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COMMENTARY

Call for a Singapore National Action Plan for Sepsis (SNAPS): Stop sepsis, save lives

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Sepsis is a life-threatening organ dysfunction syndrome caused by a dysregulated host response to an infection.[1] It affects up to 48.9 million people globally every year and causes 11 million sepsis-related deaths, accounting for 1 in every 5 deaths worldwide.[2] The huge disease burden leads to significant consumption of healthcare resources due to longer hospitalisation and the need for intensive care.[3] The resultant economic impact is tremendous; for instance, the 1-year incremental costs of sepsis to the healthcare system in Ontario, Canada approximates CAD 1 billion.[3] In addition to the complexity of care required for sepsis, the higher healthcare costs incurred may be explained by the post-sepsis syndrome. Sequelae of sepsis include physical, psychological and medical complications.[4]

In 2017, the World Health Organization (WHO) recognised sepsis as a global health priority, emphasising the need to develop and implement national strategies to improve prevention, diagnosis and management.[5] This creates a paradigm shift in promoting sepsis as a public health problem, with preventive measures to be taken at various levels.[6] Our healthcare system response to the COVID-19 pandemic further supported this concept, as a high proportion of patients who were admitted has COVID-19-related sepsis.[7] Public health and preventive measures like vaccination were instituted, disease burden was measured, and robust research evidence was generated for both COVID-19 and its sequelae (long COVID). The COVID-19 pandemic clearly illustrated the crucial role of policymakers in driving a highly effective national coordinated response.

Over the last decade, the profile of sepsis has risen significantly on international platforms, primarily due to efforts by various organisations, including the WHO, Global Sepsis Alliance and other professional societies.[8] Initiatives such as the annual World Sepsis Day (that was marked from 2012) and media coverage of high-profile deaths from sepsis have been instrumental in promoting sepsis awareness.[9] Following a WHO resolution in 2017, several countries—such as Australia, United Kingdom, and the United States—have developed coordinated national programmes against sepsis, jointly with healthcare professionals, academia, patients and policymakers.[10,11] Such programmes have demonstrated increased sepsis awareness,[12] improved process of care for patients with sepsis, decreased mortality,[12-14] and reduced healthcare costs.[13,14] As compared to other time-critical conditions like stroke and acute coronary syndromes, sepsis awareness is lacking in Singapore despite a higher disease burden and mortality. A population survey conducted in Singapore in 2010 showed that only 5.0% of respondents had heard of the term "sepsis", starkly contrasting with 90.3% who were aware of stroke.[15] This proportion is among the lowest globally despite Singapore being a high-income country.[16] Yet, the finding was unsurprising given that key population health issues such as cardiovascular and cerebrovascular diseases, diabetes, and healthy ageing have taken precedence in recent years. While the incidence of sepsis in Singapore remains unknown, pneumonia and urinary tract infections accounted for more than 5,000 deaths in 2021.[17] This number equates to approximately 20% of total mortality, comparable to global statistics of sepsis-related mortality.[2] Similarly, a recent local study reported an estimated incidence of ICU-treated sepsis of 16.6%, with 30-day mortality at almost 20%.[18] Hence, this calls for a national sepsis action plan to identify opportunities and propose strategies to reduce sepsis burden and its impact in Singapore.

A coordinated national sepsis action plan

To align and synergise with the goals of Singapore's Healthier SG strategy—the national initiative by Singapore's Ministry of Health that promotes population health and preventive medicine, we propose a framework of an all-inclusive strategy that incorporates the processes, relevant stakeholders, and key domains of the sepsis action plan (Fig. 1). A national sepsis network should be established as a core body to coordinate and

