

Paper No : (XXXX) XX/XX

**Subject : Projecting MICU Needs for SGH Campus: Towards Y2022 and Beyond**

For : Approval

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## 1. **AIM**

- 1.1. This paper aims to review current utilisation of Medical Intensive Care Unit (MICU) beds and project MICU bed requirements.
- 1.2. We seek to obtain endorsement from Medical Board to expand MICU bed capacity to 19 beds for current needs, 33 beds by Y2022 and 44 beds by Y2030.

## 2. **BACKGROUND / SUMMARY**

- 2.1. During the 6<sup>th</sup> Management Committee Meeting, CEO requested for an assessment of the ICU shortfall in SGH in October 2015, due to the high Bed Occupancy Rate (BOR) and overflows. In Y2015, the highest daily patient load in MICU was 20 patients, significantly exceeding its current capacity of 8 beds (see Figure 1, Annex A). In addition, the lack of any available ICU bed in the entire hospital during demand surges in April and August 2015 resulted in the activation of contingency MICU beds. In 2016, contingency MICU was again activated in July.

- 2.2. ICUs play a vital role in the institution to meet the needs of critically ill patients. With increasing life expectancy, an increase in chronic diseases is inevitable. Coupled with rapid advances in new medical therapies that enable better treatment of complex and previously untreatable conditions, e.g. high-dose chemotherapies, organ transplantations and organ-support devices; the demand for critical care facilities will continue to increase<sup>1</sup>. ICU facilities are especially important on SGH Campus, which has a strong reputation as a regional referral centre where many state-of-the-art therapies are offered. In some institutions, such as SGH, where there is a high demand for ICU beds, Intermediate Care Areas (ICAs) are set up to provide step-down care from ICUs. The current MICU in SGH is located at Ward 45B with 8 licensed beds and Medical ICA (MICA) is located at Ward 45C with 10 licensed beds.
- 2.3. Internationally, there is a wide variation in the recommended number of ICU beds for hospitals. In Europe, ICU beds account for approximately 5% to 10% of all hospital beds, with a higher proportion in university hospitals<sup>2</sup>.
- 2.4. Based on the Ministry's planning guidelines on ICU, dated 11 August 2004, the percentage of ICUs in tertiary general hospitals should be limited to 5% of total bed complement.
- 2.5. SGH has 2.38%<sup>3</sup> ICU beds, which is the lowest across Public Healthcare Institutions in Singapore. This figure is less than half of the ICU beds permitted by MOH. This is contrasted to NUH, which has 5.60%<sup>4</sup> ICU beds (see Table 2, Annex A). If we exclude Neonatal ICU (which cannot be deployed for adult patients) and Burns ICU (which is a protected national resource), SGH has only 1.57%<sup>5</sup> adult-general ICU beds, which is insufficient to meet our patients' needs (see Table 3, Annex A).

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<sup>1</sup> MOH Parliamentary QA 14 Feb 2012

<sup>2</sup> Andreas V, Patrick F (2011) Recommendations on basic requirements for intensive care units: structural and organisational aspects. Intensive Care Med

<sup>3</sup> Includes all types of ICU beds

Source: Ministry of Health (Singapore) Annual Statistics on Health Service Utilisation 2015

<sup>4</sup> Includes all types of ICU beds

Source: Ministry of Health (Singapore) Annual Statistics on Health Service Utilisation 2015

<sup>5</sup> Only adult-general ICU beds

Source: Ministry of Health (Singapore) Annual Statistics on Health Service Utilisation 2015

### **3. JUSTIFICATION FOR MICU EXPANSION**

#### **3.1. Negative Impact of High Overflows to Other ICUs**

- 3.1.1. During times when the MICU is fully-occupied, critically-ill medical patients are “overflowed” to other ICUs, firstly to NICU, followed by SICU, CCU and CTICU.
- 3.1.2. In the same year, the peak numbers of patients overflowed to SICU and NICU daily<sup>6</sup> were 7 and 4, respectively (see Figures 2 and 3, Annex A). It is also noteworthy that 38% of total MICU admissions<sup>7</sup> overflowed to other ICUs (see Figure 4, Annex A).
- 3.1.3. Overflowing to these ICUs result in disruption to surgical services and cancellation of elective surgical cases during periods of bed crunch. In addition, managing critically ill patients across multiple ICUs located in different wards reduces responsiveness and efficiency of patient care. Hence, the current situation is neither ideal nor sustainable.

