EDITORIAL

Intensive Care Medicine in 2050: global perspectives

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The changing world

With a projected increase in the world population from 7.2 billion currently to 9.6 billion by 2050, the population of the 49 least developed countries is expected to double from 900 million in 2013 to 1.8 billion [1]. As such, the number of patients who may need critical care will increase substantially, with a majority of these in resource-restricted settings. Coupled with an ageing global population, the complexity of the challenge will be enormous. Infectious diseases and trauma will continue to be main reasons for intensive care unit (ICU) admission, but natural as well as man-made disasters will occasionally place additional strain on critical care services, with the largest strain again in resource-restricted settings. Healthcare expenditures vary considerably from approximately US \$9400 annually per capita in the USA to less than US \$20 per capita in many African countries [2], and with limited financial resources, the strategic priority is given to public health programs and not to more expensive services such as critical care. Around the globe, what constitutes an ICU will continue to vary in terms of structure, processes and staffing, all of which often remain inadequate in resource-restricted settings [3]. However, the basic premise will remain the same: the outcome of critically ill patients will substantially be improved by the provision of essential critical care [4], and many aspects can and should be provided even if resources are low [5]. Moving towards better critical care globally will require a multifaceted approach to address not only patient and organizational challenges, but also those related to staffing, cultural and technological aspects, as well as quality and safety. Addressing these

complex challenges will certainly require involvement not only at the local ICU level but also at the level of hospitals, national societies and governments. In Table 1, we present examples of where and how critical care could and should improve, with a focus on resource-restricted settings. Some of these cases are highlighted in the following text.

Patient level challenges and solutions

Patient-level challenges to critical care in 2050, including increasing patient numbers and limited or no access to critical care, must be addressed by means other than merely increasing the number of beds per capita. Acute care services vary substantially across regions, and the variation is only partially attributable to differences in the gross domestic product [6]. Focus needs to be on early pre-ICU intervention and on better triage in order to reduce morbidity and the need for ICU admission. In addition, improving resource utilization and reducing waste will be equally essential. Finally, a strategy of appropriate end-of-life care that maintains patient integrity but avoids futile interventions needs to be introduced, especially in settings where clear standards do not yet exist.

ICU-level challenges and solutions

Lack of proper basic infrastructures, including equipment and supplies, and substandard infection control will continue to challenge critical care by 2050. Prioritization will vary depending on the setting. In some areas, availing of intravenous fluids and uninterrupted oxygen and electricity may provide the greatest return. For mechanically ventilated patients, simply improving limited or unsafe endotracheal suctioning will prove to be life saving. There is a clear need for setting-specific standards for what is minimally needed within an ICU to be adopted by hospitals and governments.

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Table 1 Examples of where and how critical care could improve globally