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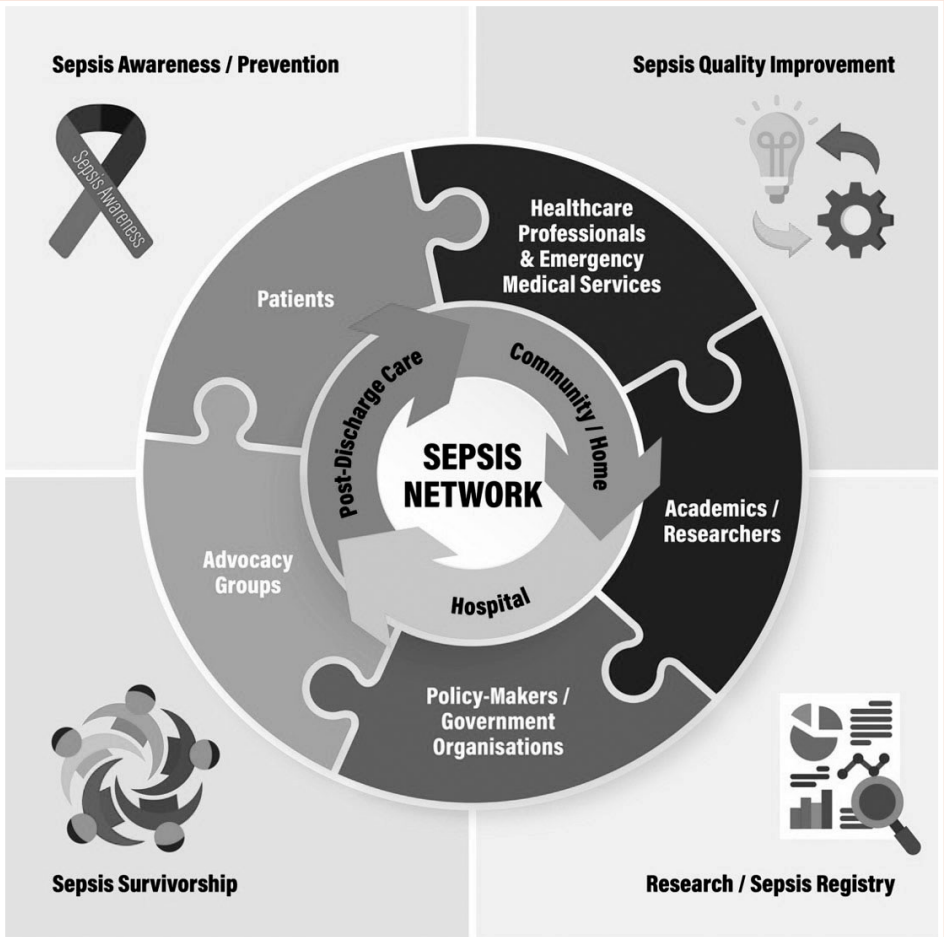
facilitate multi-sector and multi-domain collaboration. It should provide the leadership and needed resources to steer action plans in order to achieve the goals in each domain.

As shown in Fig. 1, the circular flow depicts a patient's journey from the community and primary healthcare through acute hospital care and post-discharge care. This is a continuous loop instead of a one-way process, as sepsis survivors are at risk of recurrent infections and hospital readmissions.[19] Therefore, patients should continue to receive preventive measures against infection upon hospital discharge. Patients can in turn contribute to patient advocacy groups to help raise sepsis awareness among the lay public. The jigsaw pieces represent cohesive collaboration by the key stakeholders, who should be actively engaged. Effective strategic partnerships need to be initiated and strengthened across the spectrum of healthcare delivery to be supported by government organisations and policymakers. The action plan should develop and implement initiatives based on the four key domains, namely, sepsis awareness and prevention, improvement to treatment quality, sepsis survivorship, and research.

