Malaysian Registry of Intensive Care

Report for 2015

Malaysian Registry of Intensive Care

Report for 2015

Prepared by

Dato' Dr Jenny Tong May Geok

Dr Tai Li Ling

Dr Tan Cheng Cheng

Dr Lim Chew Har

Dr Nahla Irtiza bt Ismail

Technical Committee of the
Malaysian Registry of Intensive Care

June 2016

Published by:
Malaysian Registry of Intensive Care
Clinical Research Centre
Ministry of Health Malaysia

Suggested citation:
Jenny Tong May Geok, Tai Li Ling, Tan Cheng Cheng, Lim Chew Har, Nahla Irtiza bt Ismail
Malaysian Registry of Intensive Care 2015 report

Electronic version:
This report can be downloaded at MRIC website: www.mric.org.my

CONTENTS

REPORT SUMMARY

This is the report on all intensive care admissions to the 50 participating centres from 1st January to 31st December 2015.

The following are the main findings:

1. The total number of ICU beds in the 49 MOH participating units was 660 with a median bed occupancy rate of 91.6%.

2. The number of cases analysed was 39,595, an increase of 4% over the previous year.

3. The percentage of patients denied admission due to the unavailability of ICU beds was 32%. This figure had remained fairly the same in the last five years.

4. The average age of the patients, excluding those below 18 years, was 49.5 years.

5. The average duration of ICU and hospital stay was 4.8 and 14.4 days respectively.

6. In MOH hospitals, 69% of ICU admissions were non-operative patients.

7. Direct admissions to MOH ICUs from the emergency department had increased almost three-fold over the past 10 years from 10% in 2005 to 33% in 2015.

8. Dengue infection, sepsis and head injury were the three most common diagnoses leading to ICU admission in MOH hospitals in 2015. The in-hospital mortality rates for this group of patients were 8.9%, 51.2% and 22.0%respectively.

9. The average SAPS II score was 36.8, which carries a predicted in-hospital mortality of 30.4%.

10. In MOH hospitals, 75% of patients received invasive ventilation with an average duration of 4.7 days.

11. The percentage of patients who received non-invasive ventilation increased more than three-fold from 5.1% in 2005 to 18.6% in 2015.

12. The incidence of ventilator-associated pneumonia in MOH ICUs had decreased by more than half, from 6.8 to 2.4 per 1000 ventilator days, in the last five years.

13. The incidence of central venous catheter-related bloodstream infection in MOH ICUs was 0.8, 0.7 and 0.4 per 1000 catheter days for 2013, 2014 and 2015 respectively

14. The crude in-ICU and in-hospital mortality rates for MOH hospitals were 18.8% and 26.5% respectively.

15. The crude in-ICU and in-hospital mortality rates for UMMC were 18.4% and 25.8% respectively.

16. The mean standardised mortality ratio was 0.69 [95%C.I. 0.47–0.95] and 0.68 [95%C.I.0.45 – 0.98] for MOH and UMMC ICUs respectively.

ACKNOWLEDGEMENT

The Technical Committee of the Malaysian Registry of Intensive Care would like to thank the following:

All site investigators and source data providers

The heads of Department of Anaesthesia and Intensive Care of participating ICUs

Staff of the participating ICUs

Quality of Health Care Unit, Medical Development Division, Ministry of Health

National Clinical Research Centre, Ministry of Health

Health Informatics Centre, Planning and Development Division, Ministry of Health

Malaysian Society of Intensive Care

All who have contributed in one way or another to the MRIC

FOREWORD

Time really flies and I have been given another opportunity for me to write the foreword for the MRIC report. This message is filled with pride for the tremendous achievements by this group of hardworking intensivists who have consistently produced annual reports that has been a reference source for the Ministry of Health for the continuous improvement in the delivery of critical care services to patients.

This report includes all intensive care admissions to the 50 participating centres from 1st January to 31st December 2015. The total number of ICU beds in the 49 MOH participating centres was 660, with a median bed occupancy of 91.6%. The number of cases analysed for year 2015 was 39,595, an increase of 1.7% over the previous year. The percentage of patients denied admission due to the unavailability of ICU beds was 32% in 2015.

Dengue infection, sepsis and head injury were the three most common diagnoses leading to ICU admission. 75%of patients in MOH ICUs received invasive ventilation with an average duration of 4.7 days. The percentage of patients who received non-invasive ventilation increased from 5.1% in 2005 to 18.6% in 2015 displaying the preferential trend towards non invasive ventilation. The incidence of VAP had decreased by more than half from 6.8 to 2.4 per 1000 ventilator days over the last five years.

All the MOH ICUs have in place several quality indicators: Ventilator Care Bundle, Central Venous Catheter Care Bundle, Early Mobility in ICU and the SSKIN bundle. I believe that the implementation of these quality indicators will improve the outcome of the patients in ICU.

I take this opportunity to thank Dato' Dr Jenny Tong May Geok, Dr Tai Li Ling, Dr Lim Chew Har, Dr Tan Cheng Cheng, Dr Nahla Irtiza Ismail and Sister Lim Siew Kim for working together to produce this report. I want to acknowledge the hard work of all the site investigators and source data collectors who have contributed to the registry. I also want to express my thanks to the National Clinical Research Centre, Health Informatics Centre, Ministry of Health and Medical Development Division, Ministry of Health for their continued guidance and support.

Dr. Sivasakthi V
Head of the Anaesthesia and Intensive Care Services
Ministry of Health Malaysia

TECHNICAL COMMITTEE
MALAYSIAN REGISTRY OF INTENSIVE CARE 2015

Advisors	Datin Dr Sivasakthi Velayuthapillai Consultant Anaesthesiologist and Head Department of Anaesthesia and Intensive Care Hospital Kuala Lumpur
Principal Investigator	Dato' Dr Jenny Tong May Geok Consultant Anaesthesiologist and Head Department of Anaesthesia and Intensive Care Hospital Tuanku Ja'afar Seremban
Co-Investigators	Dr Tai Li Ling Consultant Intensivist Department of Anaesthesia and Intensive Care Hospital Kuala Lumpur
	Dr Tan Cheng Cheng Consultant Intensivist Department of Anaesthesia and Intensive Care Hospital Sultanah Aminah Johor Bahru
	Dr As-Niza Abdul Shukor Consultant Anaesthesiologist and Head Department of Anaesthesia and Intensive Care Hospital Taiping
	Dr Ahmad Shaltut Othman Consultant Intensivist Department of Anaesthesia and Intensive Care Hospital Sultanah Bahiyah Alor Setar
	Dr Lim Chew Har Consultant Intensivist Department of Anaesthesia and Intensive Care Hospital Pulau Pinang
Project Manager	Sr Lim Siew Kim Department of Anaesthesia and Intensive Care Hospital Kuala Lumpur

PARTICIPATING HOSPITALS

No.	Name of hospital	Abbreviation
Sites since 2002		
1.	Hospital Sultanah Bahiyah Alor Setar	AS
2.	Hospital Pulau Pinang	PP
3.	Hospital Raja Permaisuri Bainun Ipoh	IPH
4.	Hospital Kuala Lumpur	KL
5.	Hospital Selayang	SLG
6.	Hospital Tengku Ampuan Rahimah Klang	KLG
7.	Hospital Tuanku Ja'afar Seremban	SBN
8.	Hospital Melaka	MLK
9.	Hospital Sultanah Aminah Johor Bahru	JB
10.	Hospital Tengku Ampuan Afzan Kuantan	KTN
11.	Hospital Sultanah Nur Zahirah Kuala Terengganu	KT
12.	Hospital Raja Perempuan Zainab II Kota Bharu	KB
13.	Hospital Umum Sarawak Kuching	KCH
14.	Hospital Queen Elizabeth Kota Kinabalu	KK
Sites since 2005		
15.	Hospital Sultan Abdul Halim Sungai Petani	SP
16.	Hospital Putrajaya	PJY
17.	Hospital Pakar Sultanah Fatimah Muar	MUR
18.	Hospital Teluk Intan	TI
19.	Hospital Taiping	TPG
20.	Hospital Seberang Jaya	SJ
21.	Hospital Kajang	KJG
22.	Hospital Tuanku Fauziah Kangar	KGR
Sites since 2006		
23.	Hospital Sultan Haji Ahmad Shah Temerloh	TML
24.	Hospital Tuanku Ampuan Najihah Kuala Pilah	KP
25.	Hospital Sri Manjung	SMJ
26.	Hospital Batu Pahat	BP

27.	Hospital Tawau	TW
28.	Hospital Miri	MRI
29.	Hospital Kulim	KLM
30.	Hospital Serdang	SDG
Sites since 2010		
31.	Hospital Sibu	SB
32.	Hospital Duchess of Kent Sandakan	DKS
33.	Hospital Sultan Ismail Johor Bahru	SI
34.	Hospital Sungai Buloh	SBL
35.	Hospital Ampang	AMP
36.	Hospital Wanita dan Kanak-Kanak Sabah	LIK
Sites since 2012		
37.	University Malaya Medical Centre	UMMC
38.	Langkawi	LKW
39.	Bukit Mertajam	BM
40.	Slim River	SLR
41.	Port Dickson	PD
42.	Kuala Krai	KKR
43.	Segamat	SGT
44.	Tanah Merah	TM
45.	Kemaman	KEM
46.	Kuala Lipis	KLP
47.	Labuan	LAB
48.	Keningau	KEN
49.	Bintulu	BIN
50.	Lahad Datu	LD

CATEGORIES OF ICU

Based on the number of ICU admissions in 2015, for the purpose of MRIC 2015 report

Participating sites		Number of admissions
Participating sites with ≥ 1000 admissions		
1	Hospital Sungai Buloh	2313
2	Hospital Tengku Ampuan Rahimah Klang	2184
3	Hospital Kuala Lumpur	1985
4	Hospital Sultanah Aminah Johor Bharu	1719
5	Hospital Sultan Ismail Johor Bahru	1473
6	Hospital Melaka	1430
7	Hospital Sultanah Nur Zahirah Kuala Terengganu	1398
8	Hospital Selayang	1392
9	Hospital Sultanah Bahiyah Alor Setar	1363
10	Hospital Raja Permaisuri Bainun Ipoh	1328
11	Hospital Sibu	1275
12	Hospital Raja Perempuan Zainab II Kota Bharu	1267
13	Hospital Pulau Pinang	1172
14	Hospital Umum Sarawak Kuching	1143
15	Hospital Taiping	1126
16	Hospital Tengku Ampuan Afzan Kuantan	1043
17	Hospital Sultan Abdul Halim Sungai Petani	1015
Participating sites with 500 - 999 admissions		
18	Hospital Queen Elizabeth Kota Kinabalu	925
19	Hospital Duchess of Kent Sandakan	923
20	Hospital Sultan Haji Ahmad Shah Temerloh	828
21	Hospital Putrajaya	764
22	Hospital Serdang	756
23	Hospital Ampang	671
24	Hospital Pakar Sultanah Fatimah Muar	611
25	Hospital Sultanah Nora Ismail Batu Pahat	546
26	Hospital Tuanku Ampuan Najihah Kuala Pilah	545
27	Hospital Tuanku Ja'afar Seremban	542
28	Hospital Kulim	526

Participating sites with < 500 admissions		
29	Hospital Seberang Jaya	475
30	Hospital Kajang	464
31	Hospital Tawau	444
32	Hospital Sri Manjung	441
33	Hospital Teluk Intan	424
34	Hospital Kuala Krai	391
35	Hospital Miri	377
36	Hospital Tuanku Fauziah Kangar	355
37	Hospital Bintulu	315
38	Hospital Tanah Merah	308
39	Hospital Segamat	290
40	Hospital Port Dickson	230
41	Hospital Bukit Mertajam	218
42	Hospital Slim River	201
43	Hospital Langkawi	195
44	Hospital Labuan	184
45	Hospital Kemaman	179
46	Hospital Wanita dan Kanak-Kanak Sabah	154
47	Hospital Lahad Datu	150
48	Hospital Keningau	136
49	Hospital Kuala Lipis	107
University hospital		
50	University Malaya Medical Centre	1294

LIST OF SITE INVESTIGATORS AND SOURCE DATA COLLECTORS

January – December 2015

No	Hospital	Site investigator	Source data collectors
1	Sultanah Bahiyah Alor Setar	Dr Ahmad Shaltut Othman	Sr Teoh Shook Lian SN Hafisoh Ahmad SN Haslina Khalid SN Noorazimah Salleh SN Faten Ramiza Ahmad Abdullah
2	Pulau Pinang	Dr Lim Chew Har	SN Siti Hazlina Bidin SN Rosmawati Yusoff SN Emeelia Zuzana Abdul Wahab
3	Raja Permaisuri Bainun Ipoh	Dr Foong Kit Weng	SN Saadiah Bidin SN Ng Pek Yoong SN Thila
4	Kuala Lumpur	Dr Tai Li Ling	SN Ismee Jusoh SN Nuradzlinda Saidin
5	Selayang	Dr Laila Kamariah Kamalul Baharin	SN Marliana Arshad
6	Tengku Ampuan Rahimah Klang	Dr Sheliza Wahab	SN Latifah Omar SN Tai Yoke Ching SN Rosenah Abdul Rahman
7	Tuanku Ja'afar Seremban	Dato' Dr Jenny Tong May Geok	SN Farawahida Ahmad
8	Melaka	Dr Nahla Irtiza Ismail	Sr Zaliha Emperan SN Norina Abd Kadir
9	Sultanah Aminah Johor Bahru	Dr Tan Cheng Cheng	Sr Marian Sais ak Sipit SN Aishah Abu Bakar AMO Mohd Adib Jasni AMO Anand Sivasamy AMO Hidayah Hussin
10	Tengku Ampuan Afzan Kuantan	Dr Hafizah Mohammad	Sr Gan Soo Heng SN Aminah Abd Hamid SN Nik Rosliza Nik Daud SN Linda Idris
11	Sultanah Nur Zahirah Kuala Terengganu	Dr Mohd Ridhwan Mohd Nor	SN Zauwiah Idris SN Aslinawati Chik
12	Raja Perempuan Zainab II Kota Bharu	Dr Wan Nasrudin Wan Ismail	Sr Azizum Ismail SN Roslita Abd Rahman
13	Umum Sarawak Kuching	Dr.Jamaidah Jamhuri	SN Sabia Lew SN Rosnica Jiton SN Sharon Ivy Gombek
14	Queen Elizabeth Kota Kinabalu	Dr Lily Ng Mooi Hang Dr Khoo Tien Meng	SN Conny Chong Chiew Fah SN Saihin Maun SN Suzie Tinus SN Winnie Yasin