Domains	Challenges		Stake holders		National societies/governments
			ICU teams	Hospitals	
Patient level	-Increasing patient numbers		-Have more ICU beds operable -Ensure efficient outflow of patients (e.g., those who need long-term ventilation)	-Establish one or more ICUs, or increase its size	-Indicate where more ICU beds are needed -Have a proper reimbursement system for ICU costs -Establish or expand chronic care facilities (e.g., for long-term ventilation)
			-Use proper and acceptable admission and discharge policies -Plan elective admissions so that there will always be beds available for acute admissions Have a proper triage tool in place	-Implement local transport systems -Improve the use of admission and discharge policies -Invest in larger ICU teams -Implement rapid response teams -Hospital-wide acceptance of the ICU triage tool -Develop step-downs or high-dependency units for patients with low acuity	-Develop national transport systems -Have a proper reimbursement system for ICU costs -Adopt measures for effective and efficient use of ICU resources -Demand hospitals to develop and implement triage tools; provide guidelines for triaging and discharge policies
	-Limited or no access				
	-Incorrect triage				
Unit level	-Interruptions of electricity and oxygen supplies -Unavailability of drugs		-Ensure that essential equipment have batteries -Ensure backup systems for oxygen, e.g., bedside or central oxygen tanks or oxygen concentrators -Ensure consistent availability of crucial drugs	-Guarantee uninterrupted electricity; implement backup systems -Invest in piped oxygen -Have a local pharmacy for delivery of crucial drugs	-Establish standards for minimum requirements for ICUs -Establish financial support for implementing the correct infrastructure for ICUs
	-Unavailability of essential equipment and supplies		-Ensure proper planning for essential equipment and supplies -Focus of supplies and equipment that are essential and evidence-based	-Have a system for logistics and purchasing -Establish proper maintenance system for equipment	-Build capacity for manufacturing and acquiring essential supplies and equipment -Build capacity in biomedical engineering
	-Inadequate infection prevention		-Stimulate hand washing; implement and stimulate adherence to a local infection prevention protocols -Implement strict hygiene guidelines for physicians and nurses, e.g., for insertion of vascular catheters	-Adjust the infrastructure of ICUs to allow proper infection control, e.g., for hand hygiene, clean equipment and sufficient amounts of consumables -Invest in rooms for isolation -Implement hospital-wide infection prevention programs	-Establish standards for infection control in the process for hospital accreditation -Mandate reporting of hospital-acquired infections, e.g., catheter-related infections, or ventilator-associated pneumonia
	-Inadequate infection control		-Ensure consistent availability of antibiotics -Have protocols in place for empirical antibiotic treatment and for source control -Have all stakeholders on board (e.g., microbiologist, surgeon)	-Have access to a microbiology testing -Have a local pharmacy responsible for delivery of crucial antibiotics	-Develop and disseminate national guidelines for antimicrobial therapies, e.g., for sepsis or pneumonia -Build capacity in infection control practitioners -Have a central governing body that oversees the national infection control practices

Table 1 continued

Domains	Challenges	Stake holders		
		ICU teams	Hospitals	National societies/governments
Staffing	-Limited skills in managing critically ill patients	-Establish tailored training programs to specific needs, with a multidisciplinary approach, e.g., for ventilatory and circulatory support	-Stimulate and allow continuous training of physicians and nurses -Keep ICU teams 'stable' i.e., keep well-trained personnel within the ICU team	-Have proper reimbursement systems for ICU personnel -Develop a national training system
	-Too low nurse-to-patient ratios	-Recognize the importance of having sufficient numbers of ICU-nurses at the bedside (during all shifts)	-Built sufficiently-sized ICU teams	-Invest in nursing training programs
	-Brain drain of well-trained personnel	-Improve the work environment	-Invest in sufficient salaries of ICU-team members -Evaluate and ensure satisfactory work environment, i.e., prevent 'burn-out'	-Invest in sufficient salaries -Promote critical care among residents for post-graduate training
Culture	-Task-centered instead of patient-centered care	-Enhance the patient-centered approach of care -Make shared decisions, i.e., shared between physicians and nurses -Promote patient safety culture -Empower nurses through the application of nurse-driven protocols and checklists	-Adjust the hierarchy within the workplace to improve communication, transparency and efficiency	-If necessary, change legislation with regard to what nurses are allowed to do
Quality of care	-Guidelines in use that are not feasibly or affordable, unsafe and maybe even ineffective	-Adjust (inter)-national guidelines according to local feasibility and affordability, safety and effectiveness	-	-Implement a system of performance indicators
	-Variation in care processes	-Reduce variation, e.g., by developing and implementation of SOPs and checklists	-Provide tailored and feasible evidence-based protocols and hospital-wide SOPs and checklists	-Enforce the use of SOPs and checklists
	-Too late recognition of a critically ill patient	-Create ICUs 'without walls' -Built reaching out teams for the ward and emergency departments	-Develop hospital-wide early recognition systems and rapid response teams -Use performance indicators	-Improve pre-hospital care (paramedics and ambulances) -Public awareness of e.g., sepsis -Hospital-wide training of personnel in recognition of the critically illness
Safety	-High incidence of avoidable adverse events -Unsafe treatment strategies, unsafe working surroundings for personnel	-Educate staff about the science of patient safety -Establish systems to avoid harm, such as VAP, CLABSI and others -Engage to ensure safety awareness (e.g., a broken apparatus should not be used anymore)	-Emphasize the six aims for the health care systems: safe, effective, efficient, patient-centered, timely and equitable care -Hospital-wide maintenance of medical apparatus	-Build safety into each system to prevent, reduce, report and analyze medical errors -Build capacity in patient safety -Invest in proper medical equipment for all hospitals
Technologies	-Best-fitting technologies are not or only scarcely available	-Seek advice on best-fitting technologies that support evidence-based practice -Invest wisely in best technologies	-Establish hospital-wide purchase of medical apparatus	-Establish systems to facilitate purchase of best-fitting technologies

