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Ten consensus statements were developed, focusing on the overall aim of achieving optimal perinatal mental health for women with depression and anxiety. (See full article on p.467)

Illustration by Ngiam Li Yi

Also in this issue

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EDITORIAL

Shock index: Easy to use, but can it predict outcomes following major abdominal emergency surgery?

Kai Siang Chan[1] *MBBS*, Kok Yang Tan[1] *FRCSEd*, Jerry Tiong Thye Goo[1] *FRCSEd*

Major abdominal emergency surgery (MAES) is commonly performed for various potentially life-threatening intra-abdominal surgical conditions with high perioperative mortality of up to 45%.[1] Certain patient factors (e.g. advanced age, frailty, and presence of multiple comorbidities) and disease factors (e.g. perforated viscus and intra-abdominal sepsis) have been shown to predict higher post-operative complications and mortality following MAES.[2] Pre-operative risk stratification scores, such as the Portsmouth-Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity (P-POSSUM) and National Emergency Laparotomy Audit (NELA) score, have also been developed to assist clinicians and/or surgeons in decision making and patient counselling. While these scoring systems have been widely studied and validated in patients of various demographics,[3] they require input of multiple variables which may be cumbersome, especially in the emergency setting. Simple bedside scoring systems remain attractive for quick risk stratification and guidance of subsequent management.

The shock index (SI) is a quickly calculated score derived from easily obtained vital parameters, defined as heart rate (HR) divided by systolic blood pressure (SBP). The SI was initially created in 1967 by Allgöwer and Burri to measure severity of shock,[4] but its use has been expanded to the prediction of the need for transfusion and mortality in trauma, risk of ectopic pregnancy rupture, haemodynamic response in sepsis, and in-hospital mortality in acute coronary syndrome.[5] However, literature on its use in MAES remains scarce. The recent retrospective propensity-score-matched (PSM) study by Loh et al. adds value to the lacuna in current literature on the clinical utility of SI in patients undergoing MAES.[6] Loh et al. retrospectively reviewed 212,089 patients who underwent MAES (defined as exploratory laparotomy for perforated viscus, soiled abdomen or with an infected appendix or gallbladder) across an 8-year period. PSM was performed (matched for gender, operative risk and presence of end-stage renal failure [ESRF]) in the ratio of 1:8, resulting in 3980 patients (SI>0.9: n=439, SI≤0.9: n=3521).[6] The authors demonstrated that SI>0.9 was independently associated with higher 1-month mortality (odds ratio [OR] 3.51; 95% confidence interval [CI] 1.38, 2.25; P<0.021), 3-month mortality (OR 3.05; 95% CI 1.07, 8.54; P=0.034), post-operative intensive care unit (ICU) admission (OR 2.72; 95% CI 1.03, 7.25; P=0.043) and acute kidney injury (AKI) (OR 3.39; 95% CI 2.35, 4.87; P<0.001). In light of new evidence, this editorial will re-explore the utility of SI in the prognostication of outcomes following MAES and will discuss about 3 main points: (1) timing of calculation of SI, (2) cut-off value of SI, and (3) confounding factors in their study which limits the interpretability of results.

First, while the definition of SI is clear and easily obtained, it is important to standardise the timing of calculation of SI. In the study by Loh et al.,[6] SI was defined as the first HR and SBP recorded in the anaesthesia chart, i.e. pre-operatively before induction of anaesthesia. This raises an important question about when SI should be calculated. Should SI be calculated based on the vitals taken on admission, following initial resuscitation, or just prior to induction as per the authors' study? Majority of existing studies evaluating the use of SI centres around the management of acute conditions, where most do not require surgical intervention except for trauma.[5] Hence, these studies do not face the challenge of deciding when should be the appropriate time point used to calculate SI. To our knowledge, the study by Loh et al. is the first to evaluate the use of SI to predict post-operative outcomes following MAES.[6] Kosola et al. retrospectively evaluated the use of SI in patients who underwent emergency laparotomy in 100 blunt abdominal trauma patients; patients who required complex skills (defined as need for organ-specific subspecialty surgeon) had higher SI (mean 1.43 vs 0.95, P=0.012) compared to those who did not require complex skills.[7] However, SI was measured on admission for their study.

The definition of SI was similar for studies evaluating the utility of SI for other conditions; for instance, the study by Al Aseri et al. evaluating the use of SI to predict haemodynamic collapse in patients who presented with hypotension had defined SI based on the vitals obtained on triage in the emergency department.[8] This concept of using parameters obtained on admission also applies for other scoring systems, such as the Glasgow-Imrie

[1] Department of General Surgery, Khoo Teck Puat Hospital, Singapore
Correspondence: Dr Jerry Tiong Thye Goo, Department of General Surgery, Khoo Teck Puat Hospital, 90 Yishun Central, Singapore 768828.

score for acute pancreatitis, Boey score for perforated peptic ulcer and Tokyo Guidelines for acute cholecystitis and acute cholangitis. It is likely that scoring systems use initial variables obtained to better reflect the clinical status of the patient. Hence, the choice of timing for calculation of SI used by Loh et al. is interesting. In their cohort of patients who underwent MAES for perforated/soiled abdomen, patients may be haemodynamically unstable and require resuscitation prior to transfer to surgery. Normal SI just prior to induction may suggest response to initial resuscitation and imply better intra-operative and postoperative outcomes. Clinicians should always ensure that patients are adequately resuscitated before bringing them to surgery, unless the surgery is critical for haemodynamic support, such as in the instance of ruptured aortic aneurysm. Perioperative hypotension, which reflects lack of adequate resuscitation, has been associated with intra-operative hypotension and postoperative complications, such as AKI.[9] Trend of haemodynamics and SI (i.e. delta SI) may instead reflect better on the prognosis of patients, as this reflects the physiologic response to resuscitation. Hosseinpour et al. however showed that SI measured in the emergency department (ED) outperforms delta SI (defined as change in SI from prehospital to ED) in prediction of mortality (area under curve [AUC] 0.86 vs 0.60) for trauma.[10]

Second, while the dichotomisation of a continuous variable (i.e. SI in this context) is a simple way to categorise patients into two groups and compare outcomes between the groups, care must be taken on the choice of cut-off value used. In the study by Loh et al., a cut-off value of 0.9 was used.[6] While the normal range of SI is reported to be 0.5 to 0.7, an upper limit of up to 0.9 is also acceptable.[5] The cut-off for SI used in the study by Loh et al. is reasonable. Subsequent studies evaluating the use of SI in MAES may consider calculating the AUC for the receiver operating characteristic curves for various cut-offs for SI. The cut-off value with highest AUC should then be used to dichotomise patients into two groups.

The authors also used PSM to balance covariates, which reduces bias in a retrospective study. Gender, operative risk and incidence of ESRF were matched for. However, despite PSM, patient demographics were statistically significantly different between the two groups. For instance, patients with SI>0.9 were younger (mean age 53 vs 57), had different cardiac risk profiles and higher incidence of American Society of Anesthesiologists score 3–5 (49% vs 33%). Additionally, despite matching for ESRF, patients with SI>0.9 still had higher incidence of ESRF (5.9% vs 3.3%). Higher post-operative mortality and need for ICU admission following MAES in patients with SI>0.9 may be confounded by advanced age and worse comorbidities. The findings obtained by the authors therefore need to be validated in prospective studies, or at least in patient groups with comparable demographics to reduce the effect of confounding factors.

In conclusion, the large retrospective PSM study by Loh et al. adds valuable literature to the use of SI in MAES which has not been previously evaluated.[6] This remains an attractive easy-to-use triage and scoring system to predict post-operative outcomes. This may be used to identify high-risk patient groups and triage for urgency of surgery, as well as post-operative clinical pathways for enhanced recovery. However, the clinical utility of SI remains to be validated with more large-scale prospective studies and/or PSM studies, with the need to standardise the cut-off value and timing of calculation of SI.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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EDITORIAL

Nurturing professional behaviours and ethical practice: From students to professionals

Dujeepa D Samarasekera[1] *FAMS*, Ardi Findyartini[2,3] *PhD*, Diantha Soemantri[2,3] *PhD*

Medical professionalism refers to the set of values, behaviours, and ethical principles that guide the conduct of medical professionals in their interactions with patients, peers and the broader healthcare system. From a training perspective, it is easier to focus on striving to achieve excellence in medical practice and meeting "industry" accepted standards than to remediate unprofessional behaviours of practitioners.[1] Medical professionalism encompasses a commitment to providing high-quality patient care, maintaining ethical standards, and upholding the trust and respect of patients and the community. This is essential for ensuring patient safety, promoting effective healthcare delivery, and preserving the integrity of the medical profession. Systematic reviews published on unprofessional behaviours of medical students, such as failure to engage, dishonest and disrespectful behaviours, and lack of self-awareness have shown to have a negative impact on peers, teachers and patients leading to poor teamwork and provision of quality care.[2]

Considering the above, professional development of students and trainees is something to be crafted in the curriculum. At present, there are several curricular models to teach and provide guidance to develop appropriate professional behaviours for medical students.[2] The core subject content is delivered through interactive lectures, small group discussions, self-learning sessions and reflective group learning activities, which are systematically integrated into the medical curriculum longitudinally. These aim to develop the right knowledge base and subsequently, create awareness as well as appropriate behaviours using planned exposure to simulated and real clinical contexts. These intentional teaching-learning activities enhance students' competence in the affective domain of medical professionalism. Equally significant is the role played by senior clinical practitioners as role models in this learning journey. Moreover, students are trained in the art of reflection through tools like self-assessment instruments or by engaging in systematic self-reflective processes, such as the Gibbs reflective cycle during real-life clinical encounters within a safe learning environment. This approach fosters the growth of their individual professional identities and nurtures professional behaviours. Creating a safe and conducive learning environment that would nurture the development of appropriate professional behaviours of students and trainees is thus important and necessary.

When designing such a process, the best practice is to integrate medical subject content with communication skills, empathy, and respect for patients and colleagues,[3] and by providing clear outcomes and processes in the curriculum. This should start early from the very first day of medical school emphasising the importance of engaging respectfully and professionally with peers, faculty, other health professionals and patients. Providing such opportunities will lead to the development of a professional identity, first as a student in a professional programme and later as a medical professional.[4] Teaching-learning sessions, such as discussions on professionalism through authentic case-based learning approaches must be done throughout the medical curriculum to keep students engaged and interested. Other learning activities, such as role-playing and simulations will help students explore complex ethical dilemmas they might encounter in their careers.[2]

Faculty and experienced practitioners should serve as role models for professionalism. Students learn not only from lectures but also from observing how professionals behave in clinical and ethical situations. Establishing committees or advisory groups focused on professionalism where these groups can address concerns, provide guidance, and develop initiatives to enhance professionalism within the institution is also an important element in creating a nurturing environment for students to develop their professional behaviours. This is even more important given the existence of "negative role modelling", which is almost inevitable, but students and trainees should be able to reflect, discuss and learn from it.[5] Professional identity formation is shaped through individual, interactive and social processes. Therefore, it is crucial to pay adequate attention to

[1] Centre for Medical Education, Yong Loo Lin School of Medicine, National University of Singapore, Singapore
[2] Department of Medical Education, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia
[3] Medical Education Center, Indonesian Medical Education and Research Institute, Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia
Correspondence: Dr Dujeepa D Samarasekera, Centre for Medical Education, Yong Loo Lin School of Medicine, National University of Singapore, 1E Kent Ridge Road, NUHS Tower Block, Level 11, Singapore 119228.
Email: dujeepa@nus.edu.sg

the development of individual students and trainees, as well as foster a nurturing environment for them.

Developing one's professionalism in medical practice and professional identity also requires systematic feedback and evaluation at specific time points to identify developmental gaps and for alignment with regulatory guidelines as the student or the trainee progresses in his or her learning journey. Contemporary medical education training institutions and health professional programmes have incorporated structured assessments to evaluate and provide feedback to students/trainees on their professional behaviours. A range of assessment tools is employed, spanning from cognitive evaluation instruments like multiple-choice questions and modified essay questions, to psychomotor and affective domain tests. This latter group of tests include Objective Structured Clinical Examinations, Workplace Based Assessment, Mini Clinical Evaluation Exercise, Direct Observa-tion of Procedures, Multi-Rater/Patient surveys, and Supervisor observation assessments. A comprehensive approach the assessment of professionalism is warranted as it is even more critical to identify gaps and remediate, if necessary, in workplace-based setting.

One critical element in the overall evaluation process is to develop students' or residents' own self-evaluation of how well they are progressing, and identify gaps in their learning. Developing one's ability to reflect and subsequently, apply this reflective process in day-to-day engagements is a necessary skill. Faculty members need to encourage students to reflect on their experiences and interactions with patients. Journaling, peer discussions and mentorship can help students process emotions and ethical challenges. A helpful way to develop this in the formative stages of student learning is to provide them with valid tools to engage in guided self-reflection.

In this issue of the *Annals*, Ho et al. discusses the development and validation of a new self-assessment tool to measure professionalism among medical students, which is a step in the right direction. Such tools will assist students to focus on specific areas of professional behaviours. Additionally, given that the tool is validated in the Singapore context, the results will be meaningful to the students reflecting on their educational and practice environments in Singapore. However, a key consideration in using such tools would be to have close guidance through mentoring and supervision. This is because unguided self-assessment of performance, especially in regulated professions has consistently been shown to be inaccurate.[7,8] Therefore, it is important to provide faculty guidance and other known student performance data obtained from standard assessment tools discussed earlier to improve the accuracy of self-assessment.[9] Another area for consideration when employing self-evaluation tools is that they have a strong contextual and situational focus. Some items in a tool that are valid in a particular geographical or organisational context may not be relevant in another. There are several studies highlighting how medical professionalism and the individual/group identity development could vary based on context or situation.[3,4]

Medical professionals are expected to adhere to a strong code of ethics, which includes principles like honesty, integrity, compassion, respect for patients, autonomy and rights. These professionals must navigate complex ethical dilemmas while putting the well-being of patients first. It is critical to provide medical students and trainees with the necessary support to develop the right professional attributes and their professional identity. Promoting and maintaining medical professionalism is a collective effort that involves medical schools, training institutions, professional associations, regulatory bodies and individual practitioners. Supporting students and trainees to develop self-reflective abilities early in their learning journey using tools discussed by Ho et al.[6] along with proactive guidance by the faculty are important. Through these measures to nurture medical professionalism, medical professionals can ensure that patient care remains patient-centred, ethical and of the highest quality.

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EDITORIAL

Perinatal mental health in Singapore: Implementation opportunities and relevance of gender-carer roles in screening

Eric Yu Hai Chen [1]*FRCPsych*

In this issue of the *Annals*, the consensus statement on perinatal mental health by Chen et al. covers the handling of depression and anxiety symptoms in pregnancy, childbirth and the postnatal period.[1] The guidelines were developed by a workgroup involving experts in perinatal mental health and obstetrics using a consensus process consisting of a literature review and consensus meetings involving a range of related professionals in family medicine, paediatrics, psychiatry, social services and the Health Promotion Board in Singapore. Ten consensus statements were developed with particular consideration for adolescent mothers, women with special needs, and women who suffered severe maternity events.

Perinatal mental health is an important theme in population health because the perinatal physical healthcare processes provide an important opportunity for mental health screening for child-bearing women in the population. This is in line with the awareness that mental health challenges such as depression and anxiety are more common in women than men and the risk of mental health disruption is particularly high around pregnancy. Maternal mental conditions have impacts not only on the mother but also on the infant. Many of them respond well to timely psychosocial and pharmacological management.

For easy reference, the statements are presented in sections organised to cover the preconception period, the antenatal period, and the postnatal periods; followed by attention to special groups and situations. The statements provide over-arching directions, which can be adopted for specific implementation details in a range of settings in primary care and maternity care. It also provides suggestions as to when more specialised care should be sought.

Given that common mental disorders (e.g. mood and anxiety disorders) have a high point prevalence around pregnancy, the substantial community treatment gap found in most studies suggests that insufficient attention has been focused on public education and the detection of common disorders.

It is important to note that the current guidelines do not cover mothers with existing "severe mental disorders" (such as psychosis and bipolar disorder) as specialist psychiatrist input would likely have been involved. It is important to screen for symptoms of undiagnosed severe mental disorders during antenatal care. As the boundaries between "common disorders" and "serious mental disorders" can be ambiguous, it is important that the screening and guidelines recommended be applied broadly and whenever there is doubt, specialist psychiatric input should be sought as additional measures.

In providing guideline-based perinatal care in diverse service settings, it is important to develop an appreciation of the psychosocial roles in emerging motherhood in different cultures. This awareness is crucial in facilitating engagement and help-seeking of women of childbearing age. One of the reasons for women often neglecting their mental health is related to their assuming a caring role in the family (for example, caring for elderly relatives and young children). The caring role is constructed socially from a combination of one's anticipation, as well as from others' expectations. It is well known that taking up a caring role is associated with the under-recognition of one's own needs.[2] When the role is associated with a consuming sense of self-denial, it may divert attention away from concerns for one's well-being. This underrecognition applies also to the attention of people around the women (e.g. the husband and the extended family).

The perinatal period provides a unique scenario during the life stages of women in that attention can be focused on both the child and the mother at the same time as the mother and the baby are closely connected physically during pregnancy and the postnatal period. The perinatal experience therefore provides a unique opportunity for women to strengthen a sense of self-compassion. Even women who habitually focus more on others' needs are compelled to care more for themselves as their own physical and mental health are intricately related to fetal and newborn health. The perinatal period is therefore a good time window for women to learn that "to look after others in the family well, one needs to first attend properly to one's well-being." It is a time

[1] Department of Psychiatry, School of Clinical Medicine, University of Hong Kong
Correspondence: Professor Eric Chen, Department of Psychiatry, School of Clinical Medicine, University of Hong Kong, Queen Mary Hospital, 102 Pokfulam Road, Hong Kong
Email: eyhchen.hk@gmail.com

window that is likely to close with increased infant care duties.

In implementing services, it is important to take into consideration the many traditional confinement period rituals (such as bathing, food and herbal infusions), which may serve mental health needs in reinforcing psychosocial support for mothers in a diversity of cultures.[3] However, in modern societies, these rituals may have become expensive optional extras. Integrating these practices wisely and flexibly with contemporary healthcare may play a cost-effective role in the prevention of perinatal mental health issues.