#### **3.2. Recent Activations of Contingency MICU Beds**

- 3.2.1. The minimal need for MICU in Y2015 to minimise overflows (calculated based on 80% BOR) was 14 beds<sup>8</sup>. MICU was operating with a deficit of 6 beds.
- 3.2.2. Lack of ICU beds during demand surge culminated in activation of contingency MICU beds on 3 occasions; in April and August 2015, and July 2016. The activation involved the conversion of 3 ICA beds to 2 make-shift ICU beds. This required the activation of ICU-trained nurses and loaning of equipment eg. ventilators from MICU. At the same time, MICA is an open ward and does not have isolation capability. Activation of contingency MICU is the last recourse when all ICU beds are occupied and all alternatives exhausted, including transferring out current ICU patients.
- 3.2.3. Based on 7.32% Compound Annual Growth Rate (CAGR) calculated from the Y2015 data<sup>9</sup> and in compliance with MOH Hospital Planning Manual, the minimal number of MICU beds required in 2030 would be 44 beds.

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<sup>6</sup> Source: eHIntS, period: 2015, analysis by PMMI

<sup>7</sup> Source: eHIntS, period: 2015, analysis by PMMI

<sup>8</sup> Source: eHIntS, period: 2015, analysis by PMMI

<sup>9</sup> Analysis by PMMI based on actual demand for adult-general ICU beds in 2015

### 3.3. Resource-driven Care at MICU

- 3.3.1. Due to insufficient beds in MICU currently, some critically-ill patients who would benefit from early ICU care are managed in MICA, general ward or A&E whilst waiting for ICU beds to become available. Inevitably, there are delays in transferring patients to MICU during the search for available ICU beds in the hospital. Often, the ICU team is forced to place critically-ill patients on vasopressors, high-flow oxygen therapy or even portable ventilators outside the ICU during these delays.
- 3.3.2. Insufficient ICU beds may inadvertently result in resource-driven clinical decision making as well as a tendency to delay the decision to step-up care to ICU due to limited beds. This mindset of “ICU transfer only as the last resort” even when ICU care is clinically indicated, may be detrimental to patient care, negatively impacting on clinical outcome and resulting in more resource utilisation due to delayed intervention.

### 3.4. Development of Specialized Services

- 3.4.1. The Extracorporeal Membrane Oxygenation (ECMO) service was successfully implemented to provide life-saving respiratory support for patients with severe ARDS during the H1N1 outbreak in 2009. Since then, the SGH ECMO service has grown to become the main referral centre in Singapore.
- 3.4.2. Karolinska Institute in Sweden has a 4-bedded ECMO Unit and handles about 100 ECMO cases yearly. SGH currently sees about 60 ECMO cases yearly and this number is projected to increase with improvements in ECMO technology, know-how and widening of evidence-based indications, such as ECMO-CPR for patients with refractory cardiac arrest.
- 3.4.3. The Department of Respiratory and Critical Care Medicine (RCCM) has plans to build on the current ECMO service within MICU, which will increase the provision of life-saving advanced respiratory support to suitable patients in Singapore and beyond. This would increase the demand of ICU beds in the future.
- 3.4.4. In addition, this multi-disciplinary Committee project that there would be an increasing number of interventional procedures, complex endoscopy, transplants, and clinical trials performed in the next 5 – 10 years. It is vital to build up adequate ICU capacity and capability in SGH to support these aspirations.

#### **4. PROPOSAL FOR MICU EXPANSION**

##### **4.1. Recommendation for MICU Capacity**

- 4.1.1. The proposal for MICU expansion spans over three phases in tandem with the execution of the Campus Masterplan. Phase 1 focuses on the immediate needs of MICU until additional ICU beds operationalised in the current A&E space in Y2022. Phase 2 centres on the MICU demand leading up to the new inpatient facility under the Campus Masterplan in Y2030. Phase 3 covers the demand beyond Y2030 in the new SGH.
- 4.1.2. Based on a 7.32% CAGR, calculated from actual demand for adult-general ICU beds (excluding Neonate and Burns ICUs) in Y2015 and in line with MOH Hospital Planning Manual (2004), 44 beds would be required in Phase 3 at 80% BOR. The proposal accounted for the projected total bed complement of 2,329 beds for the new SGH in Y2032 (1,762 SGH + 300 ECC + 168 AMW + 99 OCH Acute Rehab), which under the MOH planning manual, would permit up to 116 adult-general ICU beds.
- 4.1.3. Table 1 summarised the requested bed projections for Phase 1, 2 and 3 respectively, with the projected beds required assuming BOR is maintained at 80%.