15	Sultan Abdul Halim Sungai Petani	Dr Rosman Noor Ali	SN Zainun Awang
16	Putrajaya	Dr Fauziah Yusoff	Sr Latifah Mohd Korib SN Maznah Muhamad
17	Pakar Sultanah Fatimah Muar	Dr Suzaliatun Kasbullah	SN Mazlidah Osman SN Nurazlin Jawad SN Fazal Naim Ramli
18	Teluk Intan	Dr Noor Azira Haron	SN Azliza Zakaria SN Rohayu Dalila Yusof
19	Taiping	Dr As-Niza Abdul Shukor	SN Salihah Ahmad SN Che Zakiah Othman SN Rozieyana Mohd Razali
20	Seberang Jaya	Dr Vellan Sinnathamby	SN Siti Noormi Ahmad SN Mira Nabila Ramlan
21	Kajang	Dr Nursuhaila Mohd Amin	SN Normaizana Ismail SN Rosnani binti Ab.Latip SN Suriani Mat Saad
22	Tuanku Fauziah Kangar	Dr Azilah Desa	Sr Che Salma Abdul Rahman SN Zarina Mat Bistaman SN Norazlisyan Ramli SN Norshaheera Nalini
23	Sultan Haji Ahmad Shah Temerloh	Dr Rahimah Haron	Sr Rakiah Mohd Noor SN Norliza Ismail SN Rohayu Yusof
24	Tuanku Ampuan Najihah Kuala Pilah	Dr Zalifah Nordin	SN Norhafidah Ismail Sr Khadijah Md Taher
25	Sri Manjung	Dr Khairudin Zainal Abidin	Sr Hartini Abd Rahman SN Salbiah Abdul Rashid SN Norfaizal Abdul Majid
26	Batu Pahat	Dr Nasrudin Bunasir	SN Norhaezah Jani
27	Tawau	Dr Sein Win	SN Lilybeth Feliciano Ferez SN Sarwah Isa SN Sharifah Maznah Habib Muhammad
28	Miri	Dr Norhuzaimah Julai Abdul Julaihi	SN Noriah Ilai SN Zuriha Achim
29	Kulim	Dr Chua Kok Boon	Sr Mahani binti Hassan SN Mohana Omar SN Bahayah Mohamed Bakari SN Che Asmah Haji Md Isa
30	Serdang	Dr Nazarinna Muhamad	Sr Siti Ainah Buang SN Sarina Jamhari
31	Sibu	Dr Anita Alias	SN Yong Suk Moi
32	Duchess of Kent Sandakan	Dr Rusnah Abd Rahman	Sr Noorasmah Hassim SN Norahimah Dulraman SN Sofiah Yampi

33	Sultan Ismail Johor Bahru	Dr Azmin Huda Abd Rahim	Sr Azleena Mohd Yusop SN Norelessa Abd Aziz SN Salina Idris SN Khashikin Wahab SN Amira Ruduan
34	Sungai Buloh	Dr Shanti Ratnam	Matron Sri Jayanthi Gobalan SN Siti Salwa Mohd Latif
35	Ampang	Dr Rusnah Ab.Latif	Sr Normazlin Md Derus SN Amiza Dyana Abu Amin SN Asilah Fatin SN Juliana Ismail
36	Wanita dan Kanak-Kanak Sabah	Dr Lorrain Lim Tze Chi	Sr Siti Rajiah bt Muslimin SN Dayang Noreenz Mohd Yusoh SN Yusnita bt Yunus
37	University Malaya Medical Centre	Dr Vineya Rai Dr Mohd Shahnaz Hassan Dr Mohd Idzwan Zakaria	Matron Azizah Md Lajis MLT Nur Aina Muhamad Affandi
38	Langkawi	Dr Suriana Mohd Abu Bakar	Sr Hamiza Harun
39	Bukit Mertajam	Dr Vellan Sinnathamby	Sr Norhizan Ab Tholib SN Lai Lian Chooi
40	Slim River	Dr Tin Tin Myint	Sr Khairol Nazimah Musa SN Suliati Baghdadi
41	Port Dickson	Dr Hema Malini Manogharan	Sr Hapisah Mat SN Muhazni Mohammad
42	Kuala Krai	Dr Norhafidza Ghazali	Sr Norlela Ismail SN Salma Ismail
43	Segamat	Dr Zawiyah Kassim	Sr Hasneyza Baharin
44	Tanah Merah	Dr Mohd Azmi Mamat	Sr Norzilawati Ramli
45	Kemaman	Dr Ahmad Nizam Ismail	Sr Rosmazariawati Zahari SN Inu-Zubaini Mohammad Zain
46	Kuala Lipis	Dr Sharihanim Hussain	Sr Potchaine Ek Kam SN Nik Arienti Nik Man SN Rohaida Ibrahim
47	Labuan	Dr Betty Shee Ching Lee	Sr Roslin Akiu Sr Eramanis Abd Hamid SN Hafizah Ejab
48	Keningau	Dr Maswiana Abdul Majid	Sr Haineh Amin SN Aine Gadol
49	Bintulu	Dr Hairatun Ida Md Hamzah (till Aug 2015) Dr Soon Chien Chang	Sr Jennifer Anak Sahim SN Ann Lampung SN Maureen Lee Pheey SN Ubong Atan Tze
50	Lahad Datu	Dr Mohd Rohaizad Zamri	Sr Sanisah Lakim SN Mesrah Nordin SN Sasalinnah Salim

ABBREVIATIONS

Adm.	Admission
AKI	Acute kidney injury
ALI	Acute lung injury
AMO	Assistant medical officer
AOR	At own risk
APACHE II	Acute Physiologic and Chronic Health Evaluation (Version II)
ARDS	Acute respiratory distress syndrome
BOR	Bed occupancy rate
CRBSI	Catheter-related bloodstream infection
CRE	Carbapenem-resistant Enterobacteriaceae
CRRT	Continuous renal replacement therapy
CVC	Central venous catheter
CVC-BSI	Central venous catheter-related bloodstream infection
ED	Emergency department
ENT	Otorhinolaryngology
ESBL	Extended spectrum beta-lactamases
HD	Haemodialysis
HDU	High dependency unit
Hosp	Hospital
Hrs	Hours
ICU	Intensive care unit
MOH	Ministry of Health
MRIC	Malaysian Registry of Intensive Care
MRO	Multi-drug resistant organism
MRSA	Methicillin-resistant Staphylococcus aureus
MSSA	Methicillin-sensitive Staphylococcus aureus
NIV	Non-invasive ventilation
NHSN	National Healthcare Safety Network
No./n	Number
O&G	Obstetrics & Gynaecology
$PaCO_2$	Partial pressure of arterial carbon dioxide
PaO_2	Partial pressure of arterial oxygen
Refer.	Referred
SAPS II	Simplified Acute Physiologic Scoring System (Version II)
SD	Standard deviation
SIRS	Systemic inflammatory response syndrome
SMR	Standardised mortality ratio
SN	Staff nurse
SOFA	Sequential Organ Failure Assessment
Sr	Sister
SPSS	Statistical Package for Social Sciences
VAP	Ventilator-associated pneumonia
VCB	Ventilator care bundle
VRSA	Vancomycin-resistant Staphylococcus aureus
Yrs	Years

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The National Audit on Adult Intensive Care Units (NAICU) was established in 2002 as a quality improvement initiative to systematically review the intensive care practices in Malaysia and where possible, to introduce remedial measures to improve outcome. To date, this audit has published twelve yearly reports and introduced several quality measures such as ventilator care bundle, central venous catheter care bundle, early mobility in ICU and the SSKIN bundle.

In 2009, the NAICU was renamed the Malaysian Registry of Intensive Care (MRIC). This report is the eighth for MRIC, but thirteenth in the series.

The objectives of this registry are to:

1. Establish a database of patients admitted to the adult ICUs
2. Review the clinical practices of intensive care
3. Determine clinical outcome
4. Determine the resources and delivery of intensive care service
5. Evaluate the impact of quality improvement measures on patient care
6. Provide comparisons of performance of participating centres against national and international standards
7. Conduct healthcare research related to intensive care

In 2002, 14 state hospitals were first recruited into the audit. The number of centres increased to 22 in 2005. In 2006, 9 more centres were added to the list of participating sites, including one private hospital in Selangor. In 2010, 6 more centres were added to the list of 31 participating hospitals. In 2012, the total number of participating centres expanded to 51 with 49 MOH hospitals, 1 private hospital and 1 university hospital. In 2015, the private hospital withdrew from the registry.

This report describes the intensive care practices and outcomes in 49 ICUs in MOH and 1 ICU in a university hospital.

Data Collection and Verification

Data were collected prospectively by trained nurses (source data providers) and specialists (site investigators) based on a written protocol. Data was initially collected on a standard e-case report form for each patient. Since 1st January 2010, data were entered directly in a central depository via a web-based programme by individual centres.

All participating centres were to ensure "accuracy and completeness" of their individual databases.

Merged data were 'cleaned' and verified before being analysed using SPSS version 20.0.0. This report is based on all admissions into the 50 participating ICUs from 1st January to 31st December 2015. The total number of admissions in 2015 was 41,065 out of which 1470 (3.6%) were readmissions. For patients with multiple ICU admissions, only the first admission was included in the analysis. Hence, analysis was done on 39,595 admissions.

Due to missing and inconsistent data, the sum total of some variables shown in the tables may not add up to the actual number of admissions.

Data Limitations

Limitations to the registry data were mainly related to data collection and data entry. Some of the participating ICUs experienced rapid turnover of their site investigators and source data providers resulting in under-reporting and data inconsistencies. Data from several centres with low reporting rates were excluded from some of the analysis of the variables.

Format of Report

The format of this report follows the patient's journey in four sections: demographics, interventions, complications and outcomes. Information is reported on a total of 39,595 ICU admissions.

In this report, information was provided for individual centres. Wherever appropriate, comparisons were made between three categories of hospitals based on the number of ICU admissions. MOH hospitals were divided into three categories: centres with 1000 admissions and more, centres with 500 to 999 admissions and those with less than 500 admissions.

Where relevant, trends of certain variables over the years were reported.

This report also includes ICU admissions for dengue infection, central venous care bundle compliance, central venous catheter-related bloodstream infections, early mobility in ICU compliance and compliance to the SSKIN bundle in MOH participating centres.

SECTION A:

GENERAL INFORMATION

1. Number of ICU beds
2. Bed occupancy rates
3. ICU admissions
4. Reporting rates
5. Intensive care referrals

Table 1 : No. of ICU beds and bed occupancy rate, by MOH hospitals 2011–2015

Hospital	Number of functional ICU beds (as of 31-12-2015)	Median ICU bed occupancy rate %				
		2011	2012	2013	2014	2015
AS	24	87.0	96.7	93.3	88.8	86.1
PP	23	89.9	88.7	90.9	90.5	94.0
IPH	26	107.0	106.0	104.0	109.0	107.0
KL	43	107.5	111.7	110.6	114.1	112.7
SLG	25	111.4	99.8	101.8	92.7	99.2
KLG	32	87.8	108.3	105.9	112.9	110.8
SBN	8	118.4	114.6	108.3	111.7	112.5
MLK	22	106.0	107.9	97.5	90.7	91.6
JB	32	106.2	105.6	109.4	109.0	107.9
KTN	21	105.2	106.4	106.5	110.3	127.7
KT	21	102.0	103.6	104.6	94.2	105.2
KB	21	80.8	80.0	96.2	109.2	92.2
KCH	15	116.6	125.9	101.0	107.6	104.5
KK	23	101.7	93.4	95.9	90.9	98.6
SP	16	84.6	84.9	92.5	82.7	80.3
PJY	11	78.2	75.2	71.2	84.7	94.7
MUR	8	82.4	97.5	97.5	94.2	90.1
TI	4	101.3	123.8	105.2	114.0	112.0
TPG	20	103.2	92.7	84.7	81.4	102.0
SJ	10	89.6	99.1	80.2	81.3	101.0
KJG	6	78.9	77.2	77.1	84.2	82.5
KGR	5	63.3	77.3	78.1	80.8	94.5
TML	10	104.0	113.0	127.0	88.8	82.1
KP	8	68.5	61.8	72.4	91.7	80.9
SMJ	8	82.4	92.7	85.5	92.4	83.5
BP	7	69.0	87.0	79.6	74.8	72.0
TW	7	60.6	80.7	70.0	78.2	61.6
MRI	8	72.7	76.1	79.6	101.3	95.0
KLM	7	98.9	100.5	95.4	100.2	102.2
SDG	13	88.2	50.4	84.4	85.7	91.6
SB	17	99.2	60	120.5	144.0	151.7
DKS	18	87.9	87.9	99.1	82.2	79.2
SI	22	87.3	86.2	90.2	85.1	90.3
SBL	38	108.1	94.6	94.0	115.7	94.6
AMP	12	85.5	45.7	82.9	74.4	90.4
LIK	9	76.7	76.9	106.0	103.4	72.6
LKW	4	-	67.0	67.4	59.1	69.0
BM	7	-	65.6	106.8	100.9	110.5

SLR	**7**	**-**	76.0	71.0	79.3	76.0
PD	4	**-**	85.5	65.6	86.0	89.8
KKR	6	**-**	69.8	85.2	87.1	86.0
SGT	4	**-**	58.1	89.7	75.0	70.8
TM	5	**-**	68.7	74.0	113.2	151.4
KEM	2	**-**	59.6	50.9	-	-
KLP	3	**-**	21.8	53.0	54.2	82.6
LAB	5	**-**	30.7	41.2	45.5	48.5
KEN	4	**-**	90.4	78.0	80.3	70.0
BIN	5	**-**	88.3	63.2	59.7	57.0
LD	4	**-**	104.2	101.2	103.1	88.6
Total	**660**	**-**	**-**	**-**	**-**	
Median	**-**	**88.6**	**86.2**	**90.2**	**90.5**	**91.6**

The total number of ICU beds in the 49 MOH hospitals as of 31st December 2015 was 660 with a median bed occupancy rate (BOR) of 91.6%. There was a 3.6% increase (23 beds) in the number of ICU beds from the previous year.

The BOR was calculated based on throughput census and was reported to the head of the anaesthesia and intensive care services. There was a wide variation in the BOR across the centers. Seven hospitals, IPH, KL, SBN, JB, KTN, KCH and TI continuously had their bed occupancy rate more than 100% for the past 5 years while LAB had a consistently low BOR less than 50%. SB and TM had bed occupancy rates of more than 150%in 2015. KEM did not report their BOR for the past two years.

Bed occupancy is used as a measure to indicate the activity of a unit in terms of its maximum capacity. There are several methods of calculating bed occupancy and the impact of these methodological differences will tend to be greatest in specialised areas such as intensive care units, where the duration of admission is generally short but highly variable, and throughput is high. If it is measured in whole numbers of days, intensive care units can show an occupancy of greater than 100%, as more than one patient may use a particular bed on a given day.

It is believed that some MOH ICUs may still be using the "midnight count" method to calculate BOR and hence BOR maybe lower than if the throughput method was used.