Sepsis awareness and prevention

Sepsis is a time-critical medical emergency, and increasing awareness of sepsis to ensure prompt recognition and presentation for treatment is an important priority.[5] Studies have shown that sepsis awareness is low among public and even healthcare professionals.[16,20] It is essential to develop educational campaigns and communication strategies to promote public awareness effectively, ensuring consistency in messaging and widespread dissemination. Content should focus on recognising signs and symptoms of sepsis, seeking urgent medical care when symptoms are recognised, and sepsis preventive measures, including vaccination and hand hygiene. Educational materials and modes of delivery should be customised for various socio-economic and age groups, including children, to improve

Figure 1. Proposed national sepsis framework.



health literacy effectively. Empowering the public to present promptly and appropriately to either primary care or the emergency department for treatment is an integral link in the pre-hospital phase of sepsis care to reduce global burden and mortality. Promoting World Sepsis Day at a national level is paramount to gain greater impact and publicity via activities such as fundraising events, public education forums, and sharing of stories by sepsis survivors.

Sustainable educational measures are needed to establish periodic up-to-date training on sepsis for healthcare providers as part of continuous professional development. Sepsis should also be incorporated into medical, nursing, and paramedical curricula before healthcare professionals join the workforce. While up to 80% of sepsis cases start in the community, sepsis arising from healthcare-associated infections have a higher mortality rate compared to community-acquired infections.[21] This highlights the pivotal role of infection control programmes across institutions as an essential preventive measure.

Improvement to treatment quality

The Surviving Sepsis Campaign, led by the Society of Critical Care Medicine and the European Society of Intensive Care Medicine, is an international collaborative effort aimed to reduce mortality from sepsis by 25% in 5 years following the Barcelona Declaration in 2002.[22] The initiative provides updated evidence-based recommendations for clinicians to improve sepsis care.[22] Increased adherence to sepsis bundles has improved outcomes with reduced need for ICU admission, shorter hospital length of stay and possibly lower mortality.[23] Conversely, delays in executing each intervention and completing the bundle were associated with higher mortality.[24] Therefore, a key recommendation is to develop and establish a clinical standard for the diagnosis, management and follow-up of sepsis patients.

Sepsis clinical pathways—comprising sepsis screening and sepsis bundles—should be implemented in emergency departments, hospital wards and residential care facilities. These protocols encourage best clinical practice and may be tailored and adapted to different healthcare settings. Quality improvement initiatives should be executed in tandem with several simultaneous interventions, including training programmes, standardised electronic order sets, and nurse-driven sepsis protocols, amongst others, to optimise sepsis bundle compliance. Regular data collection and audits are essential to evaluate compliance. Performance measures should include process indicators, clinical outcomes and healthcare costs. Studying these measures and identifying gaps would in turn guide subsequent quality improvement programs.

Sepsis survivorship

Approximately 14 million sepsis survivors experience poor long-term outcomes from physical, cognitive and psychological impairment each year.[4] Sepsis survivors are vulnerable to further health issues, especially in the first year of survivorship, with an increased risk of recurrent infections, hospital readmissions, and mortality for up to 2 years.[25,26] In addition, sepsis survivors experience a considerable reduction in functional mobility and quality of life, as well as loss of independence, reduced work productivity and financial loss. Thus, it is essential to recognise the burden of longer-term sepsis-related morbidity and develop support systems to address the multi-faceted needs of sepsis survivors and their caregivers. We propose the following: (1) improve the understanding of post-sepsis syndrome and its long-term sequelae among patients and their caregivers and healthcare professionals; (2) develop a coordinated multi-disciplinary approach to build a post-sepsis rehabilitation program and follow-up care to address patients' and their caregivers' needs in various aspects; and (3) establish research priorities on sepsis survivorship to identify their needs, design tailored interventions and assess effectiveness of these interventions on clinical outcomes.