Table 1 continued

Domains	Challenges	Stake holders			National societies/governments
		ICU teams	Hospitals		
Research	<ul style="list-style-type: none"> -Limited infrastructure to conduct high-quality research in resource-restricted settings -Very limited funding for research in resource-restricted settings 	<ul style="list-style-type: none"> -Acquire skills for conducting and interpreting research 	<ul style="list-style-type: none"> -Develop the infrastructure to conduct research, including IRB 	<ul style="list-style-type: none"> -Establish setting-specific research priorities, with focus on high-impact-low cost initiatives -Use funding for research according to preset priorities -Establish national standards to ensure and facilitate ethical collaborative initiatives and partnerships -Prioritize pragmatic, high-impact clinical research 	

CLABS/Central line-associated bloodstream infection, ICU intensive care unit, IRB institutional review board, SOPs Standard operating procedures, VAP ventilator-associated pneumonia

Challenges in staffing

In resource-restricted settings, critical care is not yet a well-developed specialty. Consequently, there is a great potential for increasing the scope of training for physicians, nurses and other personnel. Training needs to focus on specific critical care skills, but it should also include basic management and organizational aspects, such as admission and discharge policies, multidisciplinary rounds, and proper documentation and handovers. Train-the-trainer approach will become increasingly important for sustainable training. In addition, resource-rich ICUs are increasingly committed to partner with resource-restricted ICUs for support and knowledge exchange. Several active examples include the initiatives by the World Health Organization, the Chinese University of Hong Kong, Médecins Sans Frontières, the National Intensive Care Surveillance (NICS) and our own academic groups.

Quality improvements

Wide variations in processes of care and outcomes exist among settings according to income level [7]. For example, mortality due to sepsis has decreased over the last decades to 20–40% in resource-rich settings, whereas mortality rates of up to 80% are still reported from resource-restricted regions [8]. This high mortality is attributed to late recognition of critical illness, poor translation of current knowledge [9] and poor ICU service structure. Low adherence to simple but effective evidence-based practices, such as low-tidal ventilation and the use of light sedation, is frequent in resource-restricted settings. A recent multicenter study demonstrated that implementing protocols in this setting is associated not only with lower mortality rates but also with an increased efficiency [10].

Clinical practice guidelines have been mainly based on evidence from resource-rich settings. Some of these recommendations, however, can be beyond the capability of resource-restricted ICUs and could even be dangerous, as is the case of aggressive fluid resuscitation (The FEAST trial) [11]. Treatment of infections should be setting-specific because resource-restricted countries have different pathogens, higher antibiotic resistance and less access to newer and expensive antimicrobials than resource-rich ones. An initiative from the Global Intensive Care working group of the 'European Society of Intensive Care Medicine' has started to produce setting-specific recommendations [12], but this initiative is still hampered by absence of evidence for most recommendations used in resource-rich settings.

Safety initiatives

Avoidable adverse patient events are common in the ICUs [13]. The risk in resource-restricted settings is unknown but likely to be high. Therefore, a

comprehensive approach for building safety into each system to prevent, reduce, report and analyze medical errors should be of great importance.

Technological challenges

Technology, such as telemedicine may play a significant role reducing the need for specialized staff [14]. Other measures, such as the use of remote application of checklists, are associated with improved adherence to best practices [15].

Conclusion

The journey toward excellent global critical care in 2050 is unlikely to be easy but is certainly going to be an exciting and interesting one. A comprehensive multifaceted approach is needed to improve the delivery of critical care globally, and such efforts are likely to translate to major improvement in patient outcome.

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