Given there are ongoing rapid changes in gender roles in contemporary societies, it may be opportune to develop more awareness of gender-specific issues for the mental well-being of expectant fathers, which would need to be included more in future initiatives in perinatal mental health. Involvement of other members of the family such as parents in-law may also be important as in-law conflicts have been identified as one of the most important sources of post-natal depression in mothers.[4]

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ORIGINAL ARTICLE

Preoperative shock index in major abdominal emergency surgery

Celestine Jia Ling Loh *[1]*MD*, Cheng Ming Hua *[2]*MBBS*, Shang Yuqing [3]*MS (Statistics)*, Nicholas Brian Shannon [4]*MD*, Hairil Rizal Abdullah [1,2]*MBBS*, Ke Yuhe [2]*MBBS*

ABSTRACT

Introduction: Major abdominal emergency surgery (MAES) patients have a high risk of mortality and complications. The time-sensitive nature of MAES necessitates an easily calculable risk-scoring tool. Shock index (SI) is obtained by dividing heart rate (HR) by systolic blood pressure (SBP) and provides insight into a patient's haemodynamic status. We aimed to evaluate SI's usefulness in predicting postoperative mortality, acute kidney injury (AKI), requirements for intensive care unit (ICU) and high-dependency monitoring, and the ICU length of stay (LOS).

Method: We retrospectively reviewed 212,089 MAES patients from January 2013 to December 2020. The cohort was propensity matched, and 3960 patients were included. The first HR and SBP recorded in the anaesthesia chart were used to calculate SI. Regression models were used to investigate the association between SI and outcomes. The relationship between SI and survival was explored with Kaplan-Meier curves.

Results: There were significant associations between SI and mortality at 1 month (odds ratio [OR] 2.40 [1.67–3.39], $P<0.001$), 3 months (OR 2.13 [1.56–2.88], $P<0.001$), and at 2 years (OR 1.77 [1.38–2.25], $P<0.001$). Multivariate analysis revealed significant relationships between SI and mortality at 1 month (OR 3.51 [1.20–10.3], $P=0.021$) and at 3 months (OR 3.05 [1.07–8.54], $P=0.034$). Univariate and multivariate analysis also revealed significant relationships between SI and AKI ($P<0.001$), postoperative ICU admission ($P<0.005$) and ICU LOS ($P<0.001$). SI does not significantly affect 2-year mortality.

Conclusion: SI is useful in predicting postoperative mortality at 1 month, 3 months, AKI, postoperative ICU admission and ICU LOS.

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Keywords: emergency operation, outcomes, postoperative mortality, risk stratification, shock index

INTRODUCTION

Major abdominal emergency surgery (MAES) is a complex and high-risk procedure with a significantly greater risk of complications and mortality as compared to elective surgery.[1-3] Mortality rates in MAES can range from 14% to 20%,[2,4] with current literature quoting rates as high as 45%.[5]

To objectively assess the perioperative surgical risk, several scoring and risk-stratification systems have been developed to guide the perioperative management, decision and risk of surgery, and postoperative disposition planning. They include the Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity,[6] National Surgical Quality Improvement Programme,[7] Lee's Revised Cardiac Risk Index and its variations[8,9] as well as Combined Assessment of Risk Encountered in Surgery surgical risk calculator.[10,11] Despite their usefulness, these scoring and risk-stratification systems have limited utility in emergency settings. Their complexity can lead to difficulties in calculations, inter-observer variation, and reliance on biochemical investigations,[12] which may delay treatment and negatively impact patient outcomes. Furthermore, in emergency situations, there is often insufficient time to calculate and apply these scores, and they may not reflect the unique challenges and risks associated with emergency surgery. Therefore, there is a need for simpler and more efficient tools to assess surgical risk and guide perioperative management in emergency settings.

The shock index (SI) is a simple and widely studied parameter that provides important information about a patient's haemodynamic status and tissue perfusion.[13] It was first introduced in 1967 by Allgöwer and Burri as a means of measuring the severity of hypovolemia in haemorrhagic and septic shock. The ratio is calculated by dividing the heart rate (HR) by systolic blood pressure (SBP).[14] Subsequently, the use of SI has been extended to patients with other causes of shock, including cardiogenic and obstructive shock.[15] By providing information about the ratio of HR to SBP, the SI can help clinicians identify patients who are at risk of developing shock or other haemodynamic instability. Conventionally, an SI index of more than 0.9 is considered to be a marker

[1] Duke-NUS Medical School, Singapore
[2] Division of Anaesthesiology and Perioperative Medicine, Singapore General Hospital
[3] Department of Biomedical Informatics, Yong Loo Lin School of Medicine, National University of Singapore
[4] Division of General Surgery, Singapore General Hospital
Correspondence: Dr Ke Yuhe, Division of Anaesthesiology and Preoperative Medicine, Singapore General Hospital, Outram Rd, Singapore 169608.
Email: yuhe.ke@mohh.com.sg
* Joint first authors

CLINICAL IMPACT

What is New

- The role of shock index (SI) in predicting mortality in patients undergoing major abdominal surgery remains unclear. This study explores the relationship between SI and postoperative mortality, and other secondary outcomes like length of ICU stay, incidence of AKI, and admissions to the ICU and high-dependency wards postoperatively.

Clinical Implications

- The study highlights the important role of SI in predicting postoperative mortality, duration of ICU stay, and incidence of AKI.
- SI provides a quick and reliable tool for predicting postoperative mortality at 1 month, 3 months, the incidence of AKI, and the length of ICU stay. This simple parameter can help guide future resource allocation and interventions to reduce the risk of poor outcomes.

of increased risk of adverse outcomes.[16] Higher values of SI have been associated with increased morbidity and mortality in various clinical settings, including trauma, sepsis and myocardial infarction. However, the role of SI in predicting mortality in patients undergoing major surgery remains unclear. Therefore, investigating the association between SI and mortality in this patient population could potentially provide a valuable tool for predicting outcomes and improving patient care.

In this study, we aim to investigate the role of SI in predicting the mortality of patients undergoing MAES at 1 month, 3 months, and 2 years postoperatively. Other secondary outcomes of interest include admissions to the ICU and high-dependency (HD) wards, postoperative acute kidney injury (AKI), and the length of ICU and hospital stay postoperatively.

METHOD

Ethics approval was obtained from the SingHealth Centralised Institutional Review Board (Reference number 2020/3063) prior to the start of the study. Written consent was waived. This was a retrospective study reviewing the electronic medical records of all the patients who had MAES between January 2013 and December 2020 in Singapore General Hospital (SGH). In this study, all MAES done were exploratory laparotomy with either an infected appendix or gallbladder, or perforated and soiled abdomen. To avoid complicating the analysis, all vascular operations (e.g. aortic) were removed from the study. There were minimal numbers of traumatic abdominal salvage operations due to the low trauma patient load SGH sees yearly.

Patients were included if they were above 21 years old and had undergone emergency abdominal surgery labelled as moderate or high risk. The SI (HR/SBP) was calculated using the first HR and blood pressure recorded on the anaesthesia chart before induction of anaesthesia. Invasive blood pressure was taken preferentially where available. If invasive blood pressure was not present on the first reading, the non-invasive blood pressure was recorded.

Clinical records were sourced from our institution's clinical information system (Sunrise Clinical Manager [SCM], Allscripts, IL, US) and stored in an enterprise data repository and analytics system (SingHealth-IHiS Electronic Health Intelligence System). Information from SCM, including patient demographics; urgency of operation; and preoperative comorbidities, such as ischaemic heart disease, congestive heart disease, cerebrovascular disease and diabetes, were recorded. The most recent active preoperative medication lists were extracted. Preoperative blood tests, including haemoglobin, HbA1C and creatinine, were recorded. Operative details, including details of operation, site, duration of surgery, type of anaesthesia and duration of surgery, were also obtained.

The length of stays in the hospital, HD ward and ICU were calculated from the date of surgery to the end of the respective stays. Readmission data were obtained similarly from SCM. Data on mortality date in our clinical information system are synced with the data from the National Registry of Diseases Office, ensuring a near-complete all-cause mortality capture. The cause of death was not collected. This study is reported in line with the STROCSS criteria 2019.[17]

Categorisation of groups and adverse event definitions

The first HR and SBP, which were recorded in the anaesthesia chart, were extracted. This was taken to be the preoperative vitals before induction of anaesthesia, which is in keeping with the local practice of minimum standard American Society of Anesthesiologists (ASA) monitoring prior to the start of the anaesthesia. SI was calculated with the formula of HR/SBP.

Postoperative acute myocardial injury is defined by patients who had high-sensitivity troponin-T done with a value of >65 ng/L[18] at any point of time up to 7 days postoperatively. Postoperative AKI is defined as KDIGO stage 2 with criteria of >2 times elevation of creatinine from baseline within 7 days in the postoperative period.

Statistical analysis

Missing values for ASA score account for 9.8% are imputed using the k-nearest neighbour[19] method and mode. Other variables, which had >2% missing values, were also non-essential to the purpose of the study and were discarded from the analysis.

To investigate the association between SI and outcomes, both univariable and multivariable linear regression models were performed. Mean and standard deviation were presented for continuous variables, and the Mann-Whitney U test was used to compare mean differences between groups. For categorical variables, the proportions between groups were compared using the chi-square test. The effect size was reported as an odds ratio (OR) and its 95% confidence interval (CI). To account for multiple comparisons, the Bonferroni correction was used to adjust for *P* value in multivariable regression models. Propensity score matching (PSM) analysis in a 1:8 ratio was done, and the cohorts were matched for gender, operative risk and the presence of end-stage renal failure, as these variables were found to be significantly different between both groups on preliminary analysis ($P<0.001$). To assess the impact of an SI of >0.9 on long-term survival, Kaplan-Meier (KM) curves were plotted for up to 2 years of survival stratified by SI groups.

By utilising a combination of regression models and survival analysis, this study aims to comprehensively investigate the association between SI and outcomes in patients undergoing MAES.

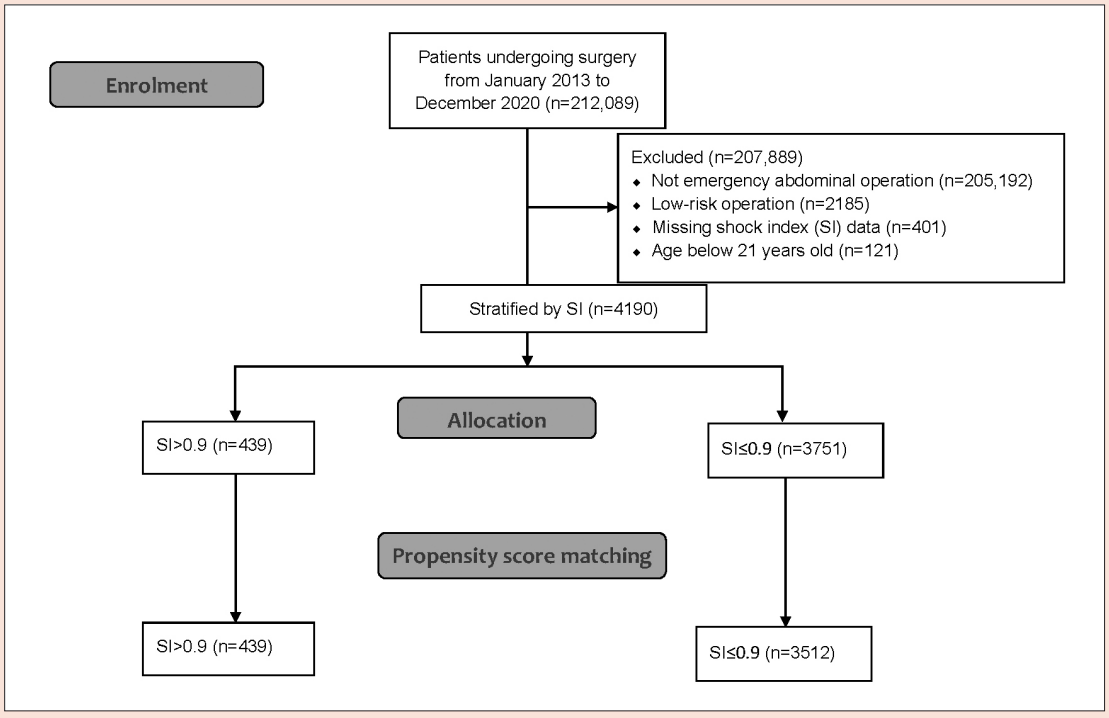
Analysis, statistical computing and visualisation were carried out with R environment version 4.0.5. The KM curve was plotted using scikit-survival package on Python 3.6.0.

RESULTS

Demographics and clinical characteristics

A total of 212,089 patients who underwent MAES between January 2013 and December 2020 were recruited. The exclusion criteria include the low-risk nature of the operation, non-emergent abdominal surgeries, and not satisfying the age criteria of being older than 21 years old. After applying the inclusion and exclusion criteria, the study was completed with 4190 patients with 205,192 patients excluded (Fig. 1). Patient demographics and clinical characteristics were stratified by their SI and compared (Table 1A). Of the included patients, 89.5% (3751) had an SI of ≤0.9, whereas 10.5% (439) had an SI of >0.9. PSM was employed to ensure comparability between groups by matching patients based on gender, operative risk and renal disease. Following the matching process, the final cohort comprised 3960 patients, with 3521 patients exhibiting an SI of ≤0.9, whereas 439 patients had an SI of >0.9. Patients with an SI of >0.9 had a

Fig. 1. CONSORT diagram for patient recruitment.



mean SI of 1.09 as compared to patients with an SI of ≤0.9 who had a mean of 0.62. Patients with an SI of ≤0.9 had a higher mean age of 56.66 ± 18.23 years compared to those with an SI of >0.9 (52.80 ± 19.15 years). There were more males in the SI≤0.9 group (51%) than in the SI>0.9 group (48%). Chinese patients constituted the majority of both groups, with 72% and 66% in the SI≤0.9 and SI>0.9 groups, respectively.

Patients with a higher SI were found to have significantly elevated cardiac risk index (P=0.002) and ASA physical status (P<0.001); and a greater proportion of them have end-stage renal failure (P=0.008), indicating a greater comorbidity burden. Table 1A shows a summary of patient characteristics. Intraoperative parameters and postoperative complications can be found in Tables 1B and 1C, respectively.

The group with an SI of >0.9 had a greater proportion of patients on long-term steroids (P<0.001) and a smaller proportion of patients on angiotensin-converting enzyme inhibitors (P=0.008). However, there was no significant difference in the use of bisoprolol and statins between the two groups. Patients with an SI of >0.9 had long ICU and HD stays and were more likely to experience AKI compared to those with an SI of ≤0.9 (Table 1C).

Outcomes

Notably, patients in the SI>0.9 group were found to have significantly higher mortality at 1 month (OR 2.40, 95% CI 1.67–3.39, P<0.001), 3 months (OR 2.13, 95% CI 1.56–2.88, P<0.001), and at 2 years postoperatively (OR 1.77, 95% CI 1.38–2.25, P<0.001) (Table 2 and Fig. 2). After adjusting for variables, patients with an SI of >0.9 remained significantly associated with higher mortality at 1 month (OR 3.51, 95% CI 1.20–10.3, P=0.021) and 3 months postoperatively (OR 3.05, 95% CI 1.07–8.54, P=0.034) (Table 2). However, SI was not found to be significantly associated with 2-year mortality (Table 2). There was a significant difference in survival probability between the two groups (P<0.001) (Fig. 3). Overall, these findings suggest that the SI is a valuable predictor of short-term mortality and adverse outcomes in patients undergoing MAES. Fig. 4 depicts the violin plots of postoperative ICU admission between the two groups.

DISCUSSION

In this study, we analysed the relationship between SI in MAES and postoperative mortality and morbidity. SI, defined as the ratio of HR to SBP, is a simple and easily obtainable parameter that has been used as a marker of haemodynamic instability in various clinical settings. Conventionally, SI has been used in the setting of emergency departments for patients who were admitted for trauma,[20,21] haemorrhagic shock,[22] and septic shock.[23,24] More recently, SI has been used as an indicator of trauma severity,[25] early acute hypovolemia,[22] early sepsis,[23,24] and an outcome predictor of postpartum haemorrhage.[26] However, from our literature review, this is one of the few studies investigating the role of SI in predicting mortality outcomes in patients undergoing MAES.

Our results show that an SI of >0.9 is associated with increased postoperative mortality, HD requirements, AKI, and length of hospital and ICU stays. However, SI was not found to be significantly associated with 2-year mortality (Table 2). While the exact mechanisms underlying the association between elevated SI and postoperative mortality are not well understood, it is thought that increased SI may reflect a combination of decreased circulating blood volume[27] and reduced tissue perfusion, such as the central vena cava oxygen saturation and lactate concentration.[28,29] SI is a valuable tool, as it is easily calculated and does not rely on any biochemical investigations. It allows clinicians to make quick judgements about a patient's disease severity and response to fluid resuscitation. SI also guides further management. Its utility extends to picking up early signs of haemodynamic instability, allowing appropriate escalation and interventions to be made.

In this study, the association between SI and postoperative ICU admission was found to be statistically significant (P=0.043) (Table 2). The decision to admit a patient to the ICU postoperatively usually depends on a multitude of different factors, including surgical success, intraoperative cardiopulmonary stability, the patient's past medical history, and the extent of the operation. Hence, SI would serve better as a predictor of mortality and morbidity than for postoperative ICU admission. SI was also found to be significantly associated with AKI in this study, which is consistent with other studies.[30,31] Some studies had also extended this association to lactate concentration.[28,32,33]

The study population included patients who underwent emergency exploratory laparotomies due to various conditions, such as an infected appendix, gallbladder, or perforated and soiled abdomen. Although the specific type of shock was not specified for all patients, it was observed that a majority of them experienced septic shock. It is important to note that patients with haemorrhagic shock constituted only a small proportion of the cohort, as vascular surgeries were excluded from the study. These findings suggest a potential correlation between SI and the severity of septic shock and these adverse outcomes.

Table 1A. Propensity-matched preoperative patient characteristics, stratified by shock index cut-off at 0.9.