Table 2 : ICU admissions, by individual hospital 2011 – 2015

Hospital	2011	2012	2013	2014	2015
	n (%)	n (%)	n(%)	n (%)	n (%)
AS	1212 (4.1)	1201 (3.5)	1347 (3.6)	1331 (3.4)	1363 (3.4)
PP	1198 (4.0)	1287 (3.8)	1121 (3.0)	1134 (2.9)	1172 (3.0)
IPH	1140 (3.8)	926 (2.7)	1203 (3.2)	1217 (3.1)	1328 (3.4)
KL	1842 (6.2)	1971 (5.8)	1905 (5.1)	2144 (5.5)	1985 (5.0)
SLG	1141 (3.8)	1289 (3.8)	1507 (4.0)	1426 (3.7)	1392 (3.5)
KLG	1608 (5.4)	2136 (6.3)	2065 (5.5)	2281 (5.9)	2184 (5.5)
SBN	554 (1.9)	537 (1.6)	471 (1.3)	541 (1.4)	542 (1.4)
MLK	1593 (5.3)	1694 (5.0)	1673 (4.5)	1432 (3.7)	1430 (3.6)
JB	1685 (5.7)	1752 (5.2)	1931 (5.2)	1687 (4.3)	1719 (4.3)
KTN	612 (2.1)	641 (1.9)	837 92.2)	1062 (2.7)	1043 (2.6)
KT	1207 (4.1)	1363 (4.0)	1180 (3.2)	1172 (3.0)	1398 (3.5)
KB	1125 (3.8)	1286 (3.8)	1337 (3.6)	1607 (4.1)	1267 (3.2)
KCH	643 (2.2)	854 (2.5)	950 (2.5)	1140 (2.9)	1143 (2.9)
KK	843 (2.8)	954 (2.8)	1022 (2.7)	987 (2.5)	925 (2.3)
SP	270 (0.9)	159 (0.5)	583 (1.6)	953 (2.4)	1015 (2.6)
PJY	537 (1.8)	574 (1.7)	606 (1.6)	654 (1.7)	764 (1.9)
MUR	473 (1.6)	636 (1.9)	675 (1.8)	600 (1.5)	611 (1.5)
TI	308 (1.0)	384 (1.1)	401 (1.1)	406 (1.0)	424 (1.1)
TPG	860 (2.9)	1203 (3.5)	1348 (3.6)	1182 (3.0)	1126 (2.8)
SJ	579 (1.9)	644 (1.9)	413 (1.1)	409 (1.1)	475 (1.2)
KJG	341 (1.1)	371 (1.1)	321 (0.9)	284 (0.7)	464 (1.2)
KGR	298 (1.0)	350 (1.1)	322 (0.9)	341 (0.9)	355 (0.9)
SJMC	2018 (6.8)	1467 (4.3)	1335 (3.6)	870 (2.2)	-
TML	543 (1.8)	436 (1.3)	599 (1.6)	837 (2.2)	828 (2.1)
KP	359 (1.2)	334 (1.0)	394 (1.1)	512 (1.3)	545 (1.4)
SMJ	380 (1.3)	403 (1.2)	376 (1.0)	432 (1.1)	441 (1.1)
BP	454 (1.5)	415 (1.2)	459 (1.2)	459 (1.2)	546 (1.4)
TW	274 (0.9)	433 (1.3)	449 (1.2)	498 (1.3)	444 (1.1)
MRI	385 (1.3)	478 (1.4)	481 (1.3)	428 (1.1)	377 (1.0)
KLM	498 (1.7)	601 (1.8)	561 (1.5)	555 (1.4)	526 (1.3)
SDG	883 (3.0)	875 (2.6)	851 (2.3)	835 (2.1)	756 (1.9)
SB	569 (1.9)	490 (1.4)	506 (1.4)	431 (1.1)	1275 (3.2)
DKS	526 (1.8)	526 (1.6)	964 (2.6)	950 (2.4)	923 (2.3)
SI	647 (2.2)	806 (2.4)	970 (2.6)	1131 (2.9)	1473 (3.7)
SBL	1260 (4.2)	1583 (4.7)	1922 (5.1)	2284 (5.9)	2313 (5.8)
AMP	553 (1.9)	572 (1.7)	566 (1.5)	634 (1.6)	671 (1.7)
LIK	376 (1.3)	270 (0.8)	517 (1.4)	353 (0.9)	154 (0.4)
UMMC	-	474 (1.4)	883 (2.4)	1344 (3.5)	1294 (3.3)

LKW	-	157 (0.5)	180 (0.5)	165 (0.4)	195 (0.5)
BM	-	38 (0.1)	158 (0.4)	141 (0.4)	218 (0.6)
SLR	-	154 (0.5)	225 (0.6)	223 (0.6)	201 (0.5)
PD	-	204 (0.6)	245 (0.7)	265 (0.7)	230 (0.6)
KKR	-	149 (0.4)	240 (0.6)	260 (0.7)	391 (1.0)
SGT	-	127 (0.4)	159 (0.4)	150 (0.4)	290 (0.7)
TM	-	17 (0.1)	127 (0.3)	160 (0.4)	308 (0.8)
KEM	-	94 (0.3)	105 (0.3)	91 (0.2)	179 (0.5)
KLP	-	7 (0.0)	116 (0.3)	96 (0.2)	107 (0.3)
LAB	-	107 (0.3)	165 (0.4)	166 (0.4)	184 (0.5)
KEN	-	82 (0.2)	161 (0.4)	144 (0.4)	136 (0.3)
BIN	-	213 (0.6)	260 (0.7)	283 (0.7)	315 (0.8)
LD	-	168 (0.5)	244 (0.7)	217 (0.6)	150 (0.4)
Total	**29794 (100)**	**33892 (100)**	**37436 (100)**	**38904 (100)**	**39595 (100)**

Figure 1 : ICU admissions 2003 – 2015

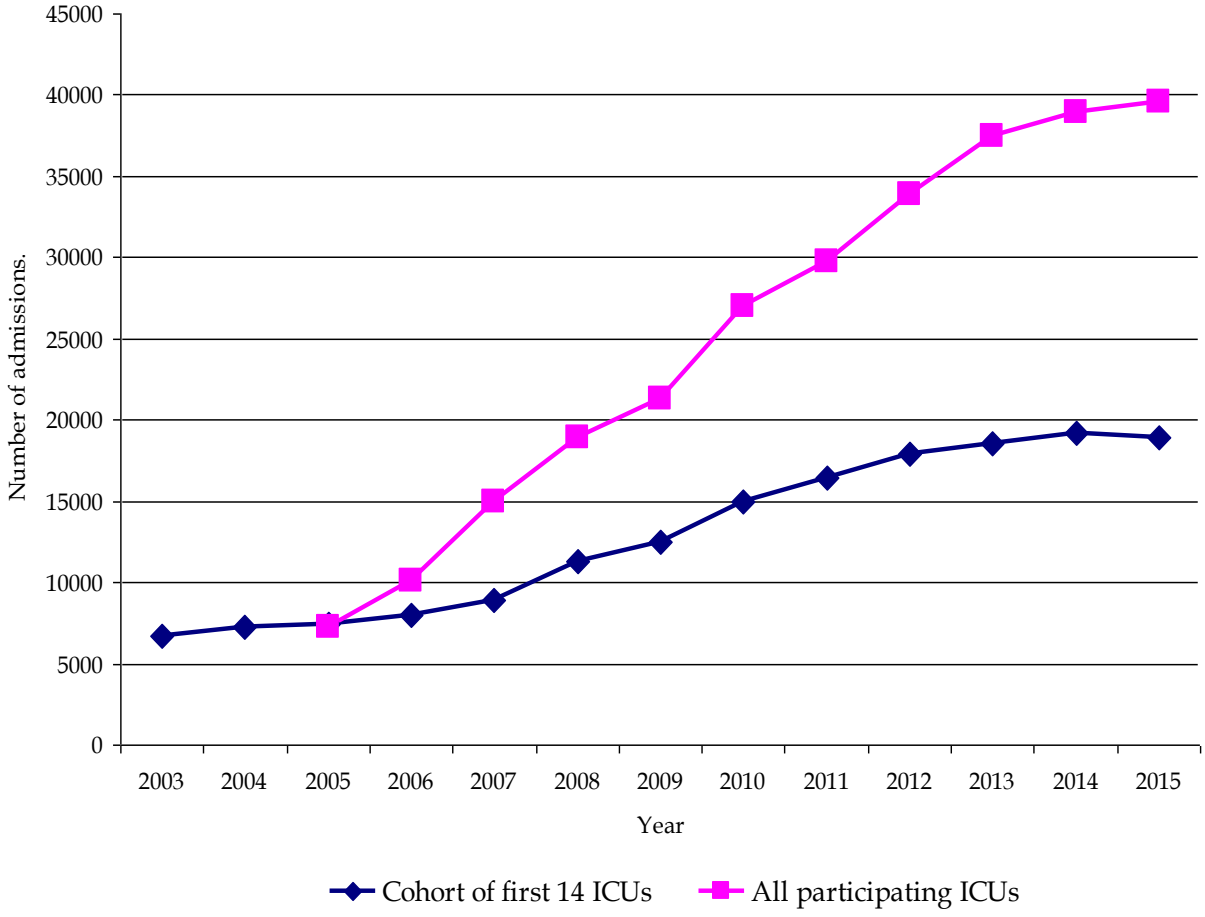
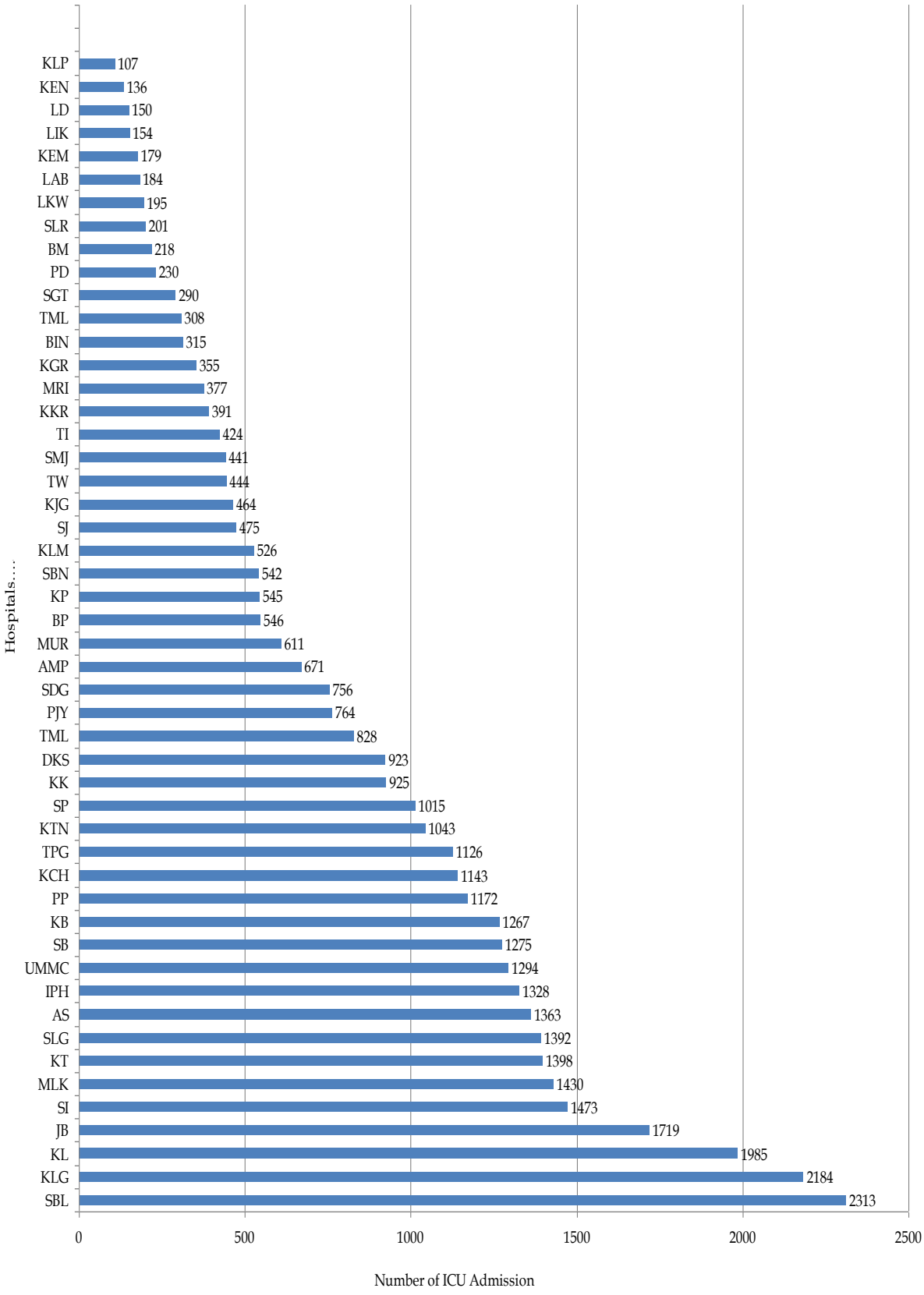


Figure 2 : ICU admissions, by participating centres 2015



The number of admissions had increased over the years in the MOH hospitals. There was an increase of 33% over the past five years from 2011 to 2015. This was attributed to the increase in the number of participating centres, increase in the number of ICU beds in the existing centres and an increase in ICU admissions.

For the initial cohort of 14 hospitals recruited in 2002, the number of admissions increased from 16,403 to 18,891 (an increase of 15%) over the last 5 years. There was an increase of 30% in the number of ICU beds from 259 to 336 over the same period of time for the same cohort.

Readmission within 48 hours is commonly used as an indicator of intensive care patient management, as it might reflect premature ICU discharge or substandard ward care. Although readmission is associated with high mortality, it is unclear whether it reflects substandard practices within a hospital. Low readmission rate may be due to inability to readmit patients due to unavailability of ICU beds.

The readmission rate within the first 48 hours of ICU discharge for the 49 MOH centres was 1.5% in 2015. This rate has varied from 1.3% to 2.1% over the past five years. This is one of the intensive care unit key performance indicators and the standard is set at less than 3%.

In a retrospective study done from 2001 to 2007, in 106 ICUs in United States of America, approximately 2% of ICU patients discharged to the ward were readmitted within 48 hours [1].

The Australian Council on Healthcare Standards reported a readmission rate of 1.68% from 2003 to 2010 [2].

Table 3 : Reporting rates, by individual hospital 2011 – 2015

Hospital	2011 %	2012 %	2013 %	2014 %	2015 %
AS	98.2	93.1	99.6	91.5	94.9
PP	90.1	96.2	92.2	94.1	94.4
IPH	99.2	97.5	95.9	91.0	97.7
KL	98.7	98.5	95.0	94.7	95.0
SLG	95.0	97.6	95.3	92.8	96.5
KLG	86.0	97.3	97.7	95.9	95.9
SBN	99.5	99.3	97.3	96.8	99.1
MLK	99.5	98.8	95.2	94.8	93.9
JB	99.8	97.2	95.7	95.4	97.2
KTN	99.0	97.2	124.4*	88.4	88.1
KT	99.8	99.1	95.0	90.4	95.2
KB	94.4	98.7	83.0	100.7*	92.7
KCH	94.3	95.3	89.6	93.2	95.3
KK	95.4	94.9	95.2	95.3	97.9
SP	53.1	30.8	106.0*	92.7	95.4
PJY	99.1	98.0	92.9	86.6	87.2
MUR	97.4	94.6	98.0	92.0	96.2
TI	98.4	91.2	90.3	94.0	96.4
TPG	94.0	99.3	95.5	94.3	82.1
SJ	98.5	98.3	85.7	73.4	39.8
KJG	95.5	99.7	75.2	57.7	90.6
KGR	98.1	98.6	94.2	95.5	97.5
TML	81.4	62.6	68.3	91.0	90.3
KP	100.0	66.4	51.0	94.6	88.5
SMJ	100.0	99.5	97.9	94.9	99.8
BP	98.5	97.9	106.3*	97.2	97.0
TW	91.7	98.6	95.5	94.0	96.7
MRI	88.5	99.2	97.6	78.0	69.8
KLM	98.9	98.5	94.1	92.2	93.8
SDG	94.9	90.5	108.4*	97.0	97.0
SB	73.1	70.0	46.7	25.7	92.2
DKS	99.6	95.5	92.7	90.3	92.6
SI	86.3	94.6	97.3	95.0	93.8
SBL	100.0	90.7	82.0	89.6	93.1
AMP	85.2	100.0	97.1	119.6*	97.4
LIK	60.9	57.4	80.7	59.9	27.0
LKW	-	69.8	87.4	82.5	97.0
BM	-	11.3	39.4	34.7	60.4
SLR	-	42.5	67.6	67.8	61.7

PD	-	84.0	93.2	92.7	96.6
KKR	-	87.1	94.9	102.4*	97.5
SGT	-	41.2	50.5	20.1	92.7
TM	-	22.4	104.1*	32.4	100.0
KEM	-	75.2	82.0	74.6	-
KLP	-	36.8	87.9	43.2	83.6
LAB	-	96.4	91.2	89.2	99.5
KEN	-	16.4	59.2	56.5	65.4
BIN	-	75.5	80.5	84.0	85.6
LD	-	67.2	92.4	83.5	61.0

** These hospitals had reporting rates more than 100%.*

The reporting rate is calculated by comparing the number of ICU admissions reported to the MRIC and to the national census, collected by the Head of Anaesthesia service. The total number reported to the MRIC should be equal or slightly less than that of the national census, as patients who were still in hospital on 31st January 2015 were excluded in the analysis.