**Table 1: Summary of projected MICU bed requirements for Phases 1, 2 and 3**

	<b>Bed Requirement (80% BOR)</b>	<b>Surge Demand (to meet 90% of peak demand)</b>	<b>Number of MICU Beds Requested</b>
<b>Phase 1: Y2015 – Y2021</b>	<b>14 – 22</b>	<b>15 – 24</b>	<b>19</b>
<b>Phase 2: Y2022 – Y2029</b>	<b>24 – 39</b>	<b>26 – 42</b>	<b>33</b>
<b>Phase 3: Y2030 and Beyond</b>	<b>41 – 48</b>	<b>44 - 52</b>	<b>44</b>

## 4.2. Catering to Peak Demand

- 4.2.1. In Y2015, the maximum and median daily patient load for MICU was 20 and 12 patients respectively, and both had already exceeded the current MICU capacity (see Figure 1, Annex A)<sup>10</sup>. Notably, daily patient load exceeded MICU capacity for approximately 90% of the time in that year.
- 4.2.2. Peak demand and occasional demand surges must be accounted into MICU capacity planning for the hospital to adequately manage unexpected surges and emergencies. While attempting to account for occasional demand surges, it is undeniable that resources are limited. Thus, the 90<sup>th</sup> percentile of daily MICU patient load would be the ideal point for identifying the buffer capacity required. In Y2015, the 90<sup>th</sup> percentile indicated a need for 15 beds, which was 7.14% more than the actual demand of 14 beds. Therefore, a factor of 7.14% had been added to the yearly projected bed numbers.
- 4.2.3. The Committee recommends planning the MICU capacity to have the ability to cope with anticipated demands and frequent surges. Sufficient beds would be secured for all patients requiring critical care, and it would be necessary in terms of delivering quality and efficient care to MICU patients, who require urgent attention and the most care by medical teams.

## 5. RECOMMENDATIONS

- 5.1. With respect to the MICA beds, the Committee recommends to keep the current capacity as status quo. With the expansion of the ICU facility in Y2022, the ICU team will monitor and review the need for a distinct MICA facility, as opposed to a combined MICU & MICA facility, in the future.
- 5.2. Renal ICA will continue to provide closer monitoring and support to high-risk renal patients. The projected needs shall be distinct and further deliberated on another platform, when necessary.
- 5.3. The Committee also proposes to convene another committee to review the ICU capacity in the new SGH for Y2030, due to the changing landscape of healthcare in Singapore, and for a more accurate projection of the actual ICU demand.

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<sup>10</sup> Source: eHIntS, period: 2015, analysis by PMMI

- 5.4. With the expansion of MICU, the respective clinical departments and Nursing should review their manpower and prioritise staff training to meet the staffing requirement for the future MICU.

**6. IMPLEMENTATION / NEXT STEPS**

- 6.1. Once A&E is relocated to Plot H9A, the existing space will house additional ICU beds; the Committee should continue to work with the Workgroup in-charge of planning for the upcoming ICU facility.
- 6.2. At the same time, there is a need to use critical care facilities appropriately and ensure right siting so that MICU can function effectively as a step-up care unit for critically ill patients, and MICA is effective to step-down recovering patients from MICU.

**7. CONCLUSION**

- 7.1. We seek endorsement of the Medical Board to expand MICU bed capacity to 19 beds for immediate needs, 33 beds by Y2022 and 44 beds by Y2030.
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## Annex A

**Table 2: Benchmarking ICU Beds across Public Healthcare Institutions in Singapore**

Hospital	No. of ICU Beds	Total No. of Beds	ICU/Total beds
SGH	41	1,725	2.38%
CGH	37	1,067	3.47%
KTPH	22	591	3.72%
TTSH	72	1,481	4.86%
NTFGH	29	557	5.21%
NUH	70	1,250	5.60%
CDC	18	299	6.02%
KKH	56	843	6.64%
NHC	25	185	13.51%

**Table 3: Benchmarking Adult-Gen ICU Beds across Public Healthcare Institutions in Singapore**

Hospital	No. of Adult-Gen ICU Beds	Total No. of Beds	ICU/Total beds
KKH	4	843	0.47%
SGH	27	1,725	1.57%
CGH	37	1,067	3.47%
KTPH	22	591	3.72%
NUH	52	1,250	4.16%
TTSH	72	1,481	4.86%
NTFGH	29	557	5.21%
CDC	18	299	6.02%
NHC	25	185	13.51%