	SI≤0.9 (n=3512)	SI>0.9 (n=439)	*P* value*
Preoperative parameters			
Age	57 ± 18	53 ± 19	**<0.001**
Gender			0.3
Female	1729 (49%)	229 (52%)	
Male	1783 (51%)	210 (48%)	
Race			0.12
Caucasian	47 (1.3%)	6 (1.4%)	
Chinese	2530 (72%)	290 (66%)	
Indian	301 (8.6%)	49 (11%)	
Malay	289 (8.2%)	42 (9.6%)	
Others	345 (9.8%)	52 (12%)	
Aspirin, warfarin or anti-platelets in the past 2 weeks			>0.9
No	2813 (88%)	334 (87%)	
Yes	400 (12%)	49 (13%)	
BMI (kg/m^2)	24.4 ± 5.2	23.7 ± 5.2	0.052
History of IHD			0.14
No	2994 (90%)	375 (93%)	
Yes	316 (9.5%)	29 (7.2%)	
History of CHF			0.7
No	3233 (98%)	393 (97%)	
Yes	74 (2.2%)	11 (2.7%)	
History of CVA			0.11
No	3207 (97%)	385 (95%)	
Yes	102 (3.1%)	19 (4.7%)	
DM on insulin			0.4
No	3169 (97%)	382 (96%)	
Yes	99 (3.0%)	16 (4.0%)	
Cardiac risk index			**0.002**
0	1312 (40%)	123 (31%)	
1	1522 (47%)	207 (52%)	
2	279 (8.6%)	46 (12%)	
3	86 (2.7%)	10 (2.5%)	
4	28 (0.9%)	8 (2.0%)	
5	13 (0.4%)	2 (0.5%)	
ASA score			**<0.001**
ASA 1-2	2359 (67%)	222 (51%)	
ASA 3-5	1144 (33%)	217 (49%)	
Preoperative haemoglobin (g/dL)	12.79 ± 2.35	12.17 ± 2.67	**<0.001**
Preoperative creatinine (mmol/L)	83.36 ± 78.18	104.58 ± 115.64	**<0.001**
Preoperative HbA1c (%)	7.18 ± 1.95	6.68 ± 1.74	0.088
Duration of operation (mins)	131 ± 81	152 ± 96	**<0.001**
Operative risk			**<0.001**
High	217 (6.2%)	50 (11%)	
Moderate	3295 (94%)	389 (89%)	
DM			0.4
Yes	608 (17%)	83 (19%)	
ESRF			**0.008**
Yes	116 (3.3%)	26 (5.9%)	
Use of steroids			**<0.001**
Yes	107 (3.1%)	32 (7.4%)	

Table 1A. Propensity-matched preoperative patient characteristics, stratified by shock index cut-off at 0.9. (Cont'd)

	SI≤0.9 (n=3512)	SI>0.9 (n=439)	*P* value*
Use of ACEIs Yes	303 (8.7%)	21 (4.8%)	**0.008**
Use of Bisoprolol Yes	240 (6.9%)	36 (8.3%)	0.3
Use of statins Yes	836 (24%)	94 (22%)	0.3

Values are presented as mean ± SD or numbers (%). ACEIs: angiotensin-converting enzyme inhibitors; ASA: American Society of Anesthesiologists; BMI: body mass index; CHF: congestive heart failure; CVA: cerebrovascular accident; DM: diabetes mellitus; ESRF: end-stage renal failure; IHD: ischaemic heart disease, SI: shock index. *Categorical variables were compared through chi-square test. Continuous variables were compared using Mann-Whitney. Bold values are significant at $P<0.05$.

Table 1B. Intraoperative patient characteristics, stratified by shock index cut-off at 0.9.

	SI≤0.9 (n=3512)	SI>0.9 (n=439)	*P* value*
First intraoperative parameters			
DBP (mmHg)	76 ± 15	66 ± 14	**<0.001**
SBP (mmHg)	136 ± 22	107 ± 18	**<0.001**
HR (bpm)	83 ± 16	115 ± 21	**<0.001**
SI (bpm/mmHg)	0.62 ± 0.13	1.09 ± 0.21	**<0.001**
PP (mmHg)	59 ± 20	41 ± 13	**<0.001**

Values are presented as mean ± SD. DBP: diastolic blood pressure; PP: pulse pressure; SBP: systolic blood pressure; SI: shock index. *Categorical variables were compared using chi-square test. Continuous variables were compared using Mann-Whitney. Bold values are significant at $P<0.05$.

Table 1C. Postoperative patient characteristics, stratified by shock index cut-off at 0.9.

	SI≤0.9 (n=3512)	SI>0.9 (n=439)	*P* value*
Postoperative complications			
Transfusion of red blood cells Yes	276 ± 21	277 ± 20	0.6
Length of hospital stay (days)	14 ± 23	23 ± 34	**<0.001**
HD and ICU stay	54 ± 151	124 ± 253	**<0.001**
Hospital readmission Yes	14 (100%)	2 (100%)	
HD admission postoperatively Yes	1571 (45%)	271 (62%)	**<0.001**

Values are presented as numbers (%) or mean ± SD. AKI: acute kidney injury; HD: high dependency; ICU: intensive care unit; SI: shock index. *Categorical variables were compared using chi-square test. Continuous variables were compared using Mann-Whitney. Bold values are significant at $P<0.05$.

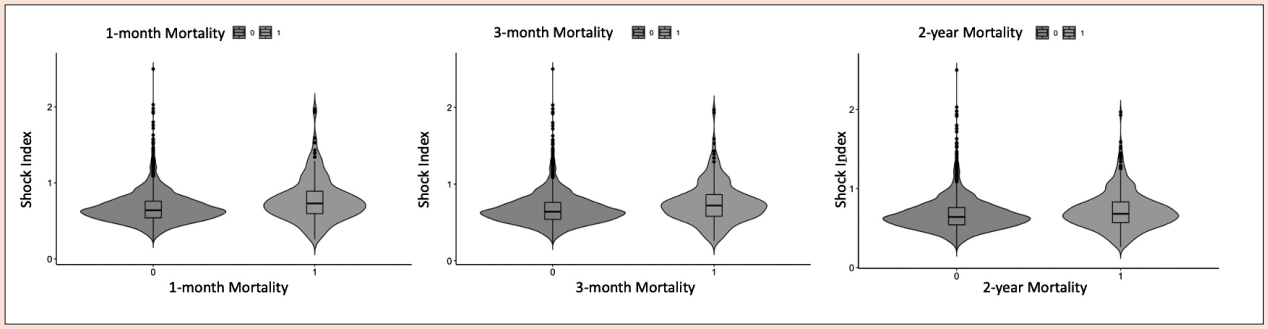
In a clinical setting, SI can be useful for anaesthesiologists, as it provides a quick indication of the severity of an illness. This enables anaesthesiologists to make guided decisions regarding the preparation of resuscitation equipment and drugs, method of induction and intraoperative management. A high SI preoperatively can also guide anaesthesiologists to adequately resuscitate the patient with fluids and vasopressors in the operating theatre prior to induction. Additionally, SI can aid anaesthesiologists in postoperative planning with regard to the need for an ICU bed for a patient. This will help facilitate getting an ICU bed early for a patient and avoid

Table 2. Univariable and multivariable regression analysis for 2-year mortality, 3-month mortality, 1-month mortality, ICU admission postoperatively, AKI postoperatively, and length of ICU stay (OR [95% CI]; *P* value).

	SI>0.9			
	Univariable		Multivariable	
	OR (95% CI)	*P* value*	OR (95% CI)	*P* value†
2-year mortality	1.77 (1.38–2.25)	**<0.001**	1.47 (0.96–2.23)	0.072
3-month mortality	2.13 (1.56–2.88)	**<0.001**	3.05 (1.07–8.54)	**0.034**
1-month mortality	2.40 (1.67–3.39)	**<0.001**	3.51 (1.20–10.3)	**0.021**
Postoperative ICU admission	4.36 (3.40–5.57)	**<0.001**	2.72 (1.03–7.25)	**0.043**
AKI	2.27 (1.80–2.88)	**<0.001**	3.39 (2.35–4.87)	**<0.001**
Length of ICU stay (days)	2.0 (1.6–2.5)	**<0.001**	1.2 (0.70–1.7)	**<0.001**

AKI: acute kidney injury; CI: confidence interval; ICU: intensive care unit; OR: odds ratio, SI: shock index. *A univariable binary logistic regression analysis was performed for each variable. †A multivariable binary logistic analysis regression analysis adjusted for shock index, age, use of aspirin, warfarin or antiplatelets over the past 2 weeks, cardiac risk index, diastolic blood pressure intraoperatively, cardiac risk index, pulse pressure intraoperatively, American Society of Anesthesiologists physical status, preoperative haemoglobin and creatinine, duration of operation, diabetes mellitus status, end-stage renal failure status, postoperative ICU admission, AKI, and length of ICU stay was performed. The multivariable analysis included variables with statistical significance ($P<0.05$). Bold values are significant at $P<0.05$. Variance inflation factor was used to ensure all factors were <5.0 to reduce multicollinearity.

Fig. 2. Violin plot of shock index against mortality at a) 1 month, b) 3 months and c) 2 years.



logistical delays. The benefits of SI can be extended to surgeons as well as patients with haemodynamic instability, and high SI could indicate a higher likelihood of bowel ischaemia. In such scenarios, SI can be one of the many considerations guiding surgeons, as these patients would have a higher likelihood of temporary abdominal closure. Future studies could explore the effect of optimising the preoperative SI with adequate resuscitation on postoperative outcomes. Other easily calculable parameters like the modified SI,[34] age SI,[35] and pulse pressure could also be studied for their associations with outcomes.

Despite promising results, there were also several limitations to this study. First, it was a single-centred, retrospective, observational study, which may increase the risk of selection bias. Second, the use of only a single time point for HR and SBP was used to calculate the SI. These parameters can change drastically with therapeutic interventions, but information on these interventions was not included. The relationship between mortality and the average of SI measurements at various time points can be considered for future studies. Third, there is a lack of differentiation of SBP readings based on the measurement device (arterial lines, non-invasive blood pressure cuff) used. The cause of death was not collected, which may limit the interpretation of mortality data.

Opponents of risk-stratification tools may argue that their utility in emergency settings is limited, as there may not be ample time to optimise the high-risk emergency patient for MAES. However, we resonate with several other authors[36,37] that a risk score for emergency surgery patients can be useful in preoperative counselling, identifying patients who require closer monitoring, and benchmarking the quality of the emergency surgery. It can also help guide providers to better

Fig. 3. Kaplan-Meier curve for postoperative mortality at 2 years. A significant difference in postoperative mortality at 2 years between the group with shock index (SI) >0.9 and SI<0.9 was observed (*P*<0.005). The confidence band represents the 95% CI.

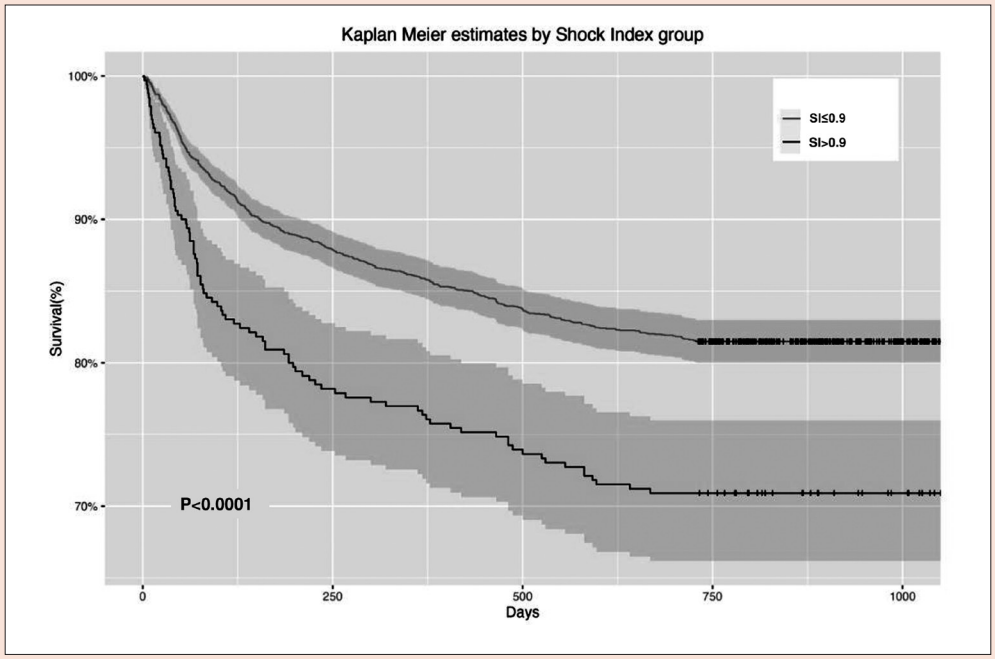
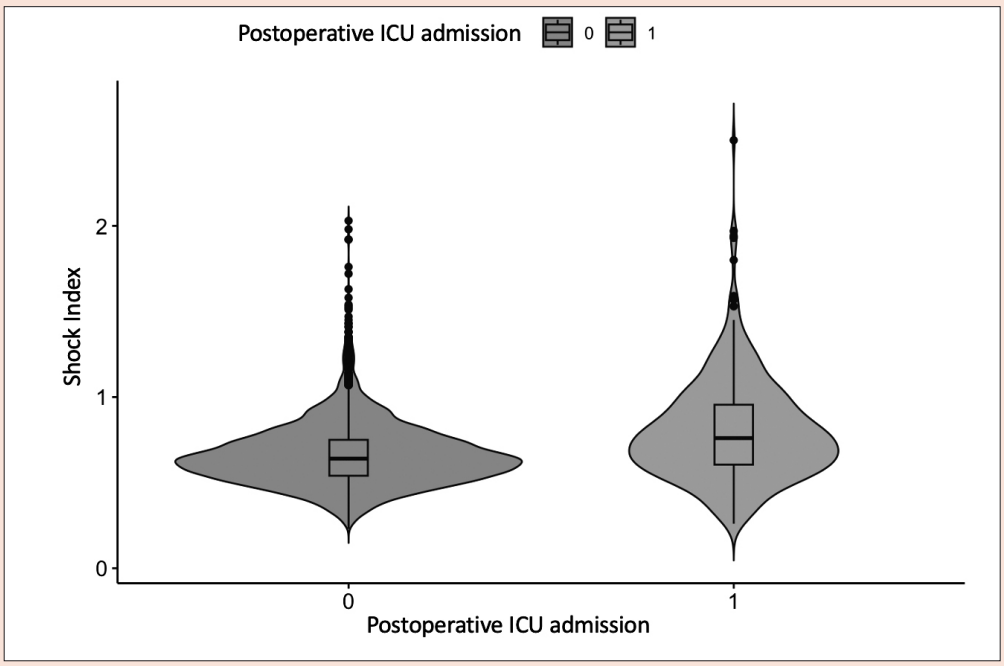


Fig. 4. Violin plot of shock index against postoperative ICU admission.



understand the patient at hand in comparison to other similar patients within the study population.

In conclusion, we found that SI is a valuable, convenient and reliable predictor of postoperative mortality, HD requirements, the incidence of AKI, postoperative ICU admission, and the length of hospital and ICU stays for patients undergoing MAES. This can help guide future resource allocation and interventions to prevent poor outcomes.

Conflict of interest

There are no conflicts of interest.

Acknowledgement

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ORIGINAL ARTICLE

Development and validation of a new self-assessment tool to measure professionalism among medical students

Jin Yang Ho[1] *MBBS*, Valerie Tuang[2] *MBBS*, Desmond B Teo[3] *MMed(Int Med)*, Gominda Ponnamperuma[4] *PhD(Dundee)*

ABSTRACT

Introduction: Professionalism is a key quality that medical students should possess, but it is difficult to define and assess. Current assessment tools have room for improvement. This study aimed to design and validate a self-assessment tool to assess professionalism among medical students.

Method: A questionnaire was created based on 10 tenets of professionalism from the Charter on Medical Professionalism jointly published by the American Board of Internal Medicine Foundation, American College of Physicians Foundation and European Federation of Internal Medicine, along with input from Singapore guides. The self-administered questionnaire was administered to Year 2 to 5 students from Yong Loo Lin School of Medicine, National University of Singapore in a voluntary, anonymised manner in the academic year of 2019/2020. Construct validity and internal reliability were evaluated using Principal Component Analysis (PCA) and Cronbach's alpha, respectively.

Results: There was a total of 541 respondents. After removing incomplete responses, 504 responses were included. Following PCA, a 17-item questionnaire titled "Medical Professionalism: A Self-assessment Tool" (MPAST) with a 5-component solution was obtained. The 5 components were commit-ment to: (1) patient's best interest, (2) honesty and integrity, (3) professional competency, (4) patient safety and care, and (5) educational responsibilities. Their Cronbach's alpha value ranged from 0.540 to 0.714, with an overall Cronbach's alpha value of 0.777.

Conclusion: MPAST is valid, reliable, practical, and is the first validated self-assessment tool to assess professional attributes and behaviours among medical students, to our knowledge.

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Keywords: medical education, professionalism, self-assessment, students

INTRODUCTION

Professionalism is a concept that is difficult to define, but in relation to medical practice, it can be summarised as values, behaviours and conduct that foster the public's trust in doctors. It comprises a complex interplay of abstract concepts that have led to many attempts at defining professionalism.[1-4] With time, changes in the doctor-patient relationship have also led to shifts in the concept of professionalism, with patient-centredness involving focus on patient autonomy and patient experience having a much larger emphasis.[4] Undergraduate medical education institutions in Singapore have also created a dedicated list of professional attributes[5,6] that their graduates are expected to achieve. Despite the myriad of definitions available for professionalism, all these institutions have a similar consensus—that professionalism is a key component of medical education.

There are presently a few models of medical professionalism as described by various organisations throughout the world such as the American Board of Internal Medicine, American College of Physicians Foundation and European Federation of Internal Medicine (ABIM, ACP-ASIM, EFIM),[1] General Medical Council[3] and Royal College Physicians of London.[4] Professionalism can also be classified as an individual, interpersonal or societal process.[7] Fundamentally, these models all describe certain attitudes that are consistent, such as personal improvement, teamwork, maintenance of appropriate doctor-patient relationship and recognition of the ethical dilemmas that physicians face daily.