The following hospitals have consistently contributed high reporting rates of over 90% over the last 5 years: AS, PP, IPH, KL, SLG, SBN, MLK, JB, KT, KB, KCH, KK, MUR, TI, KGR, SMJ, BP, TW, KLM, SDG, PD, KKR, LAB, DKS, SI and AMP.

The following hospitals had low reporting rates of less than 70% in 2015: LIK (27%), SJ (40%), BM (60%), LD (61%), SLR (62%), KEN (65%) and MRI (69.8%).

KEM did not report to the national census-hence reporting rate could not be obtained.

Figure 3 : Reporting rates by individual hospitals 2015

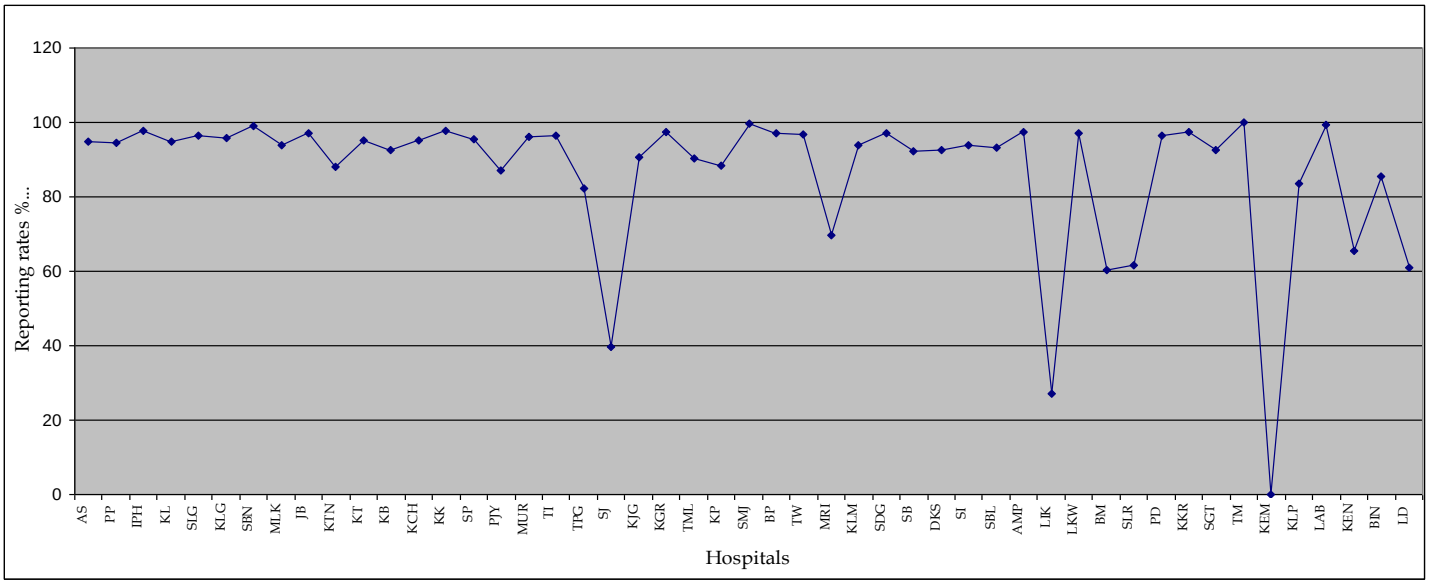


Table 4 : Intensive care referrals and refusal of admission, by individual hospital 2011 – 2015

Hosp	2011		2012		2013		2014		2015	
	No. refer.	% denied adm.	No. refer.	% denied adm.	No. refer.	% denied adm.	No. refer.	% denied adm.	No. refer.	% denied adm.
AS	*	*	*	*	*	*	*	*	*	*
PP	942	70.2	1329	67.8	1365	73.6	1145	66.1	1463	67.0
IPH	1525	66.7	1834	63.4	1639	70.2	1852	62.2	1781	65.8
KL	1971	32.8	2364	30.4	2515	30.1	3393	30.0	3294	31.5
SLG	448	27.2	1173	24.2	1537	35.3	1449	28.2	1498	35.7
KLG	2264	33.1	2458	21.2	2576	23.1	31.40	21.2	2882	20.9
SBN	2125	60.8	1929	56.0	1640	51.6	853	49.1	847	59.3
MLK	919	55.2	993	61.2	1285	73.9	2451	43.0	2444	50.2
JB	2069	39.8	2205	28.8	2634	33.7	2495	40.9	1333	36.5
KTN	791	42.4	455	39.6	608	40.0	241	29.5	224	39.7
KT	150	18.0	544	26.3	183	27.9	443	19.6	*	*
KB	1431	50.1	1417	41.5	1884	46.9	2817	46.8	2468	52.6
KCH	477	51.4	1132	57.8	1271	53.1	1474	52.7	1699	44.6
KK	1340	16.0	1282	13.0	1619	21.7	1364	17.9	1485	16.4
SP	*	*	254	44.1	562	46.1	74	21.6	*	*
PJY	*	*	36	5.6	486	0.6	*	*	*	*
MUR	685	31.4	903	34.3	1223	31.5	1368	28.7	1289	27.4
TI	54	40.7	170	42.9	156	49.1	440	49.3	585	60.3
TPG	958	0.5	1498	10.4	2004	12.4	1360	6.5	1657	12.4
SJ	625	31.2	592	34.1	813	41.7	657	28.9	489	32.9
KJG	67	19.4	*	*	488	22.1	145	37.9	52	28.9
KGR	201	20.4	405	12.8	390	16.7	397	15.1	260	12.3
TML	921	35.6	875	38.5	836	37.6	834	38.3	927	31.6
KP	412	7.3	412	9.7	587	21.8	684	14.0	780	14.0
SMJ	191	13.1	145	13.8	122	12.3	232	2.6	111	7.2
BP	454	2.6	372	2.2	458	3.7	443	1.1	529	0.6
TW	297	*	505	3.2	591	5.4	844	19.1	1026	21.5
MRI	81	18.5	132	4.6	335	22.4	61	13.1	15	33.3
KLM	509	2.9	710	5.2	699	10.7	730	6.6	825	20.9
SDG	712	14.2	506	22.9	1221	10.2	1525	12.0	1069	27.3
SB	*	*	*	*	565	22.5	506	22.7	1522	30.2
DKS	10	50.0	214	33.6	81	26.0	246	20.3	388	29.4
SI	635	34.8	547	21.4	734	31.7	484	28.5	111	27.9
SBL	*	*	689	17.4	636	14.8	1607	9.2	1588	11.3
AMP	149	39.6	716	26.7	1333	29.5	1419	21.9	1185	31.5
LIK	*	*	*	*	*	*	*	*	*	*
UMMC	-	-	657	57.5	955	41.8	55	34.6	*	*
LKW	-	-	*	*	171	0.6	*	*	*	*
BM	-	-	*	*	*	*	*	*	*	*

SLR	-	-	55	10.9	166	7.2	277	2.5	282	1.7
PD	-	-	216	7.4	249	1.6	288	0.7	247	13.0
KKR	-	-	49	24.5	105	27.6	263	36.5	242	23.1
SGT	-	-	*	*	*	*	*	*	*	*
TM	-	-	*	*	95	3.2	148	10.1	308	16.2
KEM	-	-	60	1.7	119	12.6	122	11.5	401	27.4
KLP	-	-	*	*	100	3.0	99	6.1	104	1.0
LAB	-	-	*	*	*	*	*	*	*	*
KEN	-	-	46	4.4	*	*	*	*	*	*
BIN	-	-	*	*	*	*	*	*	*	*
LD	-	-	*	*	*	*	67	43.3	252	34.9
Total	**25321**	**34.2**	**31341**	**32.0**	**37962**	**29.4**	**39586**	**29.8**	**38809**	**31.7**

* *Missing data*

The reason for ICU refusal for the purpose of this registry was limited to the unavailability of ICU beds. In 2015, 31.7% of patients were denied ICU admission.

Over the past five years, the percentage of patients denied ICU admission has not change much despite the overall increase in the number of ICU beds in most MOH hospitals.

In an observational prospective study, the ICU refusal rates varied greatly across ICUs in 11 hospitals in France ranging from 7.1 to 63.1%, with reasons for refusal as being too well to benefit, too sick to benefit and unavailability of ICU beds [3].

SECTION B:

PATIENT CHARACTERISTICS

1. Gender
2. Age
3. Ethnic groups
4. Length of ICU stay
5. Length of hospital stay
6. Referring units
7. Category of patients
8. Location before ICU admission
9. Organ failures
10. Diagnosis leading to ICU admission
11. Severe sepsis, ARDS and AKI within 24hrs of ICU admission
12. SAPS II score
13. SOFA score

Table 5 : Gender 2011-2015

Gender	2011 n (%)	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)
Male	17788 (59.7)	20295 (60.0)	22331 (59.7)	22926 (59.0)	23382 (59.2)
Female	11968 (40.2)	13554 (40.0)	15048 (40.3)	15895 (41.0)	16138 (40.8)

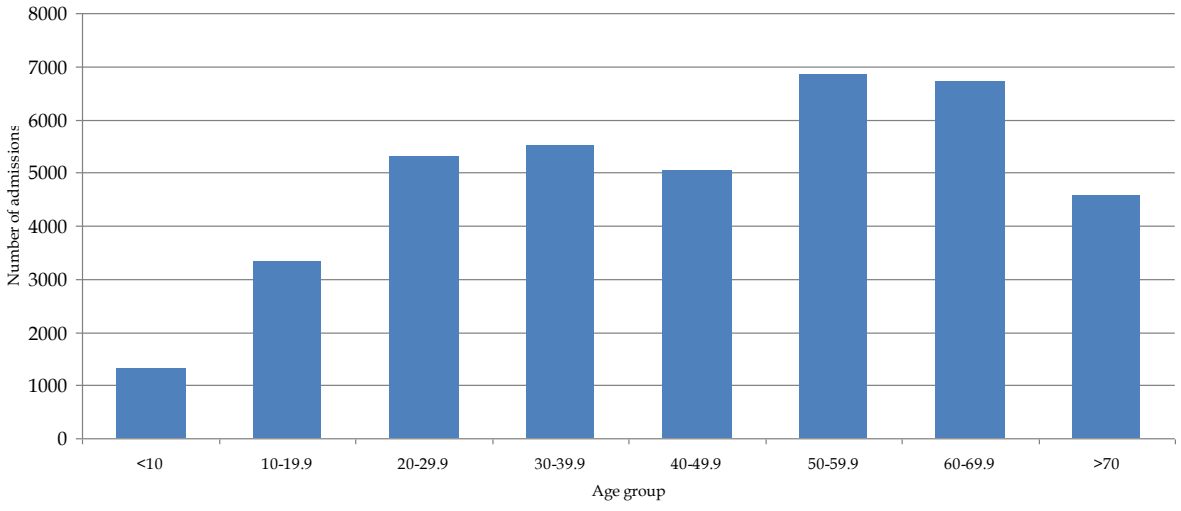
The ratio of male to female patients (3:2) has remained fairly constant over the past five years.

Table 6 : Mean age (years) 2011 – 2015

Age	2011	2012	2013	2014	2015
All ages, Mean ± SD yrs	46.5± 20.7	46.6 ± 20.7	46.5 ± 20.6	45.9 ± 20.6	45.9 ± 20.2
Age ≥ 18 years Mean ± SD yrs	50.2± 18.0	50.3 ± 17.8	50.3 ± 17.7	49.7 ± 17.8	49.5 ± 17.5

The average age for all age groups was 45.9 ± 20.2 years (median 47.8 years). For adult patients, with age exceeding 18 years, the average age was 49.5 ± 17.5 years (median 51.0 years). The average age of patients admitted to ICUs has remained fairly similar over the last five years.

Figure 4 : Age groups 2015

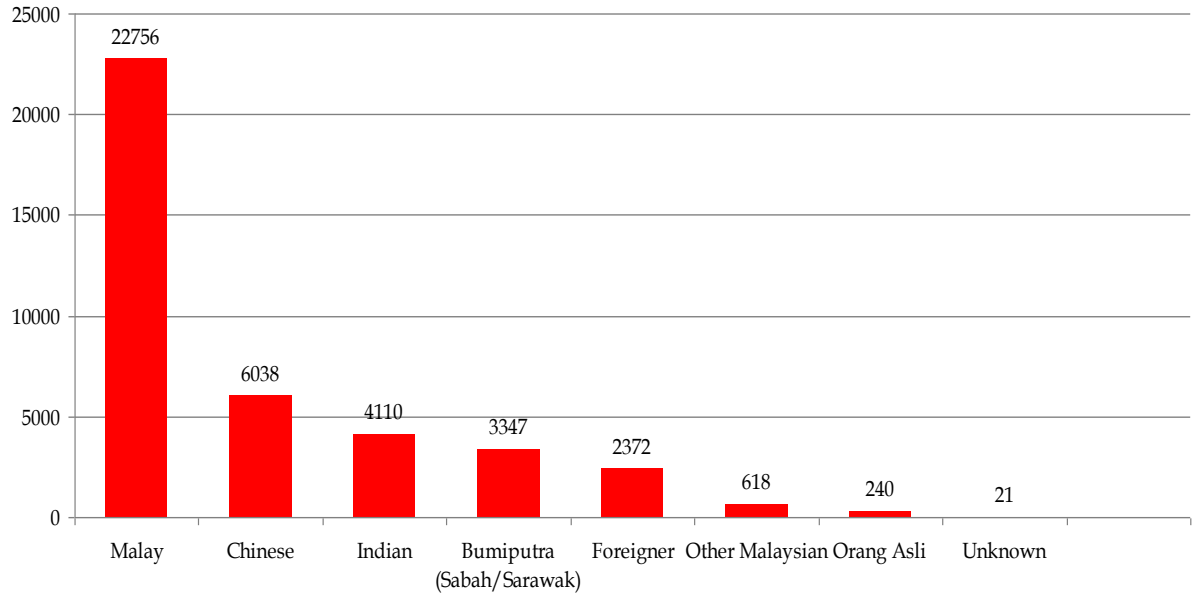


Geriatric patients (age 65 years and above) and paediatric patients (age less than 12 years) accounted for 20.3% and 3.8% of total admissions respectively in 2015. This may be due to the fact that many of the major hospitals have separate paediatric ICUs, and they do not participate in the MRIC.