## Annex A

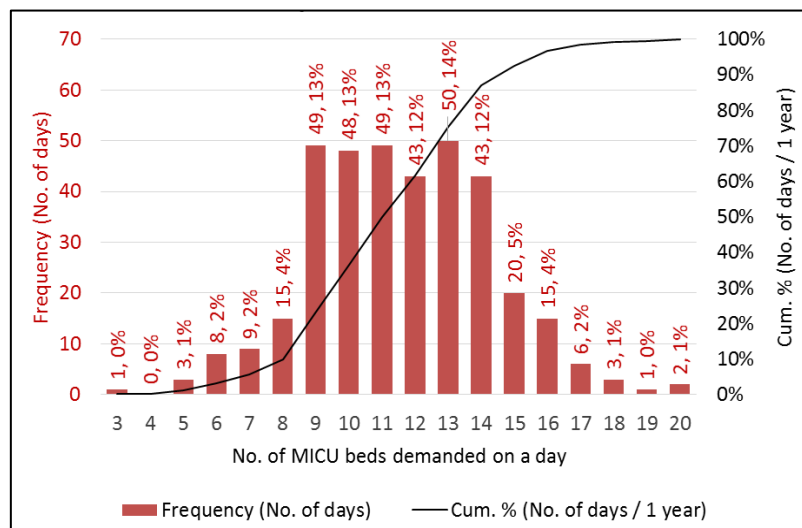


Figure 1

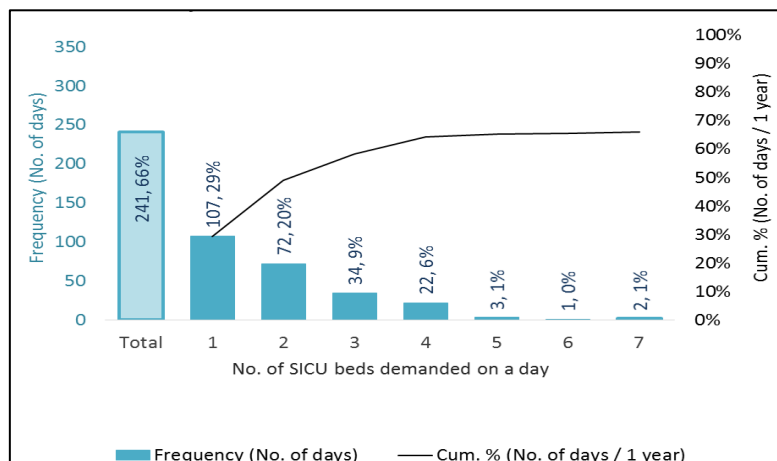


Figure 2

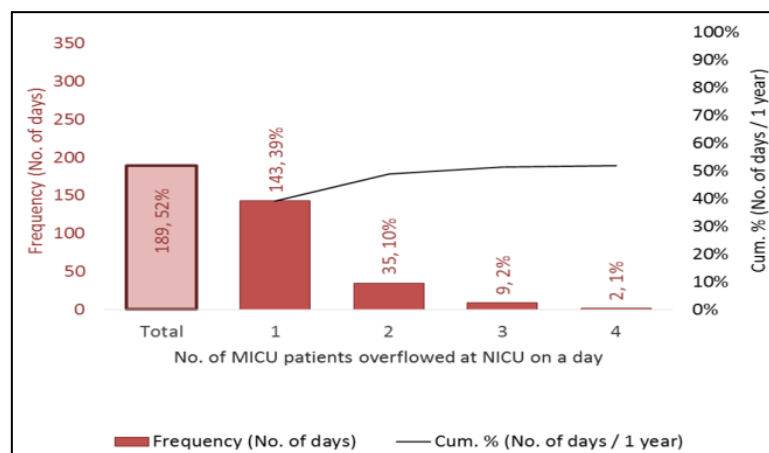
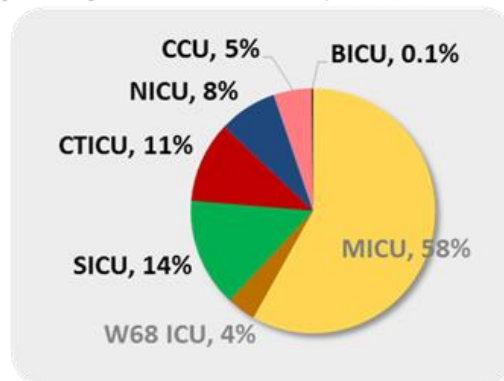


Figure 3

## Annex A

*By no. of ICU admissions (38% overflow)*



MICU patients at W68 ICU are not considered as overflows as they are rightly sited there.

**Figure 4**