Significantly, it has also been shown that unprofessional behaviours in medical school predict unprofessional behaviours in future medical practice.[8] Professionalism is closely tied to the care patients receive, and consequently their health and illness outcomes.[9] Professionalism can be developed[10] but to do so will require methods to assess professionalism.[11] Hence, this highlights the need to pay more attention to the teaching and assessment of professionalism in medical schools.[12]

However, there are many barriers to measuring professionalism.[13] Traditionally, professionalism assessment looks into personality traits, but reports[14] have shown that one's behaviour and actions cannot be

[1] Internal Medicine, National University Health System, Singapore
[2] Ministry of Health Holdings, Singapore
[3] Fast and Chronic Programmes, Alexandra Hospital, Singapore
[4] Centre for Medical Education, Yong Loo Lin School of Medicine, National University of Singapore
Correspondence: Dr Jin Yang Ho, Internal Medicine, National University Health System, 5 Lower Kent Ridge Road, Singapore 119074.
Email: jinyang00512@gmail.com

CLINICAL IMPACT

What is New

- To our knowledge, the Medical Professionalism: A Self-assessment Tool (MPAST) is the first self-assessment tool that has been validated in Singapore that assesses both professional attributes and actual behaviours to measure professionalism among medical students.

Clinical Implications

- MPAST can be used as part of a comprehensive assessment model to assess professionalism among medical students in Singapore and other countries with similar healthcare contexts.
- The findings can identify areas for action to nurture and develop professional values among students and doctors, which can translate to improvements in clinical outcomes for patients.

accurately inferred or predicted by personality traits. In a review of the methods of professionalism assessment, Ginsburg et al. came to the conclusion that studies on professionalism should emphasise behaviour instead of abstract concepts of professional traits or attributes.[13] Emphasis on behaviours rather than traits also shifts the focus away from labelling an individual as professional or unprofessional, and this allows the assessment to be less threatening to the individuals and thus encourage higher uptake.[13] Even if behaviours could be assessed accurately, the judgement of whether a certain behaviour is professional or not is highly context-dependent.[15] Behaviours demonstrated by individuals are often the result of deliberation and conflict between 2 (or more) professional values, and most assessment tools for professionalism cannot accurately capture this process.[13]

There are many different tools that have been developed to assess professionalism,[12,16] and they vary in terms of the aspect of professionalism being measured, the target group, the purpose of the assessment[17] and the role of the respondents.[13] The large number of tools is a testament to how complex the subject of professionalism is, and how a single mode of testing is unlikely to be able to fully assess professionalism.[13] In addition, the professionalism assessment tools currently available[18-26] are limited in terms of their creation, content and conduct. In terms of creation, there are tools[19,26] that were created with older definitions of professionalism. Content-wise, some tools were created for other healthcare professionals[20,21] or to assess the professional climate in a healthcare setting.[22,23] Of the tools developed specifically for medical students, many scales do not have a strong emphasis on student behaviour.[25]

Across different regions and cultures, there are differences in the understanding of professionalism.[27] Hence, cross-cultural validation of any assessment tool is important.[7] The Professionalism Mini Evaluation Exercise (P-MEX) was recently found to be suitable for use in Singapore.[28] However, aside from this consensus, it has yet to be administered and its internal validity has not yet been demonstrated. However, P-MEX places students in simulated settings and relies on assessment by external observers, which has its limitations. Assessors' own ideals and wish to avoid criticising students influenced judgement and some felt the scoring items were too basic.[29]

While there are tools to assess professionalism that rely on feedback from colleagues, friends, patients or assessors, self-administered questionnaires can be useful for assessing professionalism in large groups of students to identify patterns and associations.[13] It is also useful as a part of a multi-component evaluation.[12,30] Self-assessment has the added benefit of encouraging self-reflection, which may lead to personal improvement[31] and sustainable lifelong learning in medicine.[32] To aid in minimising biasness in self-reporting and recall, self-assessment can be done based on concrete, measurable targets determined by other parties coupled with constructive feedback.[33] This study therefore aims to design and validate a self-assessment tool for both professional attributes and behaviours among medical students.

METHOD

Developing the professionalism assessment tool

The 10 tenets of professionalism from the Charter on Medical Professionalism jointly published by the ABIM, ACP-ASIM, EFIM[1] were used as the foundation on which the survey was built upon. It was chosen because the Charter has been endorsed by a large number of national and international bodies.[34] The tenets have also been used internationally, such as in the creation of a questionnaire[34] for practising physicians. The questionnaire assessed their professional attributes and behaviours, which were associated with each tenet. These tenets were adapted for our study. To ensure contextual relevance, references were also made to the Singapore Medical Council's

Ethical Code and Ethical Guidelines[2] and the Yong Loo Lin School of Medicine, National University of Singapore (NUSMed) Student Handbook.[5]

The authors—comprising 2 medical students, a practising physician and a medical educationalist—created at least 2 items for each tenet of professionalism. Using a Likert scale, the first item assessed the attitude of how the student believed a physician should act in certain circumstances to demonstrate professionalism, whereas the second item required the student to reflect on his or her own behaviour and report the frequency at which a professional or unprofessional act was performed.

Pilot testing was conducted on a group of 10 medical students. The provisional questionnaire was administered to the students and feedback was gathered on the relevance of the questions, ease of understanding and whether there were ambiguities in the phrasing of the items. Based on the feedback provided, the questionnaire was modified to give the preliminary Medical Professionalism: A Self-Assessment Tool (MPAST) (supplementary materials, Appendix S1).

Participants

Year 2 to 5 medical students from NUSMed with clinical encounters and experience were invited for the survey. NUSMed's medicine course is a 5-year undergraduate programme, where the first 2 years are pre-clinical, involving lectures and tutorials.[5] Year 2 students had patient contact and interaction through the Clinical Skills Foundation Programme to prepare them for the clinical years. From Year 3 onwards, students acquire knowledge and skills in the clinical learning environment through postings to various healthcare institutions in Singapore. This study was approved by the National University of Singapore Institutional Review Board (reference code S-19-183).

Data collection

Students attending combined teaching sessions were invited to complete a voluntary, anonymised, non-remunerative and self-administered questionnaire, which was administered in paper-and-pencil form between October 2019 and April 2020. The responses were subsequently transcribed by members of the research team. The responses were recorded on a scale of 0 to 4. For positively worded items, "strongly agree" or "always" responses were given a value of 4, while negatively worded responses like "strongly disagree" or "never" were given a value of 0.

Statistical analysis

All statistical analyses were conducted using jamovi software, version 1.2 (The jamovi project). The construct validity of MPAST was evaluated using Principal Component Analysis (PCA). Responses with missing data were not included in the analyses. The varimax rotation was used. The assumptions for PCA were assessed using Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's test of sphericity. The threshold for KMO measure of sampling adequacy was 0.6. The threshold for Bartlett's test of sphericity was a *P* value of less than 0.05. Components were retained based on an eigenvalue more than 1.0 and the visual examination of the scree plot. A factor loading threshold of 0.3 was used.

Cronbach's alpha values were evaluated to assess the reliability of the questionnaire. A value of more than or greater than 0.7 was considered acceptable. Thematic analysis was used to analyse the items within each component.

RESULTS

Participant characteristics

Out of 812 participants, 541 (66.6%) responded. The majority of the participants were Chinese but equally distributed within each year of study and sex (Table 1). The proportion of males and females in the sample population is similar to students enrolled in the various medical schools in Singapore, at the time of study.[35]

Table 1. Characteristics of respondents.

	No.	%
Year of study		
Year 2	126	23.3
Year 3	140	25.9
Year 4	126	23.3
Year 5	149	27.5
Sex		
Male	231	42.7
Female	306	56.6
Missing	4	0.7
Ethnicity		
Chinese	491	90.8
Malay	3	0.6
Indian	37	6.8
Others	7	1.3
Missing	3	0.6

Construct validity and internal reliability

After incomplete responses were removed, 504 responses were included in the PCA. Initial analysis inclusive of all the items in the questionnaire generated a 7-component solution with a Cronbach's alpha value of 0.744. Items that had a factor loading threshold of less than 0.3 and items that had a negative impact on the individual component or the overall Cronbach's alpha coefficient values were then sequentially removed. Following 6 iterations of the PCA, a 17-item questionnaire with a 5-component solution was obtained (Appendix S2). The details of each iteration of PCA are provided in Table 2. The scree plot is shown in Fig. 1. This accounted for 54.6% of the variance in the data. The component loadings and statistics are shown in Tables 3 and 4, respectively. The overall KMO Measure of Sampling Adequacy was 0.812, which suggested that the sample was sufficient for analysis. Bartlett's test of sphericity was $\chi^2(136)=1579$, $P<0.001$, which suggested that the correlation among variables significantly differed from zero.

Although there were some items that were loaded onto multiple components, these were not removed as they were deemed to be targeting important aspects of professionalism. These items were included in the component where they had the highest component loading. The overall Cronbach's alpha value was 0.777 for the validated questionnaire and the alpha reliability for its individual components are shown in Table 4.

The 5 components were commitment to: (1) patient's best interest, (2) honesty and integrity, (3) professional competency, (4) patient safety and care, and (5) educational responsibilities (Table 5).

DISCUSSION

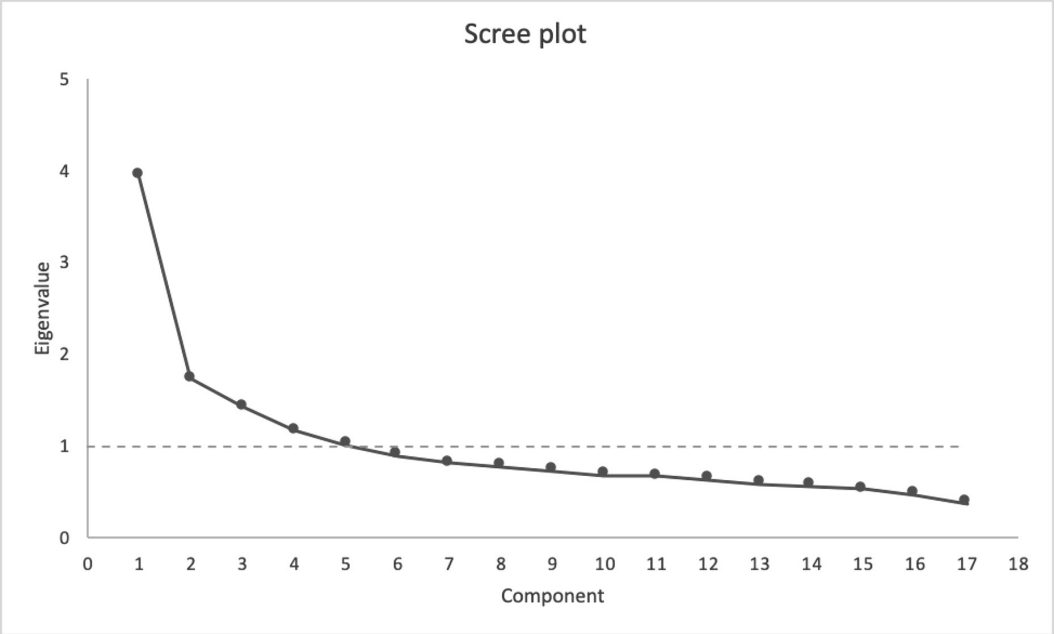
To our knowledge, this is the first study that aimed to design and validate a tool to assess both professional attributes and behaviours among medical students in Singapore. Our findings show that MPAST is valid, reliable and practical. After excluding incomplete responses, our sample size of 504 is adequate as it is recommended that validation of an instrument requires a minimum of 10 respondents per item[36] or a minimum overall sample of 300 respondents.[37]

MPAST was designed with reference to ABIM, ACP-ASIM, EFIM's Charter of Medical Professionalism, which has been used to design other professionalism assessment tools in both Western[18,23] and non-Western[26] countries. The initial questionnaire was created and contextualised using Singapore references,[2,5,6] in collaboration with medical students, a practising physician and a medical educationalist, who deemed the items representative of their respective domains of professionalism, meaningful and relevant. This provided content and face validity. The inclusion of medical students in the

Table 2. Principal Component Analysis (PCA) iterations.

PCA iterations	Questions removed	Reason for removal of questions
1	(Question no. 17) I have attended conferences sponsored by pharmaceutical companies.	Had a factor loading threshold of less than 0.3.
2	(7) Physicians should never feel guilty about how they treat a patient from a humanitarian standpoint. (10) Physicians should encourage the participation of their patients in clinical trials.	Had a low Cronbach's alpha value as a component.
3	(23) I treat all patients the same regardless of gender, age, culture, social and economic status, sexual preferences, beliefs, contribution to society, illness-related behaviours or the illness itself.	Had a negative Impact on individual component Cronbach's alpha value.
4	(14) I have reflected upon the investigations and management of a patient and questioned the team if certain orders were truly necessary. (16) I have taken part in research projects with the aim of advancing knowledge and science.	Had a negative impact on overall Cronbach's alpha value.
5	(19) I have taken part in projects to reach out to populations who have poorer access to healthcare.	Had a negative impact on overall Cronbach's alpha value.
6	(25) I have strived to understand my patients' and their families' physical and emotional needs.	Had a negative impact on individual component Cronbach's alpha value.

Fig. 1. Scree plot obtained through Principal Component Analysis.



design and creation also offers special insight into the behaviour and psyche of a medical student.

Although MPAST was created with reference to ABIM, ACP-ASIM, EFIM's Charter on Medical Professionalism, the clustering of the items based on PCA was different to what was expected. There were some items that clustered based on the professional attribute that was being assessed, while other items clustered according to whether they assessed the students' attitudes or behaviour towards professionalism. However, this is realistic, given the interrelation between attributes and the 2 different professionalism outcomes, i.e. attitudes and behavious.[11] By comparing the 5 themes with the 10 tenets, there is a suggestion the original 10 tenets could be further condensed into these 5 themes based on similarity of ideas as shown in Table 5.

Although the Cronbach's alpha value for overall questionnaire and component 1 was more than 0.7, component 2 to 5 had values that were more than 0.5 but less than 0.7, comparable with other professionalism assessment scales as shown in Table 6. Generally, Cronbach's alpha values of more than 0.7 are acceptable.[38] However, according to Taber,[39] Cronbach's alpha values should not be interpreted in isolation, but should be understood based on the context of the study and the items that are included in the instrument used. Based on the similarity of the professional attributes that are being assessed by items in their respective components, the MPAST has overall adequate construct validity and internal reliability.

In addition, there were also similarities in the themes identified for MPAST and the professional attributes that NUSMed aims to develop in its students. These include the concepts of honesty and integrity, taking responsibility for one's own learning and professional competency, taking responsibility for patient's safety and well-being, and being committed to patient's best interest by showing respect and sensitivity to patients.[5] Comparing the themes again with another Singapore qualitative study, we see similar overlaps with 3 of 4 domains of medical professionalism, namely: doctor-patient relationship, inter-professional relationship and reflective practice.[28]

Also, when comparing MPAST with other tools available, we can identify characteristics unique to MPAST. First, the MPAST features a unique emphasis for reflection on behaviour—not just ideal behaviour, but actual behaviour performed by the individual doing the assessment. Prior to this, many tools largely focused on attributes rather than behaviours[25] and even when there was an emphasis on behaviours, students were tasked to identify ideal behaviours instead of reflecting on their own actions. The flaw with such an approach is that traits alone may not accurately predict behaviour,[14] since the importance of assessing behaviour has been shown.[13] Hence, this scale included relevant and practical scenarios where professional dilemmas would arise. As current practising physicians who was a medical student not too long ago, many of these situations still leave a significant impression on the authors.

Table 3. Component loadings obtained through Principal Component Analysis.

Items	Components				
	1	2	3	4	5
Physicians should provide necessary care regardless of the patient's ability to pay.	0.806				
Physicians should put the patient's welfare above the physician's financial interests.	0.691				
Physicians should minimise disparities in care due to patient race or gender.	0.683			0.408	
Physicians have the obligation to protect the confidentiality of the patient.	0.647				
I have omitted learning about a certain condition or avoided speaking to a patient because the condition is deemed to be unimportant for examinations.		0.688			
I have reported a part of the physical examination as normal when it had been inadvertently omitted from the physical examination.		0.671			
I have discussed sensitive and confidential information about patients in a public setting with insufficient precautions taken.		0.569		0.357	
I have kept learning opportunities to myself instead of sharing them with my peers.		0.566			
Physicians should undergo recertification examinations periodically throughout their career.			0.795		
Physicians should report all instances of significantly impaired or incompetent colleagues to hospital, clinic, or other relevant authorities.			0.706		
Physicians should participate in peer evaluations of the quality of care provided by colleagues.		0.322	0.584		
I have practised beyond my limits by performing procedures beyond my capabilities under insufficient supervision.				0.617	
I did not inform the team in charge of a patient after I spoke to and retrieved additional information from the patient that was relevant to the patient's condition and management.		0.419		0.550	
I have insisted on talking to or examining a patient who was visibly tired or who had turned me down initially.		0.408		0.491	
Physicians should disclose all significant medical errors to affected patients and/or guardians.	0.301		0.337	0.466	
I pay attention to the teacher in lessons and contribute appropriately.					0.828
I have prepared myself well for my examinations and assessments in medical school.					0.797

Table 4. Component statistics and Cronbach's alpha values of overall questionnaire and individual components.

Component	Eigenvalue	Sum of squares loadings	Variance explained (%)	Cumulative variance (%)	Cronbach's alpha value
1	3.948	2.25	13.23	13.2	0.714
2	1.733	2.10	12.34	25.6	0.617
3	1.421	1.78	10.49	36.1	0.599
4	1.162	1.73	10.20	46.3	0.543
5	1.014	1.41	8.32	54.6	0.540
Overall	-	-	-	-	0.777

Table 5. Themes of components, their respective items and comparison to the 10 tenets of the Charter on Medical Professionalism by the American Board of Internal Medicine Foundation, American College of Physicians-American Society of Internal Medicine Foundation and European Federation of Internal Medicine (ABIM, ACP-ASIM, EFIM).