Table 7 : Ethnic groups 2015

Ethnic group	n	%
Malay	22756	57.6
Chinese	6038	15.3
Indian	4110	10.4
Bumiputra Sabah/Sarawak	3347	8.4
Foreigner	2372	6.0
Other Malaysian	618	1.6
Orang Asli	240	0.6
Unknown	21	0.1
Total	**39,502**	**100**

Figure 5 : Ethnic groups 2015



The distribution of patients admitted to ICU reflected the distribution of the ethnic groups in the general population in Malaysia. Foreigners contributed 6% to the overall ICU admissions.

Table 8 : Length of ICU stay, by individual hospital 2011 – 2015

Hospital	Mean (Median), days				
	2011	2012	2013	2014	2015
AS	4.6 (2.8)	5.6 (3.1)	4.9 (2.9)	4.6 (2.8)	4.5 (2.7)
PP	5.1 (2.5)	5.4 (2.6)	5.9 (2.7)	6.2 (2.9)	6.1 (2.9)
IPH	5.3 (2.6)	5.5 (2.9)	5.9 (3.0)	6.1 (3.2)	6.4 (3.3)
KL	4.7 (2.8)	5.1 (2.8)	5.0 (2.7)	4.6 (2.4)	4.9 (2.5)
SLG	4.4 (2.4)	4.5 (2.6)	4.2 (2.0)	4.7 (2.5)	5.1 (2.5)
KLG	3.6 (2.0)	4.1 (2.1)	4.3 (1.9)	4.0 (2.0)	4.5 (2.2)
SBN	4.8 (2.7)	4.9 (2.7)	5.9 (2.9)	5.0 (2.7)	5.0 (2.7)
MLK	4.0 (2.7)	4.1 (2.1)	4.1 (2.1)	4.8 (2.5)	4.6 (2.6)
JB	5.2 (3.0)	5.2 (3.0)	4.7 (2.8)	5.4 (3.1)	5.4 (3.3)
KTN	6.3 (3.4)	6.3 (3.6)	5.6 (3.3)	5.5 (2.8)	6.1 (3.0)
KT	4.0 (2.3)	4.1 (2.2)	4.6 (2.7)	4.1 (2.1)	4.0 (2.0)
KB	4.7 (1.9)	4.7 (2.3)	4.9 (2.3)	4.2 (2.3)	5.4 (2.5)
KCH	5.6 (3.0)	5.2 (2.9)	4.7 (2.6)	3.9 (2.0)	4.0 (2.0)
KK	6.3 (3.7)	6.3 (3.8)	6.2 (3.6)	5.9 (3.6)	7.0 (3.9)
SP	4.0 (2.4)	7.6 (2.2)	4.7 (2.6)	4.8 (2.8)	4.5 (2.6)
PJY	3.2 (1.5)	3.2 (1.5)	3.5 (1.8)	3.9 (1.7)	3.8 (1.7)
MUR	4.8 (2.4)	3.5 (1.8)	3.0 (1.8)	3.7 (1.9)	3.1 (1.9)
TI	4.0 (2.0)	3.5 (2.1)	3.0 (1.8)	3.2 (1.7)	2.8 (1.6)
TPG	7.0 (3.7)	5.1 (2.7)	4.1 (2.7)	4.7 (2.6)	5.2 (2.7)
SJ	4.3 (2.1)	4.2 (2.1)	6.2 (3.1)	6.5 (3.5)	5.0 (2.5)
KJG	4.0 (2.7)	4.6 (2.9)	4.7 (3.2)	4.8 (3.1)	3.8 (2.6)
KGR	3.4 (1.7)	4.3 (2.1)	4.2 (2.6)	4.2 (2.1)	4.0 (2.4)
SJMC	2.4 (1.3)	2.7 (1.6)	2.6 (1.6)	2.5 (1.6)	-
TML	5.1 (3.0)	6.4 (3.5)	4.8 (2.6)	4.7 (2.7)	5.0 (2.8)
KP	5.8 (3.1)	5.7 (3.0)	5.5 (2.9)	4.7 (2.7)	4.1 (2.6)
SMJ	3.7 (2.3)	3.9 (2.5)	3.6 (2.2)	3.2 (1.9)	3.4 (2.1)
BP	4.3 (2.2)	5.7 (3.3)	4.5 (2.8)	4.4 (2.7)	3.7 (2.4)
TW	3.5 (2.2)	3.5 (2.4)	3.8 (2.5)	4.2 (2.5)	4.7 (2.4)
MRI	4.4 (2.3)	5.2 (2.5)	4.5 (2.6)	4.9 (3.0)	5.1 (3.7)
KLM	3.6 (2.0)	3.3 (1.9)	3.2 (1.7)	3.3 (1.8)	3.8 (2.0)
SDG	4.8 (2.7)	4.8 (2.8)	4.4 (2.2)	4.4 (2.4)	5.6 (2.7)
SB	4.7 (2.4)	5.1 (2.5)	5.4 (3.3)	6.8 (4.0)	4.0 (2.2)
DKS	6.0 (3.1)	5.1 (3.1)	4.5 (2.5)	3.7 (1.9)	4.7 (2.6)
SI	7.0 (3.7)	6.2 (3.3)	5.4 (2.7)	5.1 (2.6)	4.3 (2.1)
SBL	6.0 (3.2)	5.7 (3.1)	5.5 (3.1)	4.8 (2.7)	5.1 (3.0)
AMP	5.4 (3.2)	5.0 (2.9)	5.4 (2.9)	5.7 (3.0)	4.8 (2.7)
LIK	2.5 (1.6)	3.5 (1.8)	3.5 (1.9)	4.1 (2.6)	3.3 (2.0)
UMMC	-	7.2 (3.8)	5.6 (3.3)	5.5 (2.6)	5.9 (2.8)
LKW	-	5.3 (2.0)	4.1 (2.0)	3.7 (2.1)	4.6 (2.5)
BM	-	-	9.0 (4.3)	8.8 (5.6)	5.9 (3.4)
SLR	-	6.3 (3.2)	6.3 (3.0)	6.6 (3.0)	6.2 (3.0)
PD	-	4.0 (2.5)	4.4 (2.8)	3.5 (2.0)	4.7 (2.7)

KKR	-	5.6 (2.9)	5.7 (3.4)	5.8 (3.2)	5.0 (2.9)
SGT	-	4.5 (2.8)	3.3 (2.3)	3.7 (2.1)	3.1 (1.9)
TM	-	3.5 (1.9)	3.8 (2.5)	4.5 (3.3)	3.8 (2.4)
KEM	-	3.3 (2.6)	4.2 (2.8)	5.0 (2.6)	3.0 (2.1)
KLP	-	1.3 (0.8)	2.9 (1.5)	3.0 (2.0)	6.9 (3.2)
LAB	-	4.6 (2.2)	4.4 (1.9)	4.1 (1.8)	4.9 (2.8)
KEN	-	6.5 (2.9)	5.1 (2.9)	5.4 (3.0)	4.5 (2.9)
BIN	-	5.4 (2.8)	3.9 (2.1)	3.9 (2.3)	3.8 (2.2)
LD	-	5.7 (2.7)	4.8 (2.7)	5.1 (3.4)	6.1 (3.9)
Total	**4.7 (2.4)**	**4.8 (2.6)**	**4.7 (2.5)**	**4.7 (2.5)**	**4.8 (2.6)**

The average length of ICU stay in 2015 was 4.8 days. This has not changed much over the past 5 years.

The median length of stay was 2.6 days.

Among the MOH ICUs, TI had the shortest average length of stay (2.8 days). KK recorded the longest length of ICU stay (7.0 days).

Table 9 : Length of hospital stay, by individual hospital 2011 – 2015

Hospital	Mean (Median), days				
	2011	2012	2013	2014	2015
AS	14.5 (9.5)	15.1 (9.2)	14.6 (8.8)	13.1 (7.9)	13.4 (8.8)
PP	19.0 (11.5)	19.5 (12.0)	19.2 (12.0)	20.2 (12.5)	18.2 (11.9)
IPH	15.4 (9.3)	16.0 (10.6)	15.2 (9.8)	15.3 (10.0)	15.4 (9.8)
KL	19.1 (11.0)	17.7 (10.7)	16.5 (10.2)	14.8 (8.6)	15.3 (8.4)
SLG	16.7 (11.0)	17.3 (12.1)	15.2 (10.5)	15.2 (9.9)	16.5 (10.3)
KLG	13.6 (8.4)	12.2 (7.6)	12.5 (7.80	11.5 (7.4)	13.5 (8.4)
SBN	19.9 (11.0)	17.0 (10.6)	18.5 (10.7)	17.5 (10.4)	18.4 (11.1)
MLK	14.2 (9.3)	16.0 (10.0)	14.4 (8.6)	16.2 (9.6)	14.4 (8.7)
JB	14.6 (10.1)	14.7 (9.9)	13.6 (9.3)	14.2 (9.4)	13.5 (9.3)
KTN	17.1 (12.1)	18.0 (12.3)	15.8 (10.8)	16.6 (10.4)	15.8 (10.0)
KT	12.6 (8.3)	14.5 (9.7)	14.6 (9.80)	13.5 (8.8)	12.9 (8.5)
KB	14.5 (10.0)	16.5 (10.0)	14.4 (9.6)	12.0 (8.0)	16.1 (9.6)
KCH	20.5 (12.6)	21.4 (13.7)	19.2 (12.1)	19.5 (11.8)	19.4 (12.0)
KK	21.4 (14.1)	19.9 (11.7)	17.7 (11.1)	16.4 (10.9)	18.4 (10.8)
SP	10.8 (7.4)	14.0 (8.2)	12.9 (8.9)	12.6 (8.4)	11.9 (8.0)
PJY	11.6 (8.0)	11.7 (8.6)	13.2 (8.2)	12.4 (7.4)	12.4 (7.6)
MUR	16.3 (10.3)	22.0 (10.5)	13.6 (8.4)	13.6 (9.1)	13.7 (8.6)
TI	12.5 (8.4)	14.2 (9.6)	11.4 (8.2)	11.3 (7.5)	10.0 (7.0)
TPG	15.1 (10.3)	12.6 (8.3)	10.7 (7.8)	11.7 (8.0)	12.7 (8.2)
SJ	12.9 (9.1)	13.0 (8.2)	14.3 (9.7)	15.9 (11.1)	14.1 (9.1)
KJG	11.2 (7.9)	13.5 (8.3)	12.5 (8.6)	13.4 (8.7)	10.1 (7.0)
KGR	12.6 (8.2)	18.3 (10.9)	14.2 (9.7)	13.8 (7.9)	11.6 (8.6)
TML	14.6 (9.9)	14.5 (10.7)	13.1 (9.3)	11.9 (8.0)	11.8 (7.6)
KP	12.8 (8.7)	15.5 (9.3)	13.6 (8.5)	13.3 (8.0)	11.3 (7.1)
SMJ	12.1 (7.1)	12.0 (7.2)	10.5 (7.1)	8.4 (6.1)	9.2 (6.3)
BP	11.4 (8.0)	13.6 (9.5)	14.0 (9.0)	15.9 (9.7)	11.2 (7.6)
TW	15.3 (9.1)	13.0 (8.4)	14.1 (9.1)	13.5 (8.6)	13.7 (7.8)
MRI	15.0 (9.6)	14.0 (10.8)	12.4 (9.9)	13.1 (10.0)	14.8 (10.7)
KLM	11.4 (7.3)	12.6 (7.8)	11.7 (7.9)	11.6 (7.6)	13.2 (8.0)
SDG	14.7 (9.0)	14.6 (9.4)	14.3 (8.1)	13.2 (7.5)	14.8 (7.8)
SB	13.1 (8.1)	13.1 (8.3)	15.7 (10.5)	15.3 (10.0)	13.9 (8.3)
DKS	13.7 (10.1)	12.4 (8.2)	11.4 (7.6)	11.8 (6.8)	13.5 (8.0)
SI	19.7 (12.2)	16.0 (9.7)	14.6 (9.2)	15.3 (9.3)	13.4 (8.0)
SBL	19.5 (11.2)	19.2 (10.8)	17.0 (9.8)	15.4 (7.9)	16.3 (9.2)
AMP	15.1 (10.2)	15.4 (10.5)	15.1 (10.7)	16.1 (10.5)	14.2 (10.4)
LIK	11.6 (7.6)	18.4 (9.7)	15.3 (10.9)	15.0 (10.6)	11.1 (7.5)
UMMC	-	25.2 (16.2)	22.0 (12.4)	19.7 (11.4)	19.4 (11.8)
LKW	-	12.7 (6.4)	12.5 (6.6)	10.5 (5.9)	10.1 (6.7)
BM	-	20.9 (10.1)	16.3 (10.3)	14.8 (11.5)	11.8 (8.8)
SLR	-	12.1 (7.9)	12.2 (6.6)	13.3 (8.2)	12.9 (8.2)
PD	-	10.2 (5.9)	10.9 (7.4)	10.2 (5.9)	11.8 (7.0)
KKR	-	12.5 (9.6)	13.6 (8.6)	11.4 (7.0)	11.1 (8.0)

SGT	-	14.8 (8.3)	10.4 (7.1)	10.7 (7.6)	10.1 (6.5)
TM	-	12.0 (8.2)	9.1 (6.3)	12.5 (7.3)	10.7 (7.1)
KEM	-	9.6 (7.8)	12.3 (8.0)	11.9 (8.0)	8.7 (7.2)
KLP	-	6.3 (6.9)	11.4 (6.9)	11.3 (7.5)	16.6 (10.5)
LAB	-	14.4 (6.4)	10.0 (4.3)	9.4 (5.9)	11.8 (9.5)
KEN	-	19.2 (10.4)	15.0 (9.6)	15.1 (10.4)	17.2 (10.0)
BIN	-	21.5 (12.6)	14.2 (10.3)	13.4 (7.9)	17.1 (10.6)
LD	-	12.8 (7.7)	13.2 (8.3)	14.2 (9.5)	18.3 (12.6)
Total	**14.9 (9.3)**	**15.5 (9.5)**	**14.4 (9.0)**	**14.2 (8.7)**	**14.4 (8.8)**

The average length of hospital stay was 14.4 days with a median of 8.8 days.

KCH and UMMC recorded the longest length of hospital stay of 19.4 days.

KEM recorded the shortest length of hospital stay of 8.7 days.