Research

More effort is needed to build sepsis research capacity. Research domains should span the continuum of sepsis from primary prevention to acute care and sepsis survivorship. The knowledge generated is necessary to advance our understanding of the causes of sepsis, improving the prevention, early recognition and management of sepsis, and enhancing rehabilitation and recovery from sepsis. Establishing a national sepsis registry is an essential priority as it serves as an infrastructure for sepsis epidemiological studies that are lacking in Singapore. We should leverage the expertise acquired in other registries to create a sepsis database that allows measures of disease burden and clinical outcomes.[27] Key elements should involve standardising data collection, reporting and defining key quality indicators. These findings aid in evaluating the effectiveness of sepsis prevention and improvement to quality of sepsis treatment, as well as providing benchmarking against other countries. These data would offer insights into strategies practical to policymakers and healthcare providers

Table 1. Proposed key recommended actions.

Domains	Key recommended actions
Sepsis awareness and prevention	• Design and launch public sepsis awareness campaigns • Improve and maintain the training of healthcare providers in sepsis and infection control and prevention
Sepsis treatment quality improvement	• Consider implementing sepsis clinical pathways, comprising sepsis screening and sepsis bundles • Evaluate sepsis pathway implementation
Sepsis survivorship	• Understand the mechanism of post-sepsis syndrome • Design a multidisciplinary approach to post-sepsis interventions • Establish support systems for sepsis survivors and families
Sepsis research	• Map sepsis research priorities • Establish a national sepsis registry

to prioritise cost-effective interventions. Other research areas include disease pathophysiology, adjunctive therapies and precision medicine to further support the development of novel diagnostic tools and treatment modalities.

CONCLUSION

With our ageing population and a greater number of patients having multiple comorbidities, we anticipate an increasing complexity of sepsis cases. Prolonged exposure to broad spectrum antibiotics could lead to antimicrobial resistance, with poorer clinical outcomes and greater costs. It is time for Singapore to embark on a concerted and comprehensive national sepsis action plan that extends beyond acute tertiary care. The COVID-19 pandemic, which has caused close to 7 million sepsis-related deaths worldwide, is a timely reminder to recognise sepsis as a public health priority. We cannot emphasise the importance of policymakers' leadership to engage and connect key stakeholders across all levels of society. Public health initiatives should integrate preventive measures, early diagnosis and treatment, and the support of sepsis survivors across a broad healthcare landscape. Our proposed all-inclusive framework encapsulates our vision and ideas for a roadmap to develop and implement a national sepsis action plan in Singapore (Table 1). Together we can "stop sepsis, saves lives."[8]

Conflict of interest

The authors declare no conflicts of interest.