Component	Theme	Items	ABIM, ACP-ASIM, EFIM tenets
1	Commitment to patient's best interest	Physicians should put the patient's welfare above the physician's financial interests.	Commitment to improving access to care.
		Physicians should minimise disparities in care due to patient race or gender.	Commitment to a just distribution of finite resources.
		Physicians have the obligation to protect the confidentiality of the patient.	Commitment to patient confidentiality.
		Physicians should provide necessary care regardless of the patient's ability to pay.	Commitment to improving access to care.
2	Commitment to honesty and integrity	I have omitted learning about a certain condition or avoided speaking to a patient because the condition is deemed to be unimportant for examinations.	Commitment to honesty with patients (or academic work, since the respondents are medical students).
		I have reported a part of the physical examination as normal when it had been inadvertently omitted from the physical examination.	Commitment to honesty with patients.
		I have discussed sensitive and confidential information about patients in a public setting with insufficient precautions taken.	Commitment to patient confidentiality.
		I have kept learning opportunities to myself instead of sharing them with my peers.	Commitment to scientific knowledge.
3	Commitment to professional competency	Physicians should undergo recertification examinations periodically throughout their career.	Commitment to professional competence.
		Physicians should report all instances of significantly impaired or incompetent colleagues to hospital, clinic, or other relevant authorities.	Commitment to professional responsibilities.
		Physicians should participate in peer evaluations of the quality of care provided by colleagues.	Commitment to professional responsibilities.
4	Commitment to patient safety and care	I have practised beyond my limits by performing procedures beyond my capabilities under insufficient supervision.	Commitment to improving quality of care.
		I did not inform the team in charge of a patient after I spoke to and retrieved additional information from the patient that was relevant to the patient's condition and management.	Commitment to maintaining trust by managing conflicts of interest.
		I have insisted on talking to or examining a patient who was visibly tired or who had turned me down initially.	Commitment to maintaining appropriate relations with patients
		Physicians should disclose all significant medical errors to affected patients and/or guardians.	Commitment to maintaining trust by managing conflicts of interest
5	Commitment to educational responsibilities	I have prepared myself well for my examinations and assessments in medical school.	Commitment to scientific knowledge
		I pay attention to the teacher in lessons and contribute appropriately.	Commitment to scientific knowledge

Second, by placing an emphasis on actual behaviour, MPAST provides an opportunity for self-reflection that can potentially stimulate a desire for self-improvement.[31] As medical students progress through their medical school and become doctors, they develop their professional identity, which may refer to their internalisation of what being a good doctor means and the manner in which they should behave.[40] The formation of professional identity is increasingly being accepted as a key component of professionalism education,[41] and is influenced by formal, informal and hidden curricula.[42] Self-

Table 6. Comparison of Cronbach's alpha values of the Medical Professionalism: A Self-assessment Tool with other scales.

S/N	Scale	Range of Cronbach's alpha values for individual factors	Overall scale Cronbach's alpha value
1	Penn State College of Medicine Professionalism Questionnaire[18]	0.51–0.78	Not reported
2	Scale that measures professional attitudes and behaviours associated with the medical education and residency training environment[19]	0.59–0.72	0.71
3	Professionalism Assessment Tool[20]	0.91–0.95	Not reported
4	Professionalism Scale by Project Consortium[21]	0.505–0.825	Not reported
5	Queen's University Belfast Professionalism Index[22]	0.77–0.88	Not reported
6	Instrument to Measure the Climate of Professionalism in a Clinical Teaching Environment[23]	0.75–0.91	Not reported
7	Medical Students' Attitudes Toward Providing Care for the Underserved[24]	0.4–0.91	0.87–0.91
8	Professionalism Assessment Scale[25]	0.6–0.84	Not reported
9	Arabian Learners' Attitude of Medical Professionalism Scale[26]	0.42–0.57	Not reported

reflection plays a key role in the formation of this professional identity.[42-44] It is through reflection on their experiences and actions that medical students can merge their personal and professional identities, internalise professional values as their personal values and manifest that as professional behaviour.[42] Building a strong professional identity is important as this has been shown to influence patient care and outcomes.[9] As students and doctors develop a responsibility to their patients, this may also help them find meaningful employment and remain committed, with a similar parallel being drawn in the law industry.[45] This is especially important following the recent COVID-19 pandemic having led to a significant rise in healthcare workers leaving the workforce due to burnout and increasing work commitments. With changing work environments and business practices influencing medicine, a strong set of professional values is fundamental to doctors continuing to deliver ethical and altruistic care for patients.[46]

Last, MPAST is a simple and practical self-assessment tool that can be administered quickly to a large population in a short period of time. It is useful in assessing professionalism among a large number of students.[13] This allows comparison of the levels of professionalism among various groups of students and identification of relevant factors or associations. Additionally, through the various themes of professionalism, MPAST can help individuals or schools to identify areas of professionalism that require actions. By administering MPAST to the same population at 2 different time points, it would also be possible to track changes in the level of professionalism longitudinally. In order to best assess the qualities of an individual, the MPAST can form part of a comprehensive approach that utilises different modalities. Feedback should also be sought from peers, seniors, juniors, patients and standardised patients who had extensive interaction with the individual to obtain a holistic assessment of an individual's professional attitudes and behaviour.

However, this study has several limitations. First, the sample population that was used for validation of MPAST was only from 1 undergraduate medical school, and the data collected might not be representative of all medical students from other medical schools. Furthermore, this study was limited to a single country, hence future cross-cultural validation would be required prior to application of this tool in other cultural contexts.[7] An analysis of medical professionalism in Asian cultural contexts and Western frameworks revealed differences in emphasis, with the former having stronger emphasis on morality, intrinsic values and upholding of a high moral standard when no one is around.[47] Western frameworks, such as the ABIM, ACP-ASIM, EFIM's referenced in this paper, had stronger focus on commitment to a set of professional factors. Notably, MPAST amalgamates these strengths, being built upon professional commitments while also encouraging students to reflect on their own actions and intrinsic values in private.

The MPAST was created by a small team comprising two medical students, a practising physician and a medical educationalist. A pilot trial was conducted with 10 medical students. This

could have been improved by utilising more rigorous qualitative methods, such as focused group discussions or nominal group technique to be comprehensive and inclusive, and to allow thematic analysis when developing the questionnaire items.

In addition, there can be self-reporting bias, including both social desirability bias and recall bias as this is a self-reported questionnaire. However, social desirability bias was minimised by the anonymity of the participants who completed the survey.

Lastly, the use of a single modality for the assessment of professionalism might not provide a holistic judgement of students' professionalism. However, the intent of MPAST was never to replace all other modalities, but rather to complement and represent the self-assessment component of a comprehensive, all-rounded assessment of one's professionalism.

Moving forward, relationships between the level of professionalism and demographic factors can also be determined using this new validated tool. Longitudinal studies can also be conducted to assess changes in professionalism with time. More studies on nurturing professionalism can also be pursued, in particular, on employing a method of mentorship, which has been shown to be of particular importance in the Singapore cultural context.[48] Ultimately, MPAST can help to spark further conversation and discussion about professionalism. It also emphasises the importance of behaviour as being a part of professionalism assessment and the benefits that self-assessment can provide.

CONCLUSION

Professionalism is a core attribute that medical professionals should possess. The process of inculcating professional attributes and behaviours has to begin in medical school. Identifying students who possess unprofessional behaviour, tracking their progress and targeting factors that influence professionalism are key steps that educational institutions should undertake. MPAST is a practical, reliable and validated tool to facilitate these processes and pave the way for future development in medical professionalism assessment.

Disclosure

The authors declare no conflicts of interest.

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REVIEW ARTICLE

Consensus statement on Singapore Perinatal Mental Health Guidelines on Depression and Anxiety

Helen Chen[1,2] *MMed(Psy)*, Tze-Ern Chua[1,2] *MMed(Psy)*, Theresa Mei Ying Lee[1,2] *MMed(Psy)*, Elizabeth Junpei Siak[1,2] *MRCPsych*, Lin Feng Hong[1,2] *MRCPsych*, Ying Chia Ch'ng[1] *MA App Soc Studies*, Yasmin Hassan[1] *BA(Social Work Hons)*, Cornelia Yin-Ing Chee[2] *MMed(Psy)*, Yee Ming Mok[3] *MMed(Psy)*, Say How Ong[5] *MMed(Psy)*, Victor Samuel Rajadurai[6] *MRCPaed*, Tiong Ghee Teoh[7] *FRCOG*, Vasuki Utravathy[8] *MPH*, Kok Hian Tan[2,9] *FRCOG*, Lay Kok Tan[2,9] *FRCOG*

ABSTRACT

Introduction: Perinatal depression and anxiety are public health concerns affecting approximately 1 in 10 women in Singapore, with clear evidence of association with various adverse outcomes in mother and child, including low birthweight, preterm birth and negative impact on infant neurodevelopment, temperament and behaviour. A workgroup was formed to develop recommendations to address the perinatal mental health needs of women with depression and anxiety. The approach was broad-based and aimed to incorporate holistic methods that would be readily applicable to the network of care providers supporting childbearing women.

Method: The Grading and Recommendations Assessment, Development and Evaluation (GRADE) Evidence to Decision framework was employed to draw these guidelines. Workgroup members—comprising experts in the field of perinatal mental health and obstetric medicine—deliberated on the public health needs of the target population, and reviewed literature published from 2001 to 2022 that were relevant to improve the well-being of women with depression and anxiety during the preconception and perinatal periods.

Results: A consensus meeting was held involving a wider professional network, including family physicians, paediatricians, psychiatrists, social services and the Health Promotion Board in Singapore.

Conclusion: Ten consensus statements were developed, focusing on the overall aim of achieving optimal perinatal mental health for women with depression and anxiety. They relate to awareness and advice on preconception mental health, screening and assessment, optimising care and treatment. Special considerations were recommended for women who suffered severe maternal events, tailoring care for adolescents and women with special needs, and addressing infant mental health needs.

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Keywords: perinatal mental health, preconception, antenatal depression, postnatal depression

INTRODUCTION

Perinatal mental health conditions have been recognised as a key area of focus by the World Health Organization, with the new guide published in September 2022[1] highlighting the importance of screening, diagnosis and management of perinatal mental health conditions that are integrated into maternal and child health (MCH) services. The guide provides information on identifying symptoms of mental health problems and responding in a way that is adapted to local and cultural contexts, as well as evidence on perinatal mental healthcare, plans for its integration into MCH services and assessment of its impact. In Singapore, the need for addressing maternal mental health concerns has been well recognised and established as a key priority area by an inter-agency taskforce on child and maternal health and well-being that was set up in 2021 to enhance support for families with children to foster good health and well-being. In Singapore's latest nationwide mental health study, the lifetime prevalence of major depression and generalised anxiety disorder among women of childbearing age is reported to be 7.7–9.2% and 1.9–2.2%, respectively.[2] Antenatal depression affects around 7 to 9% of women in

[1] Department of Psychological Medicine, KK Women's and Children's Hospital, Singapore
[2] Duke-National University of Singapore, Singapore
[3] Department of Psychological Medicine, National University Hospital, Singapore
[4] Department of Mood and Anxiety, Institute of Mental Health, Singapore
[5] Developmental Psychiatry, Institute of Mental Health, Singapore
[6] Neonatology, KK Women's and Children's Hospital, Singapore
[7] Obstetrics & Gynaecology, KK Women's and Children's Hospital, Singapore
[8] Outreach Division, Health Promotion Board, Singapore
[9] Department of Maternal Fetal Medicine, KK Women's and Children's Hospital, Singapore
Correspondence: Prof Kok Hian Tan, Department of Maternal Fetal Medicine, KK Women's and Children's Hospital, 100 Bukit Timah Road, Singapore 229899.
Email: tan.kok.hian@singhealth.com.sg
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CLINICAL IMPACT

What is New

- This article reviews recommendations in Singapore ensuring optimal mental health for women with depression and anxiety during the preconception, antenatal and postnatal periods.
- Holistic approach examining healthy lifestyle adjustment, early detection through opportunistic screening, and needs-based intervention can improve outcomes for mothers and mothers-to-be.

Clinical Implications

- This expert consensus can guide the professional network to support mothers and mothers-to-be, to improve the population health for childbearing women in Singapore.

Singapore,[3,4] while those with high-risk pregnancies registered a higher rate of 18 when considering both major and minor depression antepartum depressive states.[5] The prevalence of postnatal depression was reported at 6.8–10.4%.[4,6,7] Perinatal anxiety is less studied, in part because of a lack of clarity of diagnostic criteria; nonetheless, persistently high antenatal anxiety can occur in as many as 17% women locally.[8] The neurodevelopmental impact of depression and anxiety on the growing fetus has been clearly evidenced in the Growing Up in Singapore Towards Healthy Outcomes (GUSTO) birth cohort study, with reported changes in microstructure,[9] functional connectivity[10] as well as epigenetic footprint.[11] The adverse impact extends into the postpartum period, during which maternal depression and anxiety have been found to be associated with infant negative temperament,[12] reduced maternal sensitivity,[13] child behavioural problems,[10] and decreased school readiness.[14] Given that preconception mental health has been found to be closely related to antenatal mental health,[15] which in turn predicts postnatal mental health,[16] there is a crucial need for early identification and intervention to ensure the best health outcomes for women and children.

Aim of consensus statement

Our objective is to provide guidance to professionals in maternal and child health services on addressing depression and anxiety, during the preconception, antepartum and postpartum phases. In Singapore, the network of practitioners will include general practitioners, family physicians, obstetricians and gynaecologists, paediatricians, nurses, social workers and counsellors, psychiatrists, and other mental health professionals. The consensus statement includes a 10-item summary that aims to be easily understood by healthcare professionals as well as the general public, because awareness and public education are key factors to addressing maternal mental health at the population level. These recommendations are relevant to all childbearing women, irrespective of cultural background or socio-economic status; and include considerations for women with special needs, who have experienced severe obstetric adverse events or adolescent pregnancies, and infants. Severe mental disorders, such as schizophrenic and bipolar disorders, are not covered here, as they are less prevalent and require specialist attention. Future work is needed to develop guidelines in the approach to perinatal management of severe mental disorders as this remains a key area of need.

METHOD

The consensus workgroup comprised perinatal mental health specialists and clinical counsellors from KK Women's and Children's Hospital as well as National University Hospital and Institute of Mental Health, the other two public centres with perinatal mental health resourcing. The workgroup was tasked by the College of Obstetricians and Gynaecologists Singapore to develop perinatal mental health guidelines, and was supported by the SingHealth Duke-NUS Maternal & Child Health Research Institute Integrated Platform for Research in Advancing Maternal & Child Health Outcomes (IPRAMHO), funded by the National Medical Research Council. Focusing on the more prevalent conditions (i.e. depression and anxiety) during the preconception, antepartum and postpartum phases, we reviewed evidence from the UK National Institute of Health and Care Excellence (NICE) guidelines on antenatal and postnatal mental health as well as relevant literature published in MEDLINE, PubMed and Google Scholar using the keywords "preconception mental health", "antenatal mental health", "perinatal depression screening", "postnatal mental health", "serious adverse obstetric events" and "adolescent pregnancy". Studies identified included case-control studies, cohort studies, systematic reviews, meta-analyses, randomised control trials and expert reviews. Contributing to the expert consensus were experienced senior specialists comprising a paediatrician-neonatologist, obstetrician-gynaecologists and public health administrator.

The workgroup used the Grading of Recommendations Assessment, Development

and Evaluation (GRADE)[17] Evidence to Decision framework to evaluate the quality of evidence and strength of recommendation, to provide a structured and clear methodology for healthcare recommendations. The GRADE framework is available in the supplementary material of this article. The online annexes include the presentation of all consensus statements, the various screening tools, a brief summary version of the perinatal mental health guide and the AGREE Reporting Checklist for guidelines. These recommendations are intended to guide healthcare professionals and maternal and child health service providers in the provision of holistic care for childbearing women from preconception through to the first year postpartum.

We also sought input from various professional bodies, such as College of Obstetricians and Gynaecologists Singapore, College of Psychiatrists Singapore, College of Family Physicians Singapore, Perinatal Society of Singapore, Singapore Psychiatric Association, Academy of Medicine Singapore, and Health Promotion Board, and held a consensus meeting on 30 November 2022 to gather feedback through an open poll, thereby improving on the guidelines. The consensus meeting was also attended by key members from the Ministry of Social and Family Development. The final published version in this edition has been endorsed by key stakeholders, and it is hoped that with wider understanding and ownership, we can create a community that works together to support maternal mental health and well-being. The language of the guidelines is also kept simple so that non-professionals and the public might also be able to understand and make sense of the recommendations. These guidelines will be reviewed for consideration of an update in 2030.

RESULTS

Consensus Statements

1. Increase awareness and provide advice on preconception mental health

(a) Provide advice on pregnancy planning

Women should be provided advice on pregnancy planning or contraception. This is particularly important for women and adolescents of childbearing potential with a past or current depressive or anxiety disorder, as they are particularly vulnerable to the stress of an unplanned pregnancy. Any history of depression or anxiety is a well-established risk factor for antenatal depression or anxiety,[18] and unintended pregnancy is a risk factor associated with perinatal depression.[19]

(b) Provide preconception counselling on impact of maternal mental illness and treatment

Women and adolescents of childbearing potential with severe depressive or anxiety disorders should be provided information regarding how their mental health condition and its treatment might affect them or their baby if they become pregnant.[20] This information should be tailored according to individual needs and illness patterns to enable informed decisions about family planning and necessary arrangements to prepare for pregnancy.

2. Optimise preconception mental health

a) Make lifestyle adjustments to optimise preconception mental health

Lifestyle adjustments to optimise preconception mental health are recommended, particularly for women of childbearing potential with pre-existing depressive or anxiety disorders.[21] These recommendations should be tailored to match individual needs and include improving nutrition with a whole foods diet, weight management, smoking cessation, alcohol abstinence and folate supplementation to promote maternal mental well-being and fetal development. Physical activity, exercise and mindfulness practice can also help reduce symptoms of depression or anxiety and promote well-being.[22]

(b) Evaluate medication use in consideration of childbearing

Use of medication in relation to childbearing involves careful consideration of safe choices of psychotropic medication or mood stabiliser, for women or girls of childbearing potential who might require long-term treatment for their mood disorder.[23] The use of valproate should be restricted to when there are no effective or tolerated alternatives, and when pregnancy prevention plan is adequate, as valproate is teratogenic.[24] As maternal mental health state tends to remain consistent from preconception to pregnancy,[15] the recommendation is for achieving a minimum effective dose of psychotropic medication to maintain wellness during conception.

(c) Have a holistic approach to preconception mental health

A holistic approach to preconception mental health is recommended, with the use of psychological therapies, and addressing of social stressors, to

optimise the control of pre-existing depressive or anxiety disorder, as this can help minimise the dose of antidepressant medication needed. Any medication cessation should be discussed in preconception care planning. Addressing any couple conflicts is particularly important as strong couple relationship could ameliorate the risk of depression perinatally.[25]

3. Have screening and assessment for antenatal depression and anxiety

(a) Provide screening for antenatal depression and anxiety

Early screening for antenatal depression during obstetric visits provides an ideal opportunity for preventative care and treatment before delivery.[26] A short screen such as the Patient Health Questionnaire 2-item (PHQ-2)[27] may be used: "Over the last 2 weeks, how often have you been bothered by (1) little interest or pleasure in doing things, or (2) feeling down, depressed or hopeless?" (Appendix 1). Women who experience either or both symptoms for most days, can be considered screen-positive, and will benefit from support or referral for further assessment. Women may also be screened using a validated questionnaire such as the Edinburgh Postnatal Depression Scale (EPDS)[28] (Appendix 2), with follow-up actions according to referral and management protocols unique to each centre or practice. Screening is important as antenatal depression is at least as common as postnatal depression,[3,4] and antenatal depression and anxiety are significant risk factors for postnatal depression.[29] For antenatal anxiety, the Generalized Anxiety Disorder 2-item (GAD-2)[30] may be used, but will require further assessment as there is currently no robust evidence for a reliable screening tool for antenatal anxiety (Appendix 3).