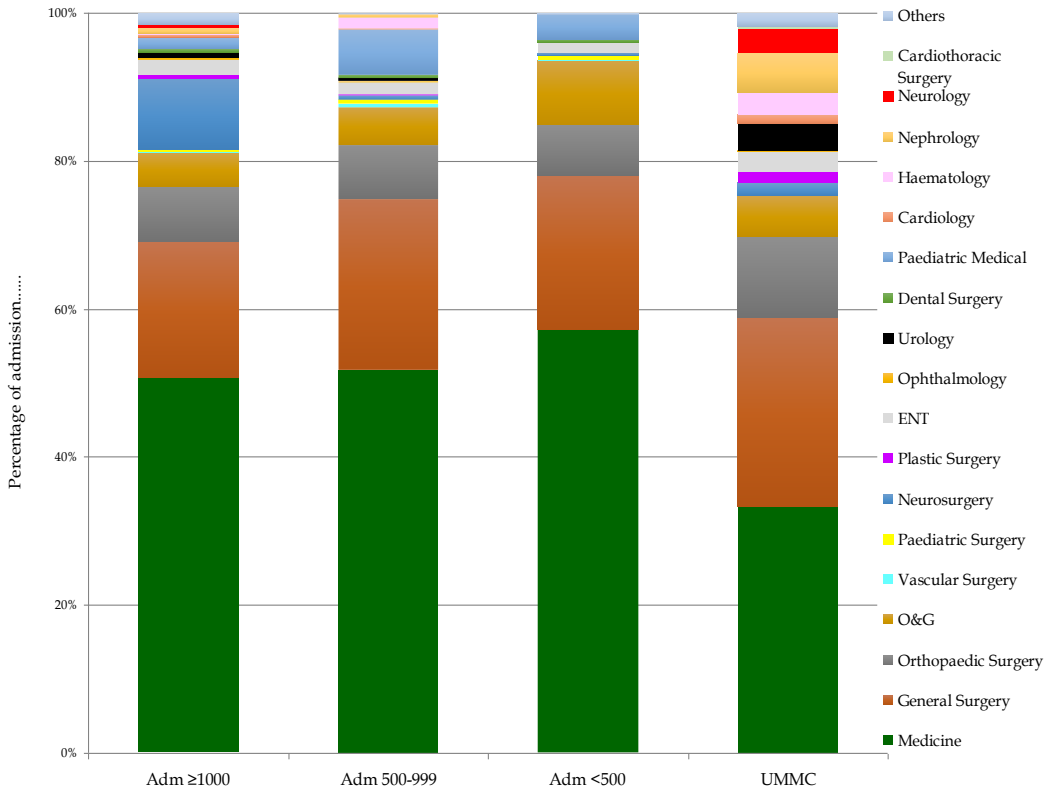
It is interesting to note that BM and TML showed a steady decrease in average length of hospital stay while LD showed an increase in the mean length of hospital stay over the last five years.

Table 10 : Referring units, by category of ICU 2015

Referring units	ICUs				
	Adm ≥ 1000 n (%)	**Adm 500 - 999 n (%)**	**Adm < 500 n (%)**	**UMMC n (%)**	**Total n (%)**
Medicine	12503 (50.8)	3952 (51.8)	3441 (57.1)	428 (33.3)	**20324 (51.4)**
General Surgery	4507 (18.3)	1758 (23.0)	1262 (20.9)	327 (25.4)	**7854 (19.9)**
Orthopaedic Surgery	1834 (7.5)	557 (7.3)	414 (6.9)	140 (10.9)	**2945 (7.4)**
O&G	1115 (4.5)	394 (5.2)	520 (8.6)	72 (5.6)	**2101 (5.3)**
Vascular Surgery	52 (0.2)	27 (0.4)	7 (0.1)	0 (0.0)	**86 (0.2)**
Paediatric Surgery	84 (0.3)	42 (0.6)	35 (0.6)	0 (0.0)	**161 (0.4)**
Neurosurgery	2339 (9.5)	49 (0.6)	21 (0.3)	23 (1.8)	**2432 (6.2)**
Plastic Surgery	143 (0.6)	6 (0.1)	0 (0.0)	18 (1.4)	**167 (0.4)**
ENT	482 (2.0)	132 (1.7)	83 (1.4)	36 (2.8)	**733 (1.9)**
Ophthalmology	32 (0.1)	11 (0.1)	5 (0.1)	1 (0.1)	**49 (0.1)**
Urology	244 (1.0)	30 (0.4)	0 (0.0)	48 (3.7)	**322 (0.8)**
Dental Surgery	89 (0.4)	28 (0.4)	22 (0.4)	0 (0.0)	**139 (0.4)**
Paediatric Medical	398 (1.6)	476 (6.2)	202 (3.4)	0 (0.0)	**1076 (2.7)**
Cardiology	62 (0.3)	8 (0.1)	0 (0.0)	16 (1.2)	**86 (0.2)**
Haematology	27 (0.1)	114 (1.5)	1 (0.0)	38 (3.0)	**180 (0.5)**
Nephrology	198 (0.8)	35 (0.5)	0 (0.0)	68 (5.3)	**301 (0.8)**
Neurology	154 (0.6)	3 (0.0)	2 (0.0)	44 (3.4)	**203 (0.5)**
Cardiothoracic Surgery	4 (0.0)	1 (0.0)	1 (0.0)	4 (0.3)	**10 (0.0)**
Others	337 (1.4)	5 (0.1)	8 (0.1)	22 (1.7)	**372 (0.9)**
Total	**24604 (100.0)**	**7628 (100.0)**	**6024 (100.0)**	**1285 (100.0)**	**39541 (100.0)**

Several major hospitals have medical subspecialities-hence the percentage of admissions from medicine unit was lower.

Figure 6 : Referring units, by category of ICU 2015



The percentage of patients admitted from the medical-based disciplines has increased from 43.0% in 2011 to 51.4% in 2015.

Table 11 : Category of patients, by category of ICU 2015

	ICUs				
	Adm ≥ 1000 n (%)	**Adm 500 - 999** n (%)	**Adm < 500** n (%)	**UMMC** n (%)	**Total** n (%)
Non-operative	16522 (67.1)	5596 (73.3)	4469 (74.2)	738 (58.3)	**27325 (69.1)**
Elective operative	2188 (8.9)	663 (8.7)	430 (7.1)	216 (17.1)	**3497 (8.8)**
Emergency operative	5898 (24.0)	1374 (18.0)	1125 (18.7)	311 (24.6)	**8708 (22.0)**
Total	**24608 (100.0)**	**7633 (100.0)**	**6024 (100.0)**	**1265 (100.0)**	**39530 (100.0)**

Non-operative — *Refers to patients in whom no surgery was done out within 7 days before ICU admission or during the first 24 hours after ICU admission*

Operative-elective — *Refers to patient in who surgery was done within 7 days before ICU admission or during the first 24 hours after ICU admission on a scheduled basis*

Operative-emergency — *Refers to patient in who surgery was done within 7 days before ICU admission or during the first 24 hours after ICU admission on an unscheduled basis*

Figure 7 : Category of patients, by category of ICU 2015

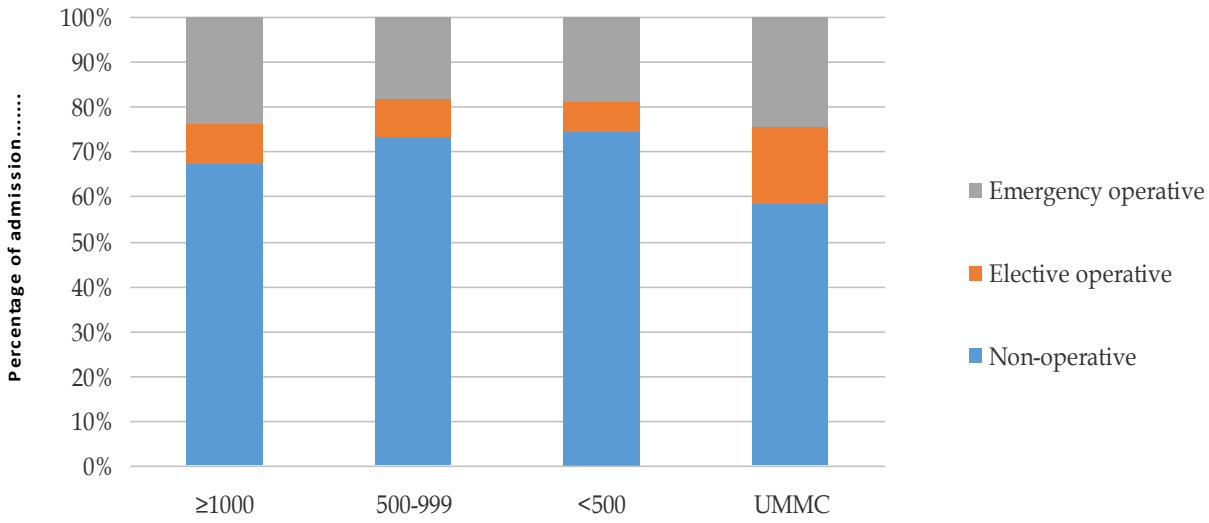
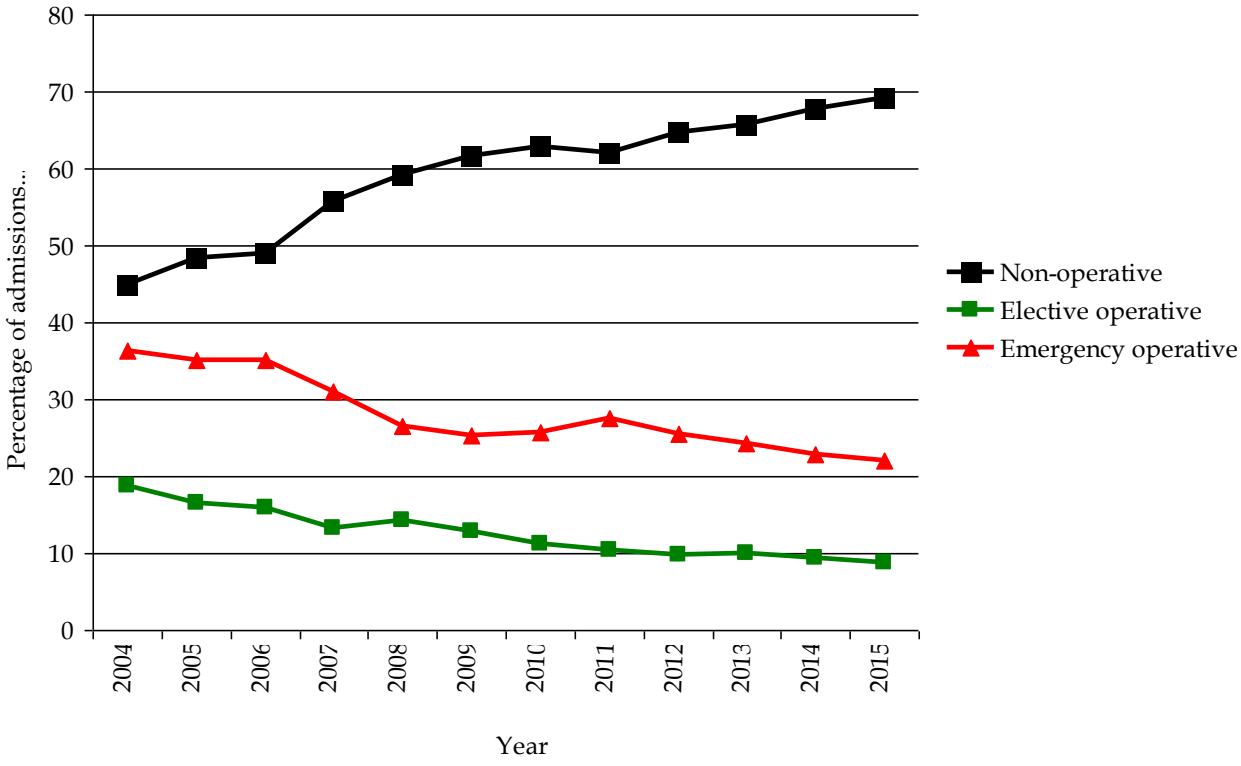


Table 12 : Category of patients in MOH hospitals 2011 - 2015

Category of patients	2011 (%)	2012 (%)	2013 (%)	2014 (%)	2015 (%)
Non-operative	62.0	65.1	66.1	67.8	69.1
Elective operative	10.5	10.3	10.4	9.4	8.8
Emergency operative	27.5	24.6	23.6	22.8	22.0

Figure 8 : Category of patients in MOH hospitals 2004 – 2015



The proportion of patients admitted into ICU after elective operations was higher in UMMC (17%) compared with that of MOH ICUs (8%).

Non-operative admissions accounted for 69% and 58% of all admissions to MOH and UMMC ICUs respectively. There was a steady increase in non-operative patients over the past 10 years with a 11% increase from 2005 to 2015, while the percentage of elective operative and emergency operative patients decreased by 8% and 13% respectively.

Table 13 : Location before ICU admission, by category of ICU 2015

Location	ICUs				
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	UMMC n (%)	Total n (%)
Ward	8534 (34.7)	3021 (39.6)	2421 (40.2)	407 (31.9)	**14383 (36.4)**
OT	6400 (26.0)	1399 (18.3)	1051 (17.5)	459 (35.9)	**9309 (23.5)**
Emergency department	7640 (31.0)	2701 (35.4)	2268 (37.7)	376 (29.4)	**12985 (32.8)**
Other critical areas	718 (2.9)	183 (2.4)	117 (1.9)	2 (0.2)	**1020 (2.6)**
Other locations	192 (0.8)	61 (0.8)	11 (0.2)	8 (0.6)	**272 (0.7)**
Other hospitals	1127 (4.6)	268 (3.5)	152 (2.5)	25 (2.0)	**1572 (4.0)**
Total	**24611 (100.0)**	**7633 (100.0)**	**6020 (100.0)**	**1277 (100.0)**	**39541 (100.0)**

*Location before ICU admission: Refers to the area/location patient was being managed **just before** being admitted into ICU*