Keywords: *epidemiology, infection, mortality, public health, sepsis*

REFERENCES

1. Singer M, Deutschman CS, Seymour CW, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA 2016;315:801-10.
2. Rudd KE, Johnson SC, Agesa KM, et al. Global, regional, and national sepsis incidence and mortality, 1990–2017: analysis for the Global Burden of Disease Study. Lancet 2020;395:200-11.
3. Farrah K, McIntyre L, Doig CJ, et al. Sepsis-Associated Mortality, Resource Use, and Healthcare Costs: A Propensity-Matched Cohort Study. Crit Care Med. 2021;49:215-27.
4. Prescott HC, Iwashyna TJ, Blackwood B, et al. Understanding and Enhancing Sepsis Survivorship. Priorities for Research and Practice. Am J Respir Crit Care Med 2019;200:972-81.
5. Reinhart K, Daniels R, Kissoon N, et al. Recognizing Sepsis as a Global Health Priority — A WHO Resolution. N Engl J Med 2017;377:414-17.
6. Kempker JA, Wang HE, Martin GS. Sepsis is a preventable public health problem. Crit Care 2018;22:116.
7. The European Society of Intensive Care Medicine, The Global Sepsis Alliance, The Society of Critical Care Medicine. Reducing the global burden of sepsis: a positive legacy for the COVID-19 pandemic? Intensive Care Med 2021;47:733-6.
8. Global Sepsis Alliance. Regional sepsis alliance. Available at: https://www.global-sepsis-alliance.org/regionalsepsisalliances. Accessed on 5 June.
9. Staunton O, Staunton C. The Urgency of Now: Attacking the Sepsis Crisis. Crit Care Med 2018;46:809-10.
10. Schlapbach LJ, Zimmermann EA, Meylan S, et al. Swiss Sepsis National Action Plan: A coordinated national action plan to stop sepsis-related preventable deaths and to improve the support of people affected by sepsis in Switzerland. Front Med (Lausanne) 2023;10:1114546.
11. Sepsis Australia. Stopping sepsis: A National Action Plan. Sydney, Australia: The George Institute for Global Health: December 2017. Accessed on 5 June.
12. Sykes K, Thursky K, Travis D, et al. Program evaluation 2017–18 "Think sepsis. Act fast." scaling collaboration. Melbourne, Australia: 2019.
13. Brusco NK, Sykes K, Cheng AC, et al. A state-wide implementation of a whole of hospital sepsis pathway with a mortality based cost-effectiveness analysis from a healthcare sector perspective. PLOS Glob Public Health 2023;3:e0000687.
14. Blythe R, Lister P, Seaton R, et al. Patient and economic impact of implementing a paediatric sepsis pathway in emergency departments in Queensland, Australia. Sci Rep 2022;12:10113.
15. Phua J, Lim HF, Tay CK, et al. Public awareness of sepsis and stroke in Singapore: a population-based survey. Ann Acad Med Singap 2013;42:269-77.

16. Fiest KM, Krewulak KD, Brundin-Mather R, et al. Patient, Public, and Healthcare Professionals' Sepsis Awareness, Knowledge, and Information Seeking Behaviors: A Scoping Review. Crit Care Med 2022;50:1187-97.
17. Singapore Ministry of Health. Principal causes of death. Available at: https://www.moh.gov.sg/resources-statistics/singapore-health-facts/principal-causes-of-death. Accessed on 5 June.
18. Jiang X, Khan FA, Ow MQ, et al. Sepsis in a Combined Medical and Surgical High Dependency/Intensive Care Unit in Singapore: A Cohort Study and Survival Analysis. Int J Gen Med 2022;15:4585-93.
19. Prescott HC, Angus DC. Enhancing Recovery From Sepsis: A Review. JAMA 2018;319:62-75.
20. Chua WL, Teh CS, Basri MABA, et al. Nurses' knowledge and confidence in recognizing and managing patients with sepsis: A multi-site cross-sectional study. J Adv Nurs 2023;79:616-29.
21. Rhee C, Wang R, Zhang Z, et al. Epidemiology of Hospital-Onset Versus Community-Onset Sepsis in U.S. Hospitals and Association With Mortality: A Retrospective Analysis Using Electronic Clinical Data. Crit Care Med 2019;47:1169-76.
22. Evans L, Rhodes A, Alhazzani W, et al. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021. Intensive Care Med 2021;47:1181-247.
23. Venkatesh B, Schlapbach L, Mason D, et al. Impact of 1-hour and 3-hour sepsis time bundles on patient outcomes and antimicrobial use: A before and after cohort study. Lancet Reg Health West Pac 2022;18:100305.
24. Seymour CW, Gesten F, Prescott HC, et al. Time to Treatment and Mortality during Mandated Emergency Care for Sepsis. N Engl J Med 2017;376:2235-44.
25. Prescott HC, Osterholzer JJ, Langa KM, et al. Late mortality after sepsis: propensity matched cohort study. BMJ 2016;353:i2375.
26. Prescott HC, Langa KM, Iwashyna TJ. Readmission diagnoses after hospitalization for severe sepsis and other acute medical conditions. JAMA 2015;313:1055-7.
27. Doctor NE, Ahmad NS, Pek PP, et al. The Pan-Asian Resuscitation Outcomes Study (PAROS) clinical research network: what, where, why and how. Singapore Med J 2017;58:456-58.