(b) Provide assessment of antenatal depression and anxiety for those screened positive

Clinical diagnoses should be made based on criteria listed in Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)[31] or International Classification of Diseases (ICD-11).[32] As part of holistic care, assessment should include holistic aspects of care such as presence of other psychiatric comorbidities (e.g. learning disability, alcohol and substance use disorders), medical and obstetric health, quality of partner and other familial relationships, care of older children, financial and occupational stressors, lifestyle practices, and bonding with unborn child. It is particularly important to assess for risk of harm to self and others (including the fetus).

4. Optimise care, treatment and support for antenatal depression and anxiety

(a) Counsel on medication use in antenatal depression and anxiety

Antidepressants are recommended for women with moderate to severe illness, or at risk of clinically significant relapse, with careful consideration of potential benefits and risks of antenatal use of antidepressants.[33] The decision-making should include consideration of factors such as symptom severity, risk of relapse or worsening, impact of illness versus medication on mother and fetus, patient's response to previous treatment, stage of pregnancy, and patient preference.[34] Clinicians should provide information regarding the risk of septal defects with selective serotonin reuptake inhibitors, such as paroxetine,[35] and discuss risk-benefit considerations.[36] Good practices for safe prescription include using the lowest effective doses, divided over the day if necessary, avoiding first-trimester use if possible, and frequent and regular reviews.[36] Benzodiazepines, commonly used for anxiety, should be avoided in pregnancy as there is an increased risk of use of ventilatory support for the newborn.[37]

(b) Provide holistic approach to care for patients with antenatal depression and anxiety

Care for patients should be coordinated among relevant healthcare professionals, which may include general and family medicine practitioners, obstetricians and gynaecologists, paediatricians, psychiatrists, nurses, counsellors, social workers and midwives.[33] Patients (and their partners or family, with their agreement) can be enabled to make informed, collaborative decisions about their care when provided with relevant mental health information. Information should include potential benefits and side effects of treatment, consequences of untreated illness, which may include poor maternal health, lower quality of life, difficulties with social relationships, poor mother-infant bonding, and poor overall development of the infant.[33] Non-pharmacological interventions may be beneficial (e.g. supportive therapy, psychology therapy and group therapy) in addition to pharmacological interventions.[38] Lifestyle behavioural interventions targeting diet, sleep, physical activity, smoking and alcohol cessation, and having social support help to prevent and reduce antenatal depressive symptoms.[39]

(c) Provide monitoring and support for women receiving care for antenatal depression and anxiety

Regular monitoring of symptoms and response to treatment during the antenatal period is recommended.[34] Considerations should be made for referral to tertiary perinatal psychiatric services (at KK Women's and Children's Hospital, National University Hospital, Institute of Mental Health) for those with severe depression or anxiety, or those not responding to treatment. Having adequate social and emotional support from spouses or partners and family during the antenatal period can help reduce depressive and anxiety symptoms.[40]

5. Have screening and assessment for postnatal depression and anxiety

(a) Provide screening for postnatal depression and anxiety

Early screening for postnatal depression during obstetric visits provide an ideal opportunity for preventative care and treatment.[41] Routine well-child visits to the paediatrician or primary health practitioner, such as for vaccination and development assessment, are also an opportune time to screen the mother for postnatal depression.[42] Screening is particularly important for women with risk factors of postnatal depression and anxiety, which include antenatal depression or anxiety, recent stressful life events and inadequate social support.[43] The short screen PHQ-2 may be used: "Over the last 2 weeks, how often have you been bothered by (1) little interest or pleasure in doing things, or (2) feeling down, depressed or hopeless?" Women who experience either or both symptoms for most days, can be considered screen-positive, and will benefit from support or referral for further assessment. Women may also be screened using a validated questionnaire such as the EPDS,[28] with follow-up actions according to referral and management protocols unique to each centre or practice. The optimal timing for the use of the EPDS for screening for postnatal depression is 6 to 8 weeks post-delivery, although it has been used up to 12 months.

For postnatal anxiety, the GAD-2 may be used but will require further assessment as there is currently no robust evidence for a reliable screening tool for antenatal anxiety.

(b) Have assessment of postnatal depression and anxiety

Clinical diagnoses should be made based on criteria listed in DSM-5 or ICD-11. As part of holistic care, assessment should include holistic aspects of care such as the presence of other psychiatric comorbidities (e.g. learning disability, alcohol and substance use disorders), medical and obstetric health, quality of partner and other familial relationships, care of older children, financial and occupational stressors, lifestyle practices, and bonding with baby. It is particularly important to assess for risk of harm to self and baby.

6. Optimise care, treatment and support for postnatal depression and anxiety

(a) Evaluate medication use in postnatal depression and anxiety

Counselling should be provided regarding the risk and benefits of starting pharmacological treatment, including potential consequences of untreated depression or anxiety, and adverse side effects of antidepressants.[44] Women should be provided support in their decision about breastfeeding and be informed that antidepressant use is not an absolute contraindication to breastfeeding.[44]

(b) Have a holistic approach towards care for patients with postnatal depression and anxiety

Care for patients should be coordinated among relevant healthcare professionals, which may include general and family medicine practitioners, obstetricians and gynaecologists, paediatricians, psychiatrists, nurses, counsellors, social workers and midwives. Patients (and their partners or family, with their agreement) can be enabled to make informed, collaborative decisions about their care when provided with relevant mental health information.[45] Information should include potential benefits and side effects of treatment, consequences of untreated illness, which may include poor maternal health, lower quality of life, difficulties with social relationships, poor mother-infant bonding, and poor overall development of the infant.[46] Lifestyle advice such as those relating to healthy eating, physical activity and sleep hygiene could be provided to patients, in consideration of the adjustment of these activities during the postnatal period.[47] Supportive counselling or structured individual psychological intervention, such as cognitive behavioural therapy or inter-personal psychotherapy, may improve depressive symptoms.[48] Interventions to improve mother-baby bonding should be considered if there are concerns with the dyadic relationship as women with depressive symptoms may experience challenges with bonding.[49]

(c) Provide monitoring and support for women receiving care for postnatal depression or anxiety

Regular monitoring of symptoms and response to treatment during the postnatal period is

recommended. Considerations should be made for referral to tertiary perinatal psychiatric services (at KK Women's and Children's Hospital, National University Hospital, Institute of Mental Health) for those with severe depression or anxiety, or those not responding to treatment. Having adequate social and emotional support from spouses, partners and family during the postnatal period can help reduce depressive and anxiety symptoms.[50]

7. Provide mental health support in severe maternal events and to those with mental health needs

Women who have experienced severe maternal events—such as haemorrhage requiring massive transfusion with or without a hysterectomy, severe hypertensive crises, eclamptic seizures, sepsis, thrombotic events and cardiovascular failure, miscarriage, termination, stillbirth or intrauterine death—are particularly at risk of depression and anxiety, as well as post-traumatic stress disorder.[51] Often, there is a struggle to understand why the event occurred, and whether the care experience or information provision might have been inadequate. These concerns add to the distress of patient, her family as well as the clinical team.[52] Care and support should be provided for the patient as well as the healthcare providers who might experience emotional effects of severe adverse events.[52] Similarly, care and support should be provided for women who have experienced a miscarriage, which can lead to grief and depression, as well as anxiety in a subsequent pregnancy.

8. Tailor perinatal mental healthcare for adolescents and women with special needs

Women with special needs (such as neurodevelopmental disorders or intellectual disability) face a higher risk of obstetric complications[53] that create stress; in addition to this, their experience can be overwhelming because they cannot verbalise anxiety. Ensuring a good support network is imperative, and guiding the mother to follow her baby's lead can help mothers who struggle with social cues. They will benefit from care delivery that is tailored to address their needs.[54] Likewise, depression is more likely among young mothers, and can predict for substance and alcohol abuse, as well as harsher parenting style.[55] Invariably, teen pregnancies are unplanned and disrupt development, especially on the young mothers' education. Additional effort to provide information and support for these vulnerable mothers can mitigate the development of depression and anxiety in their perinatal experience.

9. Promote higher caregiving quality for perinatal and infant mental health needs

Infants of mothers who are treated with antidepressant medications such as serotonin reuptake inhibitors throughout labour—even though weaning off towards term is preferred if clinically safe for maternal well-being—may have early onset respiratory distress due to persistent pulmonary hypertension, hypoglycaemia and drug withdrawal symptoms such as excessive crying, irritability, feeding and sleep disturbances during the first 4 weeks of life. Hence, regular monitoring and interventions for such infants are recommended,[56] such as ensuring neonatal standby at delivery, adequate warmth and hydration, as well as monitoring for clinical evidence of respiratory distress, oxygen saturation and blood glucose of the neonate during the first 2 days of life.

Infant neurodevelopment is related to the quality of caregiving. Maternal mental health can influence maternal attunement and sensitivity to infant needs,[13] and maternal mind-mindedness.[57] Mothers are encouraged to spend quality time attending to and caring for their infants, by following baby's cues and being mindful of baby's needs. Research shows that mothers "staying present, watching and wondering" about their infants can improve maternal reflective capacity.[58] Red flags for dysfunction in mother-infant dyads include reduced maternal attunement, reduced child responsiveness to mother, and restricted growth and development.[59]

10. Aim to integrate the above recommendations into healthcare framework for the best results

The healthcare community should aim to integrate the above recommendations in preconception, antenatal and postnatal periods into current healthcare framework, providing opportunistic care and guidance for the best results. Given that health services can have varying resourcing and care processes, these recommendations are intended to provide guidance to maternal and child health practitioners in Singapore, as a collective effort to improving perinatal mental health with direct benefits on child health and well-being.[60]

With the publication of these findings, efforts have simultaneously begun for public outreach and education, as well as advancing continuing medical education initiatives to primary healthcare network. Future efforts will include surveys of healthcare professionals and population to understand the impact of these guidelines, and whether practices have changed in tandem with recommendations laid out here.

About the workgroup

This document was developed by the COGS-IPRAMHO Perinatal Mental Health Study Group, which comprised key members practising in the field of maternal and child health. The initiative is supported by NMRC Integrated Platform for Research in Advancing Maternal & Child Health Outcomes (IPRAMHO) and the developed guidelines are endorsed by College of Obstetricians & Gynaecologists Singapore (COGS); Perinatal Society of Singapore; College of Family Physicians Singapore (CFPS); College of Psychiatrists Singapore; Singapore Psychiatric Association, Academy of Medicine, Singapore, and Health Promotion Board, Singapore.

Conflict of interest

There was no conflict of interest for all authors.

Disclaimer

This guide is intended as an educational aid and reference for healthcare professionals practising in the area of maternal and child health in Singapore. The guide does not define a standard of care, nor is it intended to dictate an exclusive course of management. It describes evidence-based and practice-based clinical and psychosocial recommendations for consideration by practitioners for incorporation into their service. Management approach may vary and must always be responsive to the need of individual patients, resources, and limitations unique to the institution or type of practice.

Supplementary materials

1. College of Obstetricians and Gynaecologists Singapore (COGS-Singapore) Integrated Perinatal Mental Health Guidelines for Depression and Anxiety Grade Evidence to Decision Framework
2. COGS-Singapore Perinatal Mental Health Guidelines on Depression and Anxiety Summary Statements
3. Appendices 1–3 PHQ-2, EPDS, GAD-2
4. AGREE Reporting Checklist

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COMMENTARY

Transforming radiology to support population health

Peter Zhi Qing Choo[1] *FRCR*, Tchoyoson Choie Cheio Lim[2] *FRCR*, Cher Heng Tan[1] *FRCR*

This commentary highlights key areas in which diagnostic radiological services in Singapore will need to evolve in order to address the needs of Healthier SG and population health. Policymakers should focus on "doing the right thing" by improving access to radiological expertise and services to support community and primary care and "doing the thing right" by establishing robust frameworks to support value-based care.

The recent launch of Healthier SG—a national initiative by Singapore's Ministry of Health (MOH) focusing on preventive health—will have far-reaching effects on the delivery of health services in Singapore.[1] Part of it involves a shift away from tertiary hospital-based to community-based care, to improve diagnostic imaging services in the home and community care settings. The proposed move from disease-related group to capitated funding means that care providers will have to adopt sound principles of cost-effectiveness. Radiological key opinion leaders, policymakers and health economists should review strengths, weaknesses, opportunities and threats.

Diagnostic radiology is deeply embedded within the healthcare value chain. The current delivery model is that of a facility-centric tertiary service, with a focus on high-end cross-sectional imaging at late disease stage.[2] Imaging performed at the primary care setting consists of mainly plain radiography and non-complex ultrasonography. The bulk of radiological expertise is concentrated in tertiary care settings, and patients are usually referred for a specialist decision if further imaging is indicated.

Together with the rest of the healthcare system, radiology needs to shift towards improving general population health, and early diagnosis and intervention instead. A focus on appropriate use of imaging[3] and value-based radiology is vital to avoid spiralling healthcare costs, over-investigation, poor outcomes for patients and wastage of limited healthcare resources.

Doing the right thing: improving access to radiological expertise and services

In this section, we discuss the adoption and implementation of current and emerging technological advances in medical imaging that are aligned with the broader system imperatives (i.e. doing the right thing). In the context of Healthier SG, this would mean up-levelling the diagnostic imaging capabilities of healthcare providers in the community to reduce referrals and hospital admissions.

Pivot away from facility-centric services

(1) Point-of-care ultrasound (POCUS)

POCUS has been steadily gaining traction among care providers over the years. In the acute care setting, there is now a high level of exposure and interest from emergency physicians and intensivists, among other specialities. POCUS allows for real-time evaluation and administration of treatment, without reliance on facility-based scanning, i.e. radiology departments.

POCUS is likewise useful for assessment of a wide range of indications in the community setting, especially for the cardiovascular system and lungs.[4] Community POCUS has been piloted by Community Health Teams at Tan Tock Seng Hospital (TTSH), with positive feedback. With trained care providers at the primary health level, POCUS can allow for a greater confidence in definitive diagnosis and management, potentially reducing unnecessary onward referrals.

The utility of POCUS is, however, limited by the expertise of the operator, and exacerbated by the less-than-ideal conditions for diagnostic-quality ultrasound in the home and inpatient settings. This highlights the need for coordinated training and accreditation frameworks that are lacking in our system today.[5] Such frameworks will need to encompass under- and post-graduate training of a wide range of health professionals, both doctors and allied health professionals. Radiologists should engage other care providers to establish the gaps in our practice today and harmonise efforts to address them across various care settings in Singapore, "Beyond Hospital to Community."

(2) Emerging novel technology

Radiologists have an opportunity to develop or adapt and assess (in partnership with health services researchers and health economists) new technology that can further

[1] Department of Diagnostic Radiology, Tan Tock Seng Hospital, Singapore
[2] Department of Neuroradiology, National Neuroscience Institute, Singapore
Correspondence: Dr Peter Zhi Qing Choo, Department of Diagnostic Radiology, Tan Tock Seng Hospital, 11 Jalan Tan Tock Seng, Singapore 308433.
Email: peter_choo@ttsh.com.sg.

shift the services into the community. For example, the potential of wearable ultrasound devices as real-time, non-invasive monitors of cardiorespiratory health[6] that do not disrupt daily routines; more novel applications will arise as technologies mature.

Practical artificial intelligence (AI) applications

Radiologists should be proactive in evaluating and adopting AI algorithms that support and augment workflows, especially initiatives that improve the current and projected future manpower limitations—not only for radiologists but also radiographers and all allied health professionals—that conversely has the damaging potential to limit service availability. AI should improve efficiency and productivity, augment healthcare workers and prevent burnout.

(1) Optimising image acquisition and processing

AI solutions can help with pre- and post-processing for CT image optimisation at all stages of acquisition and reconstruction, with the aim of decreasing radiation and contrast media dose, thus improving image quality and augmenting radiographer productivity.[7] With magnetic resonance imaging (MRI), there can be artifact correction from motion/eddy currents and scan time reduction.[8] If implemented well, with adequate quality assurance, AI should add value unobtrusively in the background.

(2) Computer vision

Computer-aided detection systems can serve as an automated second observer to augment the radiologist in feature detection, extraction and classification.[9] Individual algorithms for computed tomography (CT) lung nodule detection, mammographic breast lesion detection, and CT colonography polyp detection have been developed, but mostly in isolation, awaiting integration into general workflow. AI algorithms may also automate and accelerate quantitative analysis for lung nodule volumes, limb lengths and bone age.[10] AI-powered radiomics holds potential for quantitative analysis of subtle textural details not perceptible to the human eye and has been explored mainly in the field of oncologic imaging.[11] After initial hype, controversy and hope in the community, the consensus opinion is that AI can augment, not replace radiologists; yet few workable solutions have been deployed successfully in health systems due to the challenges of integration.[12]

Workflow optimisation

Looking beyond the radiographic image and into the wider health system, other AI predictive analytics can automate patient scheduling, with Changi General Hospital showing a 17.2% improvement in no-show rate by telephone reminders triggered by AI identification of patients at high risk of no-show.[13] Similarly, during the COVID-19 pandemic, a collaboration between TTSH and the Agency for Science, Technology and Research's Institute of High-Performance Computing and Institute for Infocomm Research developed RadiLogic, which can analyse chest radiographs quickly and prioritise abnormal radiographs to a radiologist for early review.[14] KK Women's and Children's Hospital was able to develop a deep-learning model to automatically triage paediatric MRI brain orders.[15] Such triage tools can help sicker patients access care faster.

(3) Natural language processing (NLP) and analytics

Deep learning for NLP may be able to automatically extract and compile information from prior narrative radiological reports, such as disease characteristics, classification, or follow-up recommendations, or automatically link specific images.[16] Such information can be useful to the referring physicians or radiologists reading follow-up studies.