Figure 9 : Location before ICU admission, by category of ICU 2015

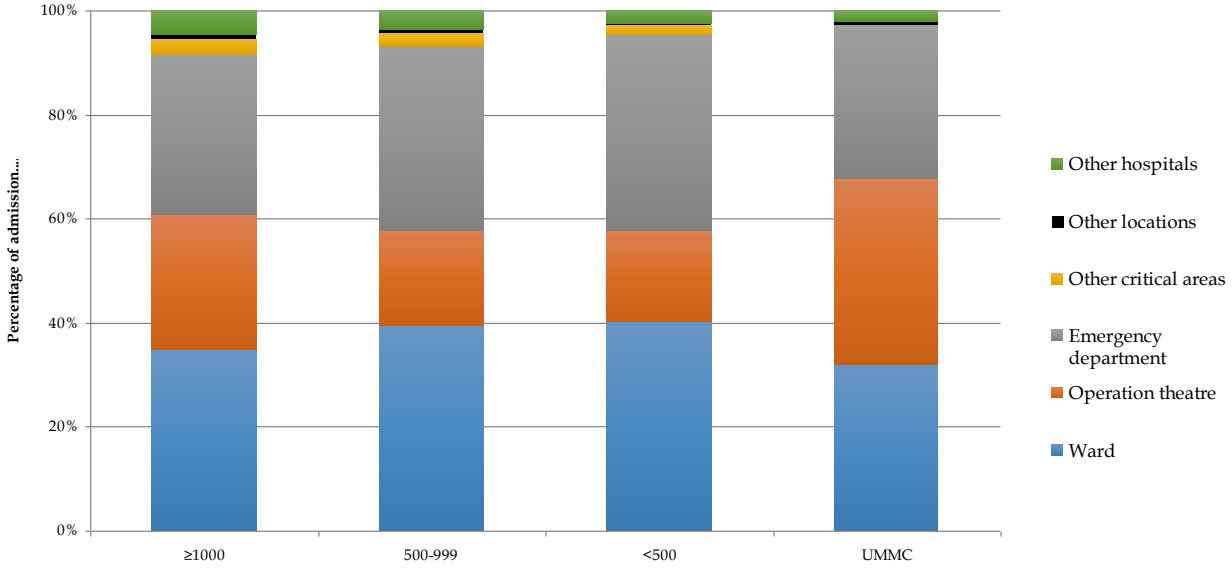
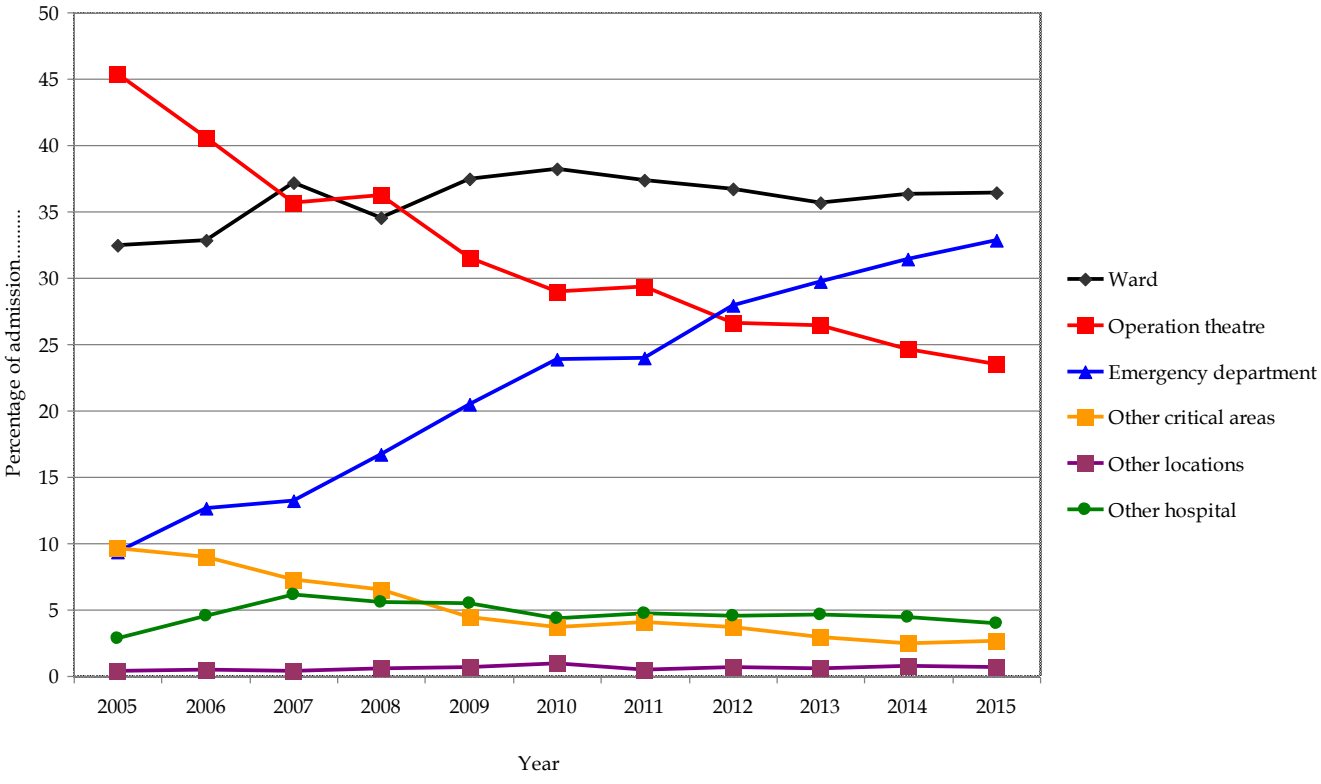


Table 14 : Location before ICU admission in MOH hospitals 2011 – 2015

Location	2011 (%)	2012 (%)	2013 (%)	2014 (%)	2015 (%)
Ward	37.4	36.7	35.7	36.3	36.4
Operation theatre	29.3	26.6	26.4	24.6	23.5
Emergency department	24.0	27.9	29.7	31.4	32.8
Other critical areas	4.1	3.7	2.9	2.5	2.6
Other locations	0.5	0.7	0.6	0.8	0.7
Other hospitals	4.7	4.5	4.6	4.4	4.0

Figure 10 : Location before ICU admission in MOH hospitals 2005 – 2015



The percentage of admissions from the emergency department had increased almost three-fold, while admissions from the operating theatre had decreased steadily over the past 10 years.

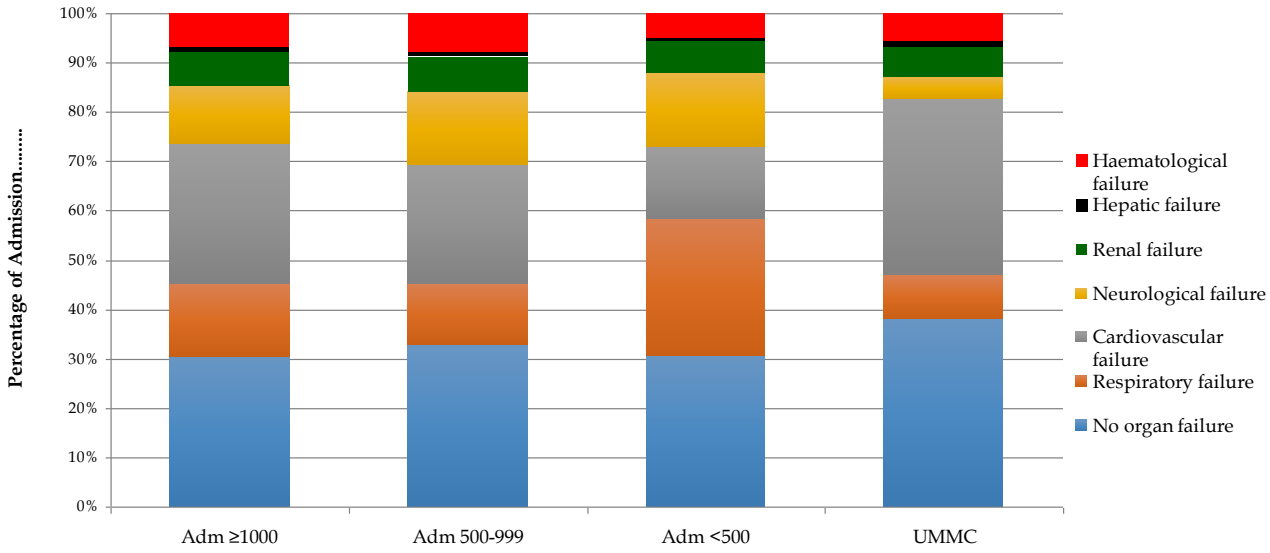
Table 15 : Main organ failure on ICU admission, by category of ICU 2015

Main organ failure	ICUs				
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	UMMC n (%)	Total n (%)
Without organ failure	6622 (30.4)	2065 (33.0)	1530 (30.7)	475 (38.1)	**10692 (31.2)**
Respiratory	3259 (15.0)	769 (12.3)	1373 (27.6)	109 (8.7)	**5510 (16.1)**
Cardiovascular	6198 (28.5)	1514 (24.2)	733 (14.7)	447 (35.8)	**8892 (26.0)**
Neurological	2545 (11.7)	927 (14.8)	740 (14.9)	56 (4.5)	**4268 (12.5)**
Renal	1485 (6.8)	442 (7.1)	314 (6.3)	75 (6.0)	**2316 (6.8)**
Haematological	1462 (6.7)	486 (7.8)	241 (4.8)	70 (5.6)	**2259 (6.6)**
Hepatic	210 (1.0)	56 (0.9)	47 (0.9)	15 (1.2)	**328 (1.0)**
Total	**21781 (100.0)**	**6259 (100.0)**	**4978 (100.0)**	**1247 (100.0)**	**34265 (100.0)**

The definition of organ failure is based on the Sequential Organ Failure Assessment (SOFA) [4]
*Main organ failure: Refers to the main or most important organ failure within **24 hours** of ICU admission and management.*

.

Figure 11 : Main organ failure on ICU admission, by category of ICU 2015



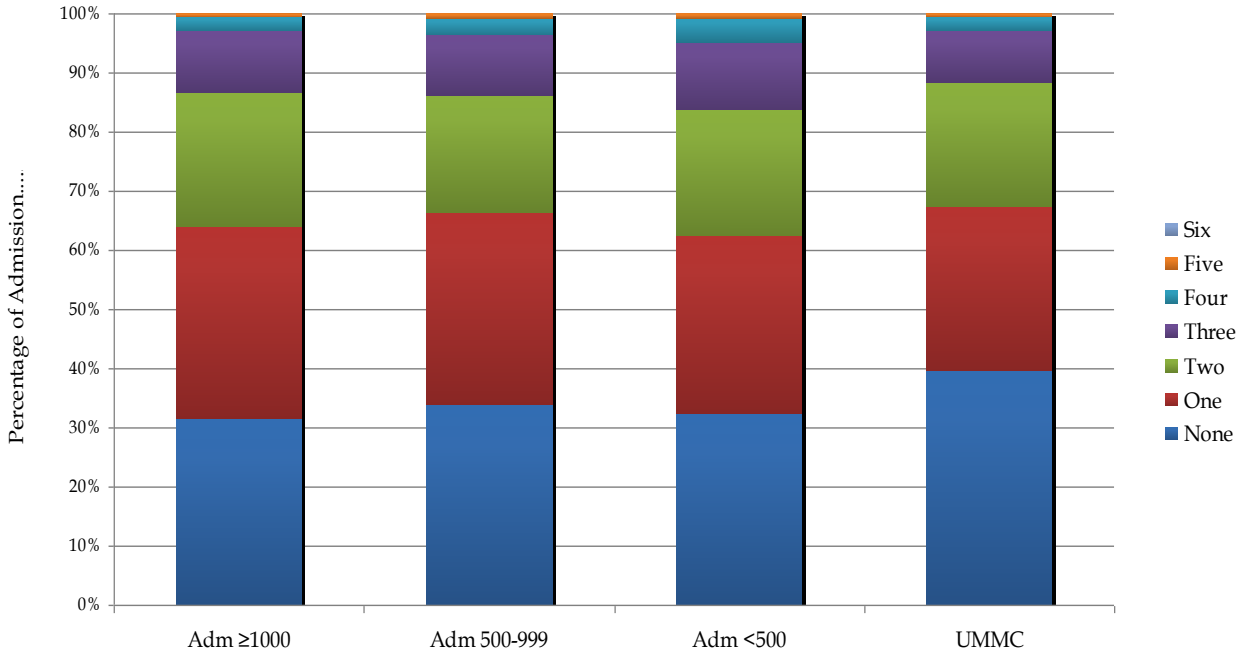
In MOH ICUs, 31% of the admissions did not have organ failure during the first 24 hours of ICU admission.

Among admissions with organ failure, cardiovascular failure (38%) was the most common organ failure during the first 24 hours of ICU admission followed by respiratory (24%), neurological (18%), renal (10%), haematological (9%) and hepatic (1%).

Table 16 : Number of organ failure(s) on ICU admission, by category of ICU 2015

Main organ failure	ICUs				
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	UMMC n (%)	Total n (%)
Without	6830 (31.4)	2117 (33.8)	1611 (32.4)	493 (39.5)	**11051 (32.3)**
Single	7124 (32.7)	2038 (32.6)	1496 (30.1)	348 (27.9)	**11006 (32.1)**
Two	4886 (22.4)	1237 (19.8)	1068 (21.5)	260 (20.9)	**7451 (21.7)**
Three	2297 (10.5)	647 (10.3)	569 (11.4)	110 (8.8)	**3623 (10.6)**
Four	545 (2.5)	181 (2.9)	200 (4.0)	31 (2.5)	**957 (2.8)**
Five	87 (0.4)	38 (0.6)	29 (0.6)	4 (0.3)	**158 (0.5)**
Six	9 (0.0)	1 (0.0)	5 (0.1)	1 (0.1)	**16 (0.0)**
Total	**21778 (100.0)**	**6259 (100.0)**	**4978 (100.0)**	**1247 (100.0)**	**34262 (100.0)**

Figure 12 : Number of organ failure(s) on ICU admission, by category of ICU 2015



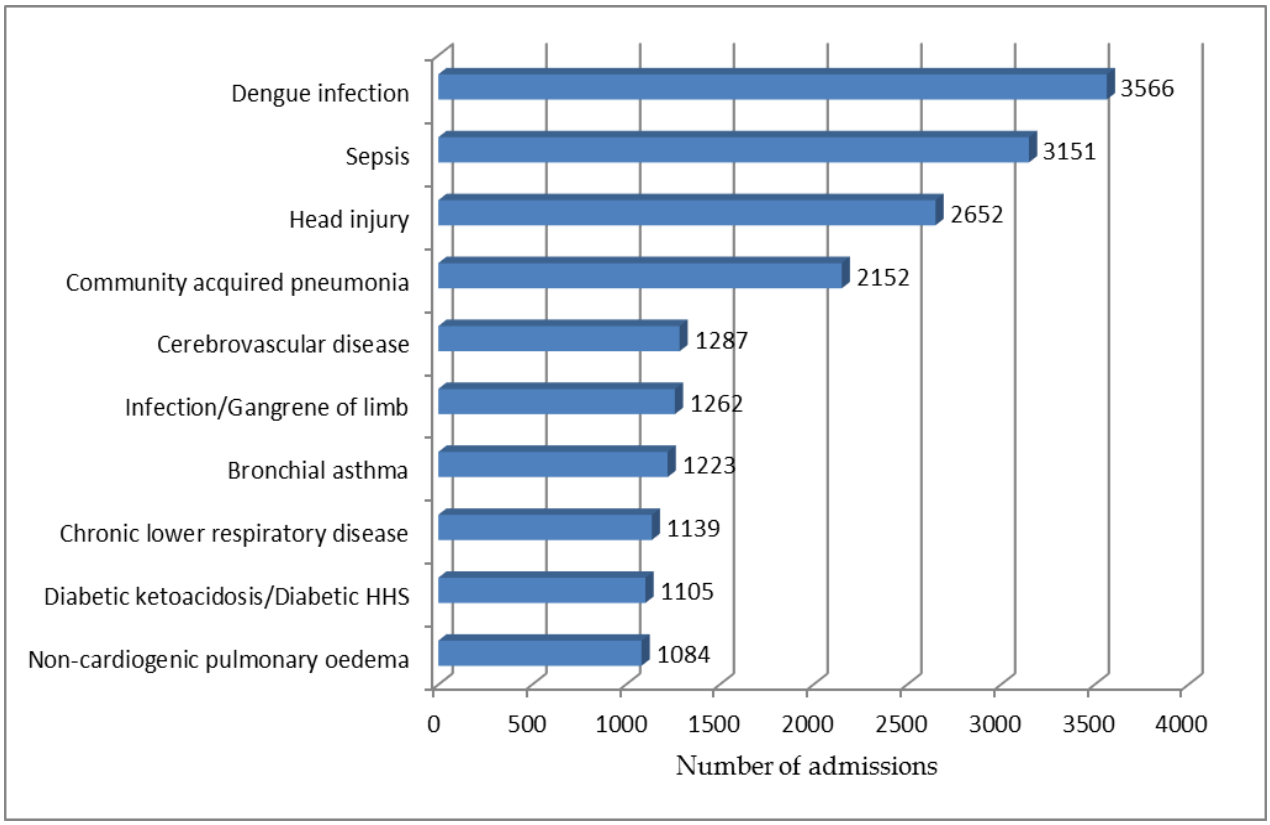
In 2015, about two-thirds (68%) of the patients were admitted with one or more organ failures in MOH ICUs. 32% of these patients had single organ failure. 22%, 11%, 2.8%, 0.5% and 0.04% had two, three, four, five and six organ failures respectively.

