (2005). Physical Assessment Skills: a descriptive study of what is taught and what is practiced. *Journal of Professional Nursing*, 21(2), 114-118.
- Social Statistic Bulletin Malaysia (2016). Retrieved from <https://www.dosm.gov.my>
- West, S. (2006). Physical Assessment: Whose role is it anyway? *Nursing in Critical care*, 11(4), 161-167.
- Zambas, S.I. (2010). Purpose of the systematic physical assessment in everyday practice: critique of a "sacred cow". *Journal of Nursing Education*, 49(6). 305-310.
- Zambas, S. I. (2013). *The consequences of using advanced assessment skills in medical and surgical nursing: keeping patients safe* (Doctoral dissertation, Auckland University of Technology).
- Zambas, S. I., Smythe, E. A., & Koziol-Mclain, J. (2016). The consequences of using advanced physical assessment skills in medical and surgical nursing: A hermeneutic pragmatic study. *International journal of qualitative studies on health and well-being*, 11(1), 32090. <https://doi.org/10.3402/qhw.v11.32090>