NLP analytics may also help with quality assurance by identifying textual mentions of quality concerns within radiological reports.[17]

Doing the thing right: implementing value-based imaging

In this section, we discuss strategies that emphasise the implementation of evidence-based, cost effective imaging procedures. Singapore's move towards capitated funding shifts emphasis on value-based rather than on volume-based care; maximising the value of imaging would therefore be aligned to policy intent.

Screening using imaging

Screening is a keystone of the Healthier SG framework,[1] "Beyond Healthcare to Health", the intent being to detect and manage diseases at an early stage to reduce resource utilisation. We see opportunities for more widespread deployment of imaging as a cost-effective primary tool for the prevention of major disease burdens of the future.

(1) Deliberate screening

Among the mature national cancer screening programmes in Singapore, colorectal and breast cancer programmes already utilise radiological imaging.[18] Greater uptake of these screening tools is needed to reap their benefits at the population level. Lung cancer screening using low-dose CT in the appropriate at-risk population has been shown in the US to save lives.[19] In 2019, the College of

Radiologists, Singapore published a position paper proposing a modified workflow for practice in Singapore, highlighting the disparity in lung cancer patterns compared with Western countries.[20]

(2) Opportunistic screening

In addition to screening programmes, opportunistic detection of abnormal findings unrelated to the primary reason for imaging studies is an added value that can and should be unlocked from the large amounts of patient data that radiological services generate daily.[21] For example, some of the AI algorithms mentioned earlier should be able to automatically detect and quantify features of important chronic diseases (Table 1). Similar opportunistic screening has been described utilising MRI and dual-energy CT.[22]

The advent of machine deep learning algorithms that can accurately segment body tissues on cross-sectional imaging is a game-changer because these measurements are laborious, time-consuming and subject to inter-operator variability. In the context of screening where the yield may be low and the volumes are high, automated software that is embedded within radiology reporting workstations can provide analysis results for clinicians to detect at-risk patients. While bone density and coronary calcium scores are already part of standard care, population-level disease prediction thresholds for newer variables, such as fat and muscle quantities, will need to be validated before mainstream deployment.

Table 1. Opportunistic CT screening.

Imaging feature screened	Application	Clinical value
Decreased bone attenuation[a]	Osteoporosis: The current gold standard for osteoporosis assessment, DXA, suffers from low screening rates and inaccuracy due to its two-dimensional nature; common confounders include vascular calcifications, degenerative changes and compression fractures. Opportunistic CT screening by direct Hounsfield unit measurement of bone attenuation may be used to infer bone quality.	Opportunistic CT screening has the potential to be useful in the relatively common scenario where DXA screening has not been performed but a CT scan is available for analysis. Early identification of at-risk individuals could be used to institute the appropriate treatment to reduce the risk of future debilitating fragility fracture.
Aortic[b] or coronary[c] calcium quantification	Cardiovascular risk stratification: For patients with a chest CT available for analysis, an AI algorithm may be able to automatically generate the CT coronary calcium score. Alternatively, where an abdominal but not a chest CT is available, the abdominal aortic calcifications may be quantified instead.	The patients at risk for cardiovascular disease can be opportunistically identified and started on preventive treatment regimens earlier.
Visceral and subcutaneous fat volumetric quantification[d]	Metabolic syndrome and cardiovascular risk stratification: Visceral fat and the visceral-to-subcutaneous fat ratio are strongly associated with future cardiovascular event and cancer risk, and automated CT volumetric quantification can be opportunistically applied for commonly performed imaging.	Clinicians may engage at-risk patients earlier for lifestyle modification; this may also trigger definitive screening for cancer and control of modifiable cardiovascular risk factors.
Cross-sectional area of truncal muscle[e]	Sarcopaenia: Cross-sectional areas of truncal muscle may be automatically calculated and utilised to diagnose sarcopaenia.	Sarcopaenia has been shown to be associated with decreased quality of life and increased mortality, especially in the context of illness/surgery. Early detection and intervention can retard progression.
Liver attenuation[f]	Hepatic steatosis: Automatic CT segmentation and attenuation measurement can be used to estimate CT fat fraction of the liver, to prevent diabetes, obesity, hyperlipidaemia, and metabolic syndrome.	Hepatic steatosis is a major risk factor for non-alcoholic steatohepatitis, with attendant risks of cirrhosis and hepatocellular carcinoma.

AI: artificial intelligence, CT: computed tomography, DXA: dual x-ray absorptiometry

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Appropriate use of diagnostic imaging tests

Increasing access and demand in diagnostic imaging results in dramatic increase in volume and complexity of imaging studies; although these bring benefits to patients, they also put a strain on healthcare workers and the financial resources of the national health system. Wellness issues, such as repetitive stress injury, fatigue and burnout, need to be addressed before they reach a tipping point. The first target should be inappropriate use of diagnostic imaging services that are not supported by evidence. Decisions to undergo imaging tests require a sound understanding of the utility, limitations and potential harm of the procedures, and are best advised by medical professionals, made jointly with patients whenever possible.

The Appropriateness Criteria for Use of Imaging Technology initiative was started in 2018 by the Agency for Care Effectiveness (ACE), MOH Singapore. Supported by chapters and colleges within the Academy of Medicine, Singapore, 3 ACE Clinical Guidances (ACGs) have been published: when to order CT/MRI for headache (2022), when not to order a chest radiograph (2021), and when to order MRI for low back pain (2020).[23]

These multidisciplinary guidelines, based on international consensus guidelines and cost-effectiveness analysis literature, address high-volume and high-cost tests, and will be periodically reviewed and integrated as clinical decision support tools into electronic medical records and order systems to assist implementation, like the American College of Radiology (ACR) Select tool.[24] In Singapore, MOH has collaborated with SingHealth to hardwire the "MRI for low back pain" ACG as a radiology order form into the electronic medical record system, as a behavioural nudge for ordering physicians. It is important that the international guidelines are contextualised to local practice; the ACR has to date more than 200 clinical scenarios, and we continue to prioritise our efforts towards implementing ACGs for high-value and high-volume imaging procedures to contribute towards the thrust of "Beyond Quality to Value."

Structured reporting templates

As disease management trends towards algorithmic evidence-based pathways, it is helpful for referring physicians to be able to efficiently access and use actionable radiological reports.[25] Structured reporting templates are not only easier for the reader to understand, they guide the radiologist in including pertinent information without omission, while presenting the information in a systematic and uniform manner.

Structured radiology reports will undoubtedly elevate the value of imaging and radiologists in the overall patient care continuum. Work is now underway at the regional level by the Asian Oceanian Society of Radiology to conduct a survey of the knowledge, attitudes and practice of radiologists and referring clinicians as an initial step towards promoting widespread adoption. Structured reports also open up the possibility of large-scale data mining for developing predictive and AI algorithms, something that would be much harder to achieve through unstructured free text reports.

CONCLUSION

There are seismic shifts for the healthcare sector in Singapore on the horizon, and non-trivial obstacles to overcome: behavioural change is difficult, and manpower constraints in our small island are real. The policy, implementation and educational challenges require a thoughtful, coherent strategy to defeat the devil in the details. Yet at this post-COVID juncture, there appears to be willingness to consider innovative strategies and address wicked problems. The stars may align to improve radiological services in Singapore to democratise expertise and access, creating favourable conditions to maximise value. With visionary leadership and united effort, we can chart the continued success of Singapore's health services. Our staff, patients and population deserve the best diagnostic radiology care we can provide. For this call to action, the time is now.

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LETTER TO THE EDITOR

Impact of an ageing population on the intensive care unit

Dear Editor,

Intensive care unit (ICU) resources are scarce and expensive, and deciding if intensive care is suitable for older patients involves complex clinical reasoning, ethical challenges and cost considerations. Although some studies show that ICU mortality increases with age, others suggest that age alone is not predictive of poor prognosis, and other factors such as frailty, premorbid functional status and comorbidities could be important.[1-4]

Prior studies on this topic in Singapore are from the late 1990s to early 2000s, and most did not distinguish between the elderly and the very elderly population.[5,6] There is also a paucity of data on the long-term outcomes of older ICU survivors.[5,7]

We conducted a retrospective cohort study of medical ICU patients admitted to Tan Tock Seng Hospital between July 2015 and October 2016. Patients were divided into 3 groups: young (<65 years), elderly (74–79 years) and very elderly (≥80 years). The primary outcome measured was hospital mortality. Secondary outcomes measured were ICU mortality, ICU and hospital length of stay, functional status at hospital discharge and 1-year mortality after hospital discharge. We also evaluated factors affecting triage decision-making among the aged. Ethics approval was obtained from the National Healthcare Group Domain Specific Review Board (Reference number 2019/01028).

Differences between age groups were compared using Kruskal-Wallis H test for continuous variables, and Pearson chi-square test or Fisher's Exact test for categorical variables. Multivariable-modified Poisson regression was used to identify factors associated with hospital mortality and 1-year mortality after hospital discharge among the elderly and the very elderly.

Of 874 patients, 361 (41.3%) were young, 360 (41.2%) were elderly and 153 (17.5%) were very elderly. The baseline characteristics of elderly and very elderly differed from the young. The 2 former groups had more comorbidities, poorer premorbid functional status, and were more likely to be admitted for sepsis-related diagnoses. They also had fewer direct ICU admissions from the emergency department, though this did not confer increased hospital mortality in multivariable analysis. Importantly, there was no difference in the ICU treatment between groups. In fact, there were more elderly and very elderly who received vasopressor/inotropic support (Supplementary Table S1).

In terms of outcomes, hospital mortality increased significantly with age: 34.1% in young, 43.9% in elderly and 55.6% in very elderly patients. ICU mortality also showed an increasing trend with age but did not reach statistical significance: 28.5%, 30.0% and 38.6%, respectively. Similar trends were seen in 1-year mortality after hospital discharge: 16.9%, 22.9% and 28.4%, respectively. There was no difference in median ICU length of stay, but hospital length of stay was longer in elderly (18 days) and very elderly (19 days) compared to young (11 days) patients. Elderly and very elderly also had worse functional status at discharge. There was no difference in the discharge destination among hospital survivors (Supplementary Table S1).

A notable finding in our study was that the elderly and very elderly had significantly higher hospital mortality, despite having similar disease severity as the young. Disease severity was measured by Acute Physiology and Chronic Health Evaluation II modified to exclude age (APACHE IIM) score and Sequential Organ Failure Assessment score. Possible reason for this discrepancy is the non-inclusion of additional risk factors known to influence mortality in the aged, such as functional deficits, delirium, frailty and other geriatric syndromes.[1,3,8,9] Another limitation of these models is that they are derived exclusively from data obtained from the first 24 hours of ICU admission and do not account for complications that develop subsequently.[4]

As we increasingly recognise the substantial interindividual differences in the ageing process, we begin to understand the poor prognostic discrimination of current models for older patients and the urgent need for further research in this area. A recent publication utilised cluster analysis to identify phenotypes within the geriatric ICU cohort.[10] Unlike prior studies that homogenously grouped ages ≥65, or included only ages ≥80 or ≥90 years to represent aged ICU population, thus losing depth and breadth in the process, we chose to analyse subgroups of elderly and very elderly separately to determine their prognostic factors. We found that the short-term (hospital mortality) and long-term outcomes (1-year mortality after hospital discharge) were affected by different factors.

For hospital mortality, a higher APACHE IIM score and need for vasopressor/inotropic support were independent predictors of hospital mortality, in both the elderly and the very elderly (Table 1), consistent with previous publications.[1,2,4-6] We also postulate that the seemingly protective effect of chronic lung disease in the elderly may be a result of a highly selected ICU population, as

Table 1. Multivariable regression analysis for factors associated with hospital mortality and 1-year mortality after hospital discharge among elderly (74–79 years) and very elderly (≥80 years) patients.

	Factors associated with hospital mortality					
	Elderly (74–79 years)			Very elderly (≥80 years)		
	Adjusted RR	95% CI	*P* value	Adjusted RR	95% CI	*P* value
Age (continuous)	1.022	0.997–1.048	0.082	0.994	0.953–1.036	0.766
Sex						
Female	Ref	Ref	Ref	Ref	Ref	Ref
Male	0.982	0.793–1.217	0.872	0.916	0.704–1.192	0.514
Race						
Chinese	Ref	Ref	Ref	Ref	Ref	Ref
Non-Chinese	0.855	0.669–1.093	0.211	0.893	0.632–1.261	0.520
Comorbidities						
Atrial fibrillation	1.401	1.108–1.772	**0.005**	1.010	0.734–1.391	0.951
Chronic lung disease	0.579	0.385–0.869	**0.008**	0.780	0.552–1.102	0.159
APACHE IIM score	1.018	1.002–1.033	**0.023**	1.036	1.041–1.058	**0.001**
Vasopressor/inotropic support	4.025	2.465–6.575	**<0.001**	1.966	1.115–3.467	**0.019**
Factors associated with 1-year mortality after hospital discharge						
	Elderly (74–79 years)			Very elderly (≥80 years)		
	Adjusted RR	95% CI	*P* value	Adjusted RR	95% CI	*P* value
Age (continuous)	1.027	0.961–1.097	0.438	1.056	0.938–1.188	0.367
Sex						
Female	Ref	Ref	Ref	Ref	Ref	Ref
Male	2.793	1.205–6.594	**0.017**	1.906	0.786–4.622	0.154
Race						
Chinese	Ref	Ref	Ref	Ref	Ref	Ref
Non-Chinese	1.027	0.627–1.683	0.847	1.224	0.548–2.732	0.622
BMI category, kg/m^2						
Normal (18.5–22.9)	Ref	Ref	Ref	Ref	Ref	Ref
Underweight (<18.5)	0.554	0.207–1.480	0.239	7.681	3.146–18.750	**<0.001**
Overweight (23.0–27.4)	0.328	0.132–0.817	**0.017**	1.768	0.635–4.922	0.275
Obese (≥27.5)	1.341	0.541–3.321	0.526	0.598	0.157–2.277	0.451
Charlson comorbidity index	1.119	1.010–1.240	**0.031**	1.415	1.209–1.656	**<0.001**
Ambulatory status at hospital discharge						
Independent	Ref	Ref	Ref	NA	NA	NA
Assisted	1.893	0.934–3.837	0.077	NA	NA	NA
Chair or bedbound	3.229	1.614–6.659	**0.001**	NA	NA	NA

APACHE IIM: Acute Physiology and Chronic Health Evaluation II modified to exclude age; BMI: body mass index; CI: confidence interval; ICU: intensive care unit; NA: not applicable; RR: relative risk; Ref: reference. Bold values are significant at $P<0.05$. Ambulatory status at hospital discharge could not be determined for the very elderly as there were no patients in the reference group (i.e. independent).

patients with advanced lung conditions had early end-of-life discussion and were managed in the general ward.

As for 1-year mortality after hospital discharge, body mass index (BMI) and Charlson comorbidity index were found to be independent predictors (Table 1). In the very elderly, low BMI (underweight) conferred higher mortality, whereas in the elderly, high BMI (overweight) conferred lower mortality. Whether there was truly a difference with BMI by age group is uncertain, as our multivariable models were developed separately for each age group and the patient population was small. BMI is a surrogate of nutritional status and may correlate with the degree of sarcopaenia—both are risk factors for mortality in the aged. Additionally, we found that being chair/bedbound at hospital discharge was independently associated with 1-year mortality. This highlights the importance of addressing physical dependency as another potentially modifiable risk factor.

Our study had several limitations. First, it was a single-centre study involving medical ICU, and results may not be generalisable. Second, it was a retrospective study, and data on baseline cognition, frailty, functional status scores and decision to withhold or withdraw life-sustaining treatment in the ICU were not available. Last, we did not evaluate other long-term outcome measures as described in post-intensive care syndrome.

In conclusion, the ageing population represents an emerging challenge for the healthcare system. The result of this study is a crucial first step in raising awareness on the short- and long-term outcomes and prognostic factors (especially treatable traits) in aged ICU patients. Ultimately, the goal is to create true ICU survivors, and not victims.

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Sharlene Ho[1] *MRCP (UK)*,
Hwee Pin Phua[2] *BSc*, Wei-Yen Lim[2] *PhD*,
Niranjana Mahalingam[3] *MRCP (UK)*,
Jin Wen Sennen Lew[1] *MRCP (UK)*

[1] Department of Respiratory and Critical Care Medicine, Tan Tock Seng Hospital, Singapore
[2] Department of Preventive and Population Medicine, Office of Clinical Epidemiology, Analytics, and Knowledge, Tan Tock Seng Hospital, Singapore
[3] Department of General Medicine, Tan Tock Seng Hospital, Singapore

Correspondence: Dr Sharlene Ho, Department of Respiratory and Critical Care Medicine, Tan Tock Seng Hospital, 11 Jalan Tan Tock Seng, Singapore 308433.
Email: sharlene_ho@ttsh.com.sg

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LETTER TO THE EDITOR

A case series of higher-order multifetal pregnancies managed at a tertiary maternity unit

Dear Editor,

Delayed childbearing and increased use of assisted reproduction technology (ART) have resulted in a dramatic rise in the incidence of multifetal pregnancies. In 2022, the incidence of twin birth was 1 in 38.2 (932 live births) and triplet birth 1 in 1978 (18 live births) in Singapore.[1] Preterm birth and its associated complications remain the most significant risks of multifetal pregnancies—60.5% of twins and 100% of triplets were born <37 weeks in Singapore in 2019. The relative risks of cerebral palsy in triplets and twins compared with singletons are 12.7 and 4.9, respectively.[2]

A Cochrane review reported that multifetal pregnancy reduction (MFPR) is associated with a reduction in pregnancy loss, antenatal complications, birth before 36 weeks, low birth weight and neonatal death. However, the evidence was drawn from non-randomised studies.[3] Skilled management of multifetal pregnancies is crucial in contemporary obstetrical practice. This study aims to compare the outcomes of multifetal pregnancies with and without fetal reduction (FR).

This is a retrospective cohort study of patients with higher-order pregnancies managed at the National University Hospital, Singapore, between January 2014 to April 2019. Ethics approval from Domain Specific Review Board and waiver of patient consent was obtained. Data on demographics, antenatal and neonatal complications were retrieved from electronic medical records.

Descriptive statistics were used to report pregnancy and neonatal outcomes. Continuous variables were reported as mean and standard deviation, and analysed with sample Student's t-test. Categorical variables were reported as frequency (percentage) and were analysed by chi-square test. A *P* value of <0.05 was taken as statistically significant.

After confirmation of a higher-order pregnancy at a first trimester dating scan, women will be seen by experienced fetal medicine specialists and counselled on all 3 possible options: expectant management, MFPR to twins or singleton, or the least desirable option of termination of pregnancy.

Women who choose MFPR will be thoroughly counselled on the risks of MFPR procedure, including risks of reducing to monochorionic (MC) twins. Structural abnormalities in either fetus, patient's preference for a singleton or twin pregnancy, accessibility, and distance from the cervix were some factors considered. In our study, all FR procedures were done with potassium chloride injection. Following the procedure, patients were reviewed within 1 week and followed up at the high-risk pregnancy clinic.

Women who choose expectant management will also be followed up closely in the high-risk pregnancy clinic with frequent scans—2 weekly for amniotic fluid volume and umbilical artery doppler assessments and 4 weekly for growth estimation.

A total of 24 higher-order pregnancies were included: 91.6% (22/24) triplet pregnancies and 8.4% (2/24) quadruplet pregnancies. Of these, 91.6% (22/24) were conceived via ART procedures and 16.7% (2/24) were spontaneously conceived; 54.1% (13/24) opted for expectant management and 45.8% (11/24) underwent FR. Both cases of quadruplet pregnancies underwent FR to twins. Fourteen higher-order pregnancies were excluded as they were lost to follow-up.

Of the 11 MFPR cases, 8/11 (73%) were reduced to dichorionic twins, 2/11(18%) to MC twins and 1/11 (8.1%) to a singleton. The pregnancy that was reduced to a singleton was initially a dichorionic diamniotic triplet (1 monochorionic monoamniotic twin and a separate singleton).

Table 1 summarises pregnancy and neonatal outcomes. The results show that FR prolongs pregnancy and reduces the risk of preterm birth <30 weeks. The gestational age (GA) at delivery was significantly higher in the FR group—34.2 weeks in the expectant management group versus 36.3 and 40 weeks in the FR to twins and singleton, respectively (*P*=0.014). When GA was examined as a categorical outcome, the FR group was more likely to deliver >30 weeks compared with the expectant management group (*P*=0.018). The risk of preterm birth <32–33 weeks following FR has been reported to be between 24% and 37%.[4-6] In our study, a lower rate of 20% in the FR group delivered between 30–34 weeks. The mean birth weight in the FR to twin group was 1073 g, higher than that in the expectant management group (*P*<0.05).

A later GA at delivery also correlates with improvement in neonatal outcomes.[7,8] The composite neonatal complication rate and admittance to neonatal intensive care unit (NICU) was significantly lower in the FR group compared with the expectant management group

Table 1. Pregnancy and neonatal outcomes of higher order pregnancies who had expectant management, reduced to twins and reduced to singleton.

Pregnancy outcomes	No. (%)[a]				*P* value
	Composite (n=24)	(A) Expectant management (n=13)	(B) Reduction to twins (n=10)	(C) Reduction to singleton (n=1)	(A) vs (B) + (C)
Chorionicity (after reduction)					-
TC	16 (66.7)	8 (61.5)	-	-	-
DC	7 (29.2)	4 (30.7)	8 (80.0)	-	-
MC	1 (4.2)	1 (7.6)	2 (20.0)	1 (100)	-
Method of reduction					-
Intracardiac KCL injection		-	10 (100)	1 (100)	-
Radiofrequency ablation		-	-	-	-
Miscarriage of whole pregnancy (<24 weeks)		0	0	0	-
Miscarriage of 1 fetus in pregnancy (<24 weeks)		1 (7.6)	0	0	0.517
Pregnancies with at least 1 IUGR fetus		10 (76.9)	5 (50.0)	0	0.008
Maternal complications					
PIH/PE		2 (15.3)	3 (30.0)	0	0.316
GDM		5 (30.6)	2 (20.0)	0	0.087
PPROM		2 (15.3)	0	0	0.195
Gestational age at delivery, mean ± SD, weeks		34.2 ± 19(d)	36.3 ± 11.5	40	0.014
<30		2 (15.6)	0	0	0.195
30–34		4 (30.7)	2 (20.0)	0	0.289
>34		7 (53.8)	8 (80.0)	1 (100)	0.018
Neonatal outcomes		**(n=37)**	**(n=20)**	**(n=1)**	
Outcome at birth					
IUFD at 24 weeks		1 (2.7)	-	-	0.609
Live births		36 (97.3)	20 (100)	1 (100)	0.609
Mean birth weight, g		1884	2346	3340	<0.001
<1500		9 (24.3)	1 (5.0)	-	
1500–2000		9 (24.3)	1 (5.0)	-	
>2000		19 (51.3)	18 (90.0)	1 (100)	
NICU stay		15	8		0.321
Mean duration of NICU stay (days)		26 (70.2)	8 (40.0)		<0.001
Neonatal morbidity (composite)[b]		16 (43.2)	4 (20.0)	0	<0.001
RDS		9 (24.3)	0	0	<0.001
Intubation		12 (32.4)	6 (30.0)	0	0.371

Table 1. Pregnancy and neonatal outcomes of higher order pregnancies who had expectant management, reduced to twins and reduced to singleton. (Cont'd)

Pregnancy outcomes	No. (%)[a]				*P* value
	Composite (n=24)	(A) Expectant management (n=13)	(B) Reduction to twins (n=10)	(C) Reduction to singleton (n=1)	(A) vs (B) + (C)
Hypoglycaemia		4 (11.0)	0	0	0.037
Sepsis		0	0	0	NA
NEC		1 (2.7)	0	0	0.602
Birth asphyxia		1 (2.7)	0	0	0.602
HIE					

DC: dichorionic; GDM: gestational diabetes mellitus; HIE: hypoxic ischaemic encephalopathy; IUFD: intrauterine fetal demise; KCL: potassium chloride; MC: monochorionic; NA: not applicable; NEC: necrotising enterocolitis; NICU: neonatal intensive care unit; PIH/PE: pregnancy-induced hypertension/preeclampsia; PPROM: preterm premature rupture of membrane; RDS: respiratory distress syndrome; SD: standard deviation; TC: term childbirth

[a] All values in no. (%) except gestational age at delivery, mean ± SD.

[b] Excluded 1 case of IUFD after 24 weeks.

(*P*<0.001). Lower rates of respiratory distress syndrome, intubation and sepsis were also observed in the FR group (*P*<0.05). However, rates for necrotising enterocolitis, birth asphyxia, hypoxic ischaemic encephalopathy and hypoglycaemia were similar across both groups.

The expectant management group was more likely to have at least 1 intrauterine growth restriction fetus (*P*=0.008). There was no significant difference in rates of spontaneous fetal loss, intrauterine death, preterm premature rupture of the membranes and length of NICU stay. No neonatal and post-neonatal deaths were observed in our cohort.

There are some reported cases of anencephaly and limb amputation associated with FR.[9] Spontaneous loss of whole pregnancy has been reported as 8.1% and 4.4% in reduced versus non-reduced triplets respectively.[10] None of these complications were observed in our cohort. This may be because all procedures were carried out by specialists who are considered to be experts in the field and pregnancies were followed up very closely.

A limitation of this study is its retrospective nature and relatively small sample size, owing to the loss of follow-ups for many foreign patients seen at the hospital. Some incomplete data sets had to be excluded and as a result, we could not obtain statistical power to demonstrate some reductions in neonatal morbidities in babies born following MFPR.

The strength of our study lies in the fact that it is the first and largest study of FR in higher-order pregnancies in Southeast Asia with comprehensive perinatal outcomes. The expectant management group made up almost one-third of all triplet births in Singapore during the study period. Our study provides valuable data, which will be useful in counselling women with higher-order pregnancies.

In conclusion, FR prolongs GA at delivery and reduces neonatal morbidity rates. For women who chose expectant management, close follow-up at a tertiary maternity unit that provides antenatal care to high-risk pregnancies and neonatal support can lead to superior neonatal outcomes.

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Lakshmi V Dhevi*[1] *MBBS(Singapore)*,
Sarah Wei Ling Li*[2] *MRCOG(UK)*,
Lin Lin Su[2,3] *MMED(O&G S'pore)*,
Arundhati Gosavi[2,3] *MRCOG(UK)*,
Arijit Biswas[2,3] *FRCOG (UK)*

[1] Department of Obstetrics and Gynaecology, KK Women's and Children's Hospital, Singapore
[2] Department of Obstetrics and Gynaecology, National University Hospital, Singapore
[3] Department of Obstetrics and Gynaecology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore

Correspondence: Dr Lakshmi V Dhevi, Department of Obstetrics and Gynaecology, KK Women's and Children's Hospital, 5 Lower Kent Ridge Rd, Singapore 119074.
Email: lakshmidhevi.v@mohh.com.sg
* Joint first authors

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LETTER TO THE EDITOR

Outcomes of patients admitted for drowning

Dear Editor,

According to the latest Utstein-style consensus, drowning is defined as the primary respiratory impairment resulting from submersion or immersion in a liquid medium.[1] Patients may experience hypothermia, acute respiratory distress syndrome and shock.[1] The pathophysiology is poorly understood, but could relate to physiological responses to temperature, water swallowing and electrolyte disturbances.[2] Globally, more than 500,000 deaths from drowning are reported every year.[3] Poor prognostic factors include low Glasgow Coma Scale (GCS) score and cardiorespiratory arrest. Treatment is largely supportive. Most preventative measures are centred on aquatic safety education and swimming lessons. Based on the National Sport Participation Survey 2018–2022, swimming has consistently ranked among the 5 most popular sports in Singapore.[4] This study aimed to describe the outcomes of patients admitted for drowning.

All patients admitted to a tertiary hospital for drowning between January 2011 and December 2021 were identified from a prospectively maintained institutional database and included in this study. Relevant clinical data pertaining to the pre-hospital, emergency department (ED), inpatient and discharge care were anonymised and extracted. The primary outcome measured was in-hospital mortality and the secondary outcome measured was hospital length of stay (LOS). Statistical analysis was performed using R version 4.0.5 (R Core Team 2020, Vienna, Austria). Univariate and multivariate logistic regression analyses were performed to evaluate potentially prognostic risk factors. The odds ratio (OR) and corresponding 95% confidence intervals were calculated and $P<0.05$ was deemed statistically significant.

A total of 56 patients were included. All patients had signs of life in the ED. The majority were male (73.2%), under 40 years of age (57.1%) and had GCS scores more than 12 (64.3%). Most drowning incidents occurred at the open sea (41.1%) and private pools (37.5%); 14 patients (25%) consumed alcohol and the majority of these patients were male (78.6%). None of the patients consumed psychoactive drugs. Occupational accidents and suicide attempts were uncommon, with only 2 (3.6%) and 4 (7.1%) occurrences, respectively. There was equal sex distribution for suicide attempts.

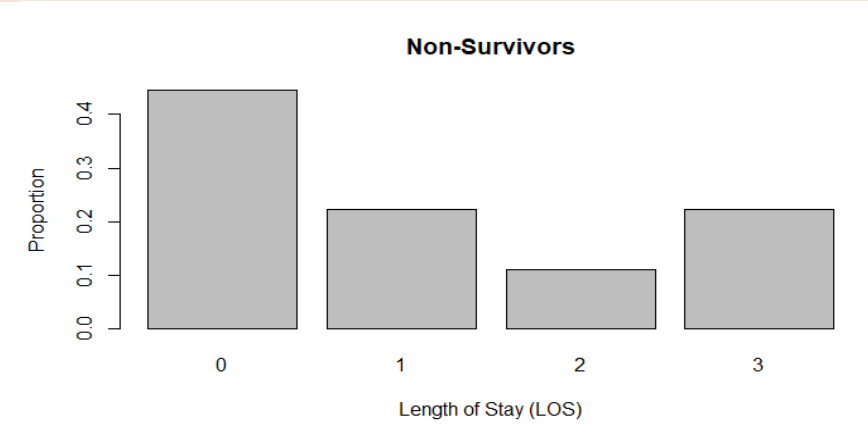
Cardiac arrest and pneumonitis were the most common complications, and these were observed in 27 patients (48.2%) and 18 patients (32.1%), respectively. Mild hypothermia (temperature 32–35°C) was observed in 5 patients (8.9%). Invasive ventilation was required in 32 patients (57.1%) for a median duration of 1 day (interquartile range [IQR] 0–2). Operations were performed in 2 patients (3.6%) for cervical spine injury and facial fractures. The median duration of high dependency and intensive care were 0 and 1 day, respectively.

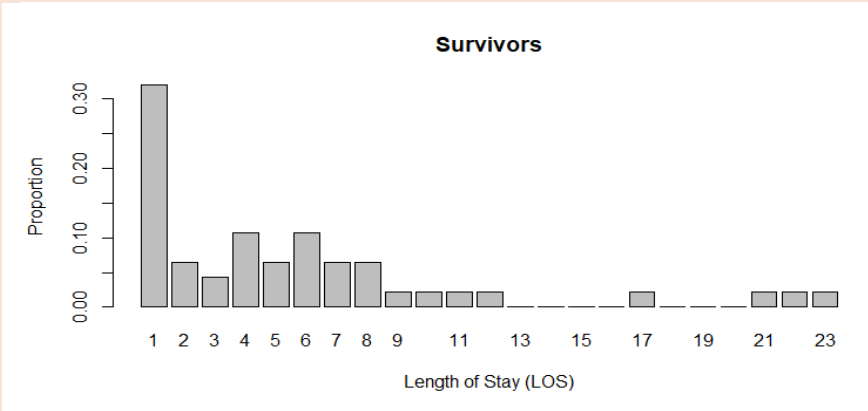
There were 9 deaths (16.1%) and 4 (7.1%) took place in the ED. Low GCS score (OR 0.014, 95% CI 0.001–0.276, $P=0.005$), cardiac arrest (OR 0.047, 95% CI 0.003–0.872, $P=0.040$), hypothermia (OR 0.078, 95% CI 0.010–0.633, $P=0.017$), hypoxic-ischaemic encephalopathy (OR 0.078, 95% CI 0.010–0.633, $P=0.017$) and traumatic brain injury (OR 0.017, 95% CI 0.0008–0.356 , $P=0.009$) were predictive of mortality in the univariate analysis, but none were statistically significant in the multivariate analysis. Low GCS score approached significance with OR 0.064 (95% CI 0.004–1.05, $P=0.054$).

The median LOS was 3.00 days (IQR 1–6.75). The need for mechanical ventilation (OR 25.62, 95% CI 3.80–172.80, $P=0.001$), duration of ventilation (OR 7.95, 95% CI 1.63–38.68, $P=0.010$) and duration in intensive care (OR 6.51, 95% CI 1.48–28.65, $P=0.013$) were predictive of longer LOS in the univariate analysis. The need for mechanical ventilation (OR 22.91, 95% CI 2.29–229.48, $P=0.008$) alone was statistically significant in the multivariate analysis. The area under the curves of the multivariate logistic regression models for in-hospital mortality and LOS were 0.85 (95% CI 0.7–1) and 0.9 (95% CI 0.704–1), respectively. Fig. 1 shows the distribution of observed LOS for survivors and non-survivors. The distribution of LOS was skewed to the right for survivors, with a median of 4 days and mean of 5.57 days (standard deviation [SD] 5.61). For non-survivors, the median LOS was 1 day and mean was 1.11 days (SD 1.27).

Inpatient mortality was 16.1%. Among the possible predictive factors for mortality, hypothermia can be easily addressed by covering patients with warmed blankets and infusing warmed fluids. Hypoxic-ischaemic encephalopathy may be preventable with early recognition of cardiopulmonary compromise and prompt resuscitation in accordance to Advanced Cardiac Life Support and Advanced Trauma Life Support. With regards to LOS, the need for mechanical ventilation and duration in intensive care are contingent on the severity of injuries and these factors are non-modifiable. Patients who undergo major surgery or require mechanical ventilation

Fig 1. Distribution of hospital length of stay for survivors and non-survivors.





may require a multidisciplinary approach for discharge planning.

In terms of preventive measures, a targeted approach to public health education and instituting stricter safety policies at beaches and private pools may be helpful. Public health education and drowning prevention campaigns targeting male youth may be effective, including water safety lessons during full-time national service. Refresher lessons can also be conducted for operationally ready national servicemen. Since 78.6% of patients who consumed alcohol prior to the drowning incidents were male, targeted public education efforts on responsible drinking may help.

Most patients (78.6%) experienced drowning at beaches and private pools. In contrast to public pools, not all beaches and private pools employ lifeguards and there is no legal requirement to do so.[5,6] It is likely costly and difficult to find trained lifeguards for every swimming pool. Perhaps cameras can be installed to allow remote surveillance and alarms can be activated when help is needed. Even in the absence of lifeguards, trained civilians can help too. Beaches and private pools also do not have restrictions on alcohol consumption and this should be re-evaluated. The Singapore Life Saving Society (SLSS) is the primary organisation leading national efforts in promoting water safety in Singapore.[7] SLSS regularly conducts lifesaving courses and examinations to not only develop a pool of trained lifeguards, but also impart skills to the common civilian. There is also SwimSafer, which is a national programme designed to teach essential swimming skills, water safety awareness and build water confidence from a young age. Public campaigns should also increase awareness and adoption of such programmes.

One limitation of this study is the absence of data on out-of-hospital mortality. The results presented in this study are derived from the survivors and are prone to selection bias. There is also a lack of data on drowning among children as this study was conducted in an adult ED. Nonetheless, establishing a baseline inpatient mortality rate remains a strength of this paper. Like all aspects of trauma management and prevention, work in the pre-hospital setting is required.

Disclosure

The authors declare no conflict of interest.

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Mingzhe Cai[1] *MMed(Surgery)*, Piea Peng Lee[2] *MAS*, Pei Leng Chong[3] *BPharmSci(Hons)*, Fiona Teng Teng Peh[3] *BHSc(Nursing)*, Sachin Mathur[1] *PhD*

[1] Department of General Surgery, Singapore General Hospital, Singapore
[2] Division of Surgery and Surgical Oncology, National Cancer Centre Singapore
[3] Trauma Service, Singapore General Hospital, Singapore

Correspondence: Dr Mingzhe Cai, Department of General Surgery, Singapore General Hospital, Outram Road, Singapore 169608.
Email: mingzhe.cai@u.nus.edu

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ANNALS, ACADEMY OF MEDICINE, SINGAPORE
81 Kim Keat Road, #11-00 & #12-00 NKF Centre, Singapore 328836
Tel: +65 6593 7800 | Fax: +65 6593 7867 | Email: annals@ams.edu.sg | Website: https://www.annals.edu.sg