Table 17 : Ten most common diagnoses leading to ICU admission 2015

Diagnosis	Number	Percentage
Hospitals with admission ≥ 1000		
Dengue	2470	10.0
Sepsis	2050	8.2
Head Injury	1887	7.7
Community acquired pneumonia	1257	5.1
Cerebrovascular disease (infarct, thrombosis, haemorrhage)	1009	4.1
Infection/gangrene of limb (including osteomyelitis, necrotizing fasciitis)	902	3.7
Non-cardiogenic pulmonary oedema	776	3.2
Bronchial asthma	737	3.0
Diabetic ketoacidosis / diabetic hyperosmolar hyperglycaemic state (HHS)	701	2.8
Chronic lower respiratory disease	647	2.6
Hospitals with admission 500 – 999		
Dengue	696	9.1
Sepsis	646	8.5
Community acquired pneumonia	460	6.0
Head injury	448	5.9
Bronchial asthma	277	3.6
Chronic lower respiratory disease	269	3.5
Diabetic ketoacidosis / diabetic hyperosmolar hyperglycaemic state (HHS)	230	3.0
Other respiratory conditions	198	2.6
Gastrointestinal perforation (including anastomotic leak)	189	2.5
Non-cardiogenic pulmonary oedema	185	2.4
Hospitals with admission < 500		
Sepsis	455	7.5
Community acquired pneumonia	435	7.2
Dengue	400	6.6
Head injury	317	5.3
Chronic lower respiratory disease	223	3.7
Bronchial asthma	209	3.5
Infection / gangrene of limb (including osteomyelitis, necrotizing fasciitis)	180	3.0
Leptospirosis	147	2.4
Gastrointestinal perforation (including anastomotic leak)	157	2.5
Injury to extremities including fractures	133	2.2
UMMC		
Sepsis	234	18.1
Dengue	70	5.4
Diabetic ketoacidosis / diabetic hyperosmolar hyperglycaemic state (HHS)	51	3.9
Other renal / genito-urinary conditions (UV prolapse, TURP syndrome)	46	3.6
Head injury	41	3.2

Gastrointestinal perforation (including anastomotic leak)	39	3.0
Pancreatic disorder (including acute pancreatitis)	37	2.9
Community acquired pneumonia	35	2.7
Bronchial asthma	34	2.6
Gastrointestinal bleeding	33	2.6
Intra-abdominal / pelvic malignancy	33	2.6

Figure 13 : Ten most common diagnoses leading to ICU admission in MOH hospitals 2015



Since the inception of this registry, dengue infection became the most common diagnosis leading to ICU admission in 2014, followed by sepsis, head injury and community-acquired pneumonia. This situation has remained the same for 2015. The top 10 diagnoses leading to ICU admission had been the same for 2014 and 2015.

Sepsis, head injury and community-acquired pneumonia were the three most common diagnoses leading to ICU admission over the last 10 years until 2013.

.

Table 18 : Ten most common diagnoses leading to ICU admission using APACHE III diagnostic category 2015

Diagnosis	Number	Percentage
Hospitals with admission ≥ 1000		
Non-operative: Sepsis (other than urinary)	2586	10.5
Non-operative: Sepsis with shock (not urinary)	2067	8.4
Non-operative: Head trauma +/- multi trauma	1053	4.3
Non-operative: Bacterial pneumonia	1033	4.2
Operative: Head trauma +/- multi trauma	875	3.6
Non-operative: Other medical diseases	803	3.3
Non-operative: Pulmonary oedema (non-cardiogenic)	742	3.0
Non-operative: Asthma	720	2.9
Non-operative: Diabetic ketoacidosis	682	2.8
Operative: Orthopaedic surgery	651	2.6
Hospitals with admission 500 – 999		
Non-operative: Sepsis with shock (not urinary)	602	7.9
Non-operative: Other medical diseases	456	6.0
Non-operative: Other respiratory disease	373	4.9
Non-operative: : Sepsis (other than urinary)	368	4.8
Non-operative: Bacterial pneumonia	344	4.5
Non-operative: Head trauma +/- multi trauma	332	4.3
Non-operative: Other haematological diseases	257	3.4
Non-operative: Asthma	255	3.3
Non-operative: COPD	243	3.2
Non-operative: Diabetic ketoacidosis	207	2.7
Hospitals with admission < 500		
Non-operative: Sepsis with shock (not urinary)	386	6.4
Operative: Other medical/surgical diseases	378	6.3
Non-operative: Other medical diseases	260	4.3
Non-operative: : Sepsis (other than urinary)	256	4.2
Non-operative: Other respiratory disease	228	3.8
Non-operative: Bacterial pneumonia	227	3.8
Non-operative: Head trauma +/- multi trauma	213	3.5
Non-operative: Asthma	199	3.3
Non-operative: COPD	188	3.1
Non-operative: Other cardiovascular disease	162	2.7
UMMC		
Non-operative: Sepsis with shock (not urinary)	158	12.2
Non-operative: Other haematological diseases	78	6.0
Operative: Orthopaedic surgery	66	5.1
Non-operative: Bacterial pneumonia	55	4.3
Operative: GI neoplasm	53	4.1
Operative: GI perforation /rupture	46	3.6
Non-operative: Diabetic ketoacidosis	39	3.0

Non-operative: Other respiratory disease	36	2.8
Operative: Cellulitis / soft tissue infection	35	2.7
Non-operative: Asthma	34	2.6

Table 19 : Severe sepsis, ARDS and AKI within 24hrs of ICU admission 2015

	ICUs				
	Adm ≥ 1000 n (%)	**Adm 500 - 999 n (%)**	**Adm < 500 n (%)**	**UMMC n (%)**	**Total n (%)**
Severe sepsis*	4410 (17.9)	1370 (18.0)	833 (13.8)	319 (24.7)	**6932 (17.5)**
ARDS#	1388 (5.6)	725 (9.5)	366 (6.1)	89 (6.9)	**2568 (6.5)**
AKI^	3801 (15.5)	1112 (14.6)	926 (15.4)	238 (18.4)	**6077 (15.4)**

** Sepsis refers to documented infection with 2 out of 4 SIRS criteria:*

1) Temperature >38.3 or < than 36℃
2) Total white cell count > 12000 or < 4000
3) Heart rate > 90/min
4) Respiration rate > 20 breath / minute or PaCO2 < 32mmHg

Severe sepsis is sepsis with one of the following organ dysfunction:

(1) Hypotension: Systolic blood pressure < 90 mmHg or mean arterial pressure < 70 mm Hg
(2) PaO_2/F_IO_2 ≤ 300 mmHg
(3) Acute decrease in platelet count to < 100 000 u/L
(4) Acute increase in total bilirubin to > 70 umol/L
(5) Acute increase in serum creatinine to >170umol/L or urine output < 0.5 mL/kg/hour for > 2 hours
(6) Serum lactate >4 mmol/l

 # ARDS refers to a severe form of acute lung injury with a PaO_2/F_IO_2 ratio ≤ 200 mm Hg with diffuse radiologic infiltrates which is not predominantly due to heart failure

^AKI : Serum creatinine x 2 baseline or urine output < 0.5 ml/kg/hr x 12 hours

Table 20 : Severe sepsis, ARDS and AKI within 24hrs of ICU admission, by individual hospital 2013 – 2015

Hospital	2013			2014			2015		
	Severe sepsis n (%)	ARDS n (%)	AKI n (%)	Severe sepsis n (%)	ARDS n (%)	AKI n (%)	Severe sepsis n (%)	ARDS n (%)	AKI n (%)
AS	380 (28.3)	198 (14.7)	227 (16.9)	394 (29.7)	200 (15.1)	290 (21.9)	344 (25.2)	102 (7.5)	236 (17.3)
PP	413 (36.8)	58 (5.2)	377 (33.6)	370 (32.6)	35 (3.1)	293 (25.8)	414 (35.3)	23 (2.0)	294 (25.1)
IPH	149 (12.4)	87 (7.2)	129 (10.8)	148 (12.2)	123 (10.1)	197 (16.2)	188 (14.2)	181 (13.7)	288 (21.7)
KL	727 (38.2)	46 (2.4)	245 (12.9)	694 (32.4)	26 (1.2)	269 (12.6)	345 (17.4)	21 (1.1)	320 (16.1)
SLG	409 (27.1)	190 (12.6)	259 (17.2)	270 (18.9)	189 (13.3)	232 (16.3)	257 (18.5)	116 (8.4)	219 (15.8)
KLG	491 (23.8)	346 (16.8)	229 (11.1)	925 (40.6)	405 (17.8)	353 (15.5)	765 (35.0)	309 (14.1)	408 (18.7)
SBN	134 (28.5)	133 (28.2)	95 (20.2)	289 (53.6)	130 (24.1)	141 (26.2)	115 (21.2)	140 (25.8)	62 (11.4)
MLK	10 (0.6)	1 (0.1)	30 (1.8)	37 (2.6)	7 (0.5)	26 (1.8)	45 (3.1)	3 (0.2)	101 (7.1)
JB	557 (28.9)	95 (4.9)	465 (24.1)	510 (30.2)	68 (4.0)	391 (23.2)	542 (31.6)	91 (5.3)	340 (19.8)
KTN	201 (24.0)	109 (13.0)	180 (21.5)	254 (23.9)	146 (13.8)	230 (21.7)	222 (21.3)	147 (14.1)	223 (21.4)
KT	11 (0.9)	3 (0.3)	55 (4.7)	7 (0.6)	3 (0.3)	53 (4.5)	5 (0.4)	0 (0.0)	31 (2.2)
KB	168 (12.6)	241 (18.0)	234 (17.5)	92 (5.7)	232 (14.4)	198 (12.3)	202 (16.0)	137 (10.8)	209 (16.5)
KCH	122 (12.8)	9 (0.9)	48 (5.1)	121 (10.6)	8 (0.7)	63 (5.5)	46 (4.0)	7 (0.6)	30 (2.6)
KK	348 (34.1)	293 (28.7)	243 (23.8)	226 (22.9)	139 (14.1)	230 (23.3)	222 (24.0)	107 (11.6)	222 (24.0)
SP	92 (15.8)	20 (3.4)	72 (12.3)	14 (1.5)	6 (0.6)	88 (9.2)	3 (0.3)	7 (0.7)	55 (5.4)
PJY	115 (19.0)	91 (15.0)	91 (15.0)	126 (19.3)	90 (13.8)	112 (17.2)	115 (15.1)	113 (14.8)	111 (14.5)
MUR	16 (2.4)	44 (6.5)	45 (6.7)	10 (1.7)	96 (16.0)	37 (6.2)	5 (0.8)	69 (11.3)	23 (3.8)
TI	24 (6.0)	5 (1.2)	38 (9.5)	68 (16.8)	2 (0.5)	77 (19.0)	80 (18.9)	2 (0.5)	80 (18.9)
TPG	650 (48.2)	18 (1.3)	99 (7.3)	249 (21.1)	37 (3.1)	108 (9.1)	299 (26.6)	18 (1.6)	74 (6.6)
SJ	97 (23.5)	29 (7.0)	72 (17.5)	132 (32.6)	19 (4.7)	73 (18.0)	86 (18.1)	19 (4.0)	92 (19.4)
KJG	8 (2.5)	1 (0.3)	23 (7.2)	16 (5.6)	3 (1.1)	36 (12.7)	43 (9.3)	3 (0.6)	66 (14.2)
KGR	11 (3.4)	0 (0.0)	3 (0.9)	6 (1.8)	2 (0.6)	10 (2.9)	4 (1.1)	5 (1.4)	6 (1.7)
SJMC	12 (0.9)	9 (0.7)	7 (0.5)	3 (0.3)	3 (0.3)	3 (0.3)	-	-	-
TML	56 (9.3)	11 (1.8)	112 (18.8)	62 (7.4)	34 (4.1)	127 (15.2)	87 (10.5)	54 (6.5)	119 (14.4)
KP	142 (36.0)	22 (5.6)	77 (19.6)	208 (40.6)	21 (4.1)	95 (18.6)	252 (46.2)	15 (2.8)	98 (18.0)

SMJ	2 (0.5)	1 0.3)	2 (0.5)	0 (0.0)	0 (0.0)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)
BP	75 (16.4)	8 (1.7)	42 (9.2)	56 (12.2)	15 (3.3)	57 (12.4)	40 (7.3)	8 (1.5)	77 (14.1)
TW	30 (6.7)	45 (10.0)	54 (12.1)	49 (9.8)	32 (6.4)	29 (5.8)	82 (18.5)	21 (4.7)	57 (12.8)
MRI	78 (16.2)	6 (1.2)	35 (7.3)	53 (12.4)	10 (2.3)	66 (15.4)	61 (16.2)	4 (1.1)	86 (22.9)
KLM	70 (12.5)	36 (6.4)	47 (8.4)	96 (17.3)	48 (8.6)	75 (13.5)	81 (15.4)	31 (5.9)	90 (17.1)
SDG	75 (8.8)	117 (13.8)	141 (16.6)	111 (13.3)	24 (2.9)	193 (23.1)	94 (12.4)	23 (3.0)	132 (17.5)
SB	72 (14.3)	47 (9.3)	82 (16.2)	68 (15.8)	33 (7.7)	80 (18.6)	196 (15.4)	75 (5.9)	161 (12.7)
DKS	100 (10.4)	48 (5.0)	65 (6.8)	37 (3.9)	12 (1.3)	45 (4.7)	101 (10.9)	46 (5.0)	69 (7.5)
SI	275 (28.6)	116 (12.1)	156 (16.2)	319 (28.6)	62 (5.6)	219 (19.7)	364 (25.0)	96 (6.6)	333 (22.9)
SBL	160 (8.3)	92 (4.8)	321 (16.8)	457 (20.0)	423 (18.6)	521 (22.9)	173 (7.5)	55 (2.4)	479 (20.7)
AMP	235 (41.5)	120 (21.2)	126 (22.3)	226 (35.7)	139 (22.0)	145 (22.9)	258 (38.5)	119 (17.8)	109 (16.3)
LIK	5 (1.0)	11 (2.1)	8 (1.6)	7 (2.0)	8 (2.3)	4 (1.1)	10 (6.5)	3 (2.0)	10 (6.5)
UMMC	225 (25.9)	99 (11.4)	210 (24.1)	475 (35.4)	126 (9.4)	270 (20.1)	319 (24.7)	89 (6.9)	238 (18.4)
LKW	21 (11.7)	10 (5.6)	17 (9.4)	19 (11.6)	13 (7.9)	31 (18.9)	18 (9.3)	6 (3.1)	34 (17.6)
BM	17 (11.1)	3 (2.0)	6 (4.0)	16 (11.5)	13 (9.4)	21 (15.1)	72 (33.2)	24 (11.1)	70 (32.1)
SLR	40 (17.9)	15 (6.7)	45 (20.2)	80 (35.9)	72 (32.4)	103 (46.2)	58 (29.0)	47 (23.5)	69 (34.5)
PD	16 (6.5)	1 (0.4)	38 (15.5)	1 (0.4)	0 (0.0)	5 (1.9)	2 (0.9)	2 (0.9)	2 (0.9)
KKR	64 (26.9)	59 (24.9)	39 (16.3)	82 (31.8)	90 (34.7)	40 (15.6)	49 (12.6)	41 (10.5)	24 (6.2)
SGT	24 (15.1)	16 (10.1)	37 (23.4)	29 (19.3)	20 13.3)	33 (22.1)	66 (22.8)	53 (18.3)	59 (20.3)
TM	21 (16.5)	15 (11.8)	16 (12.7)	15 (9.4)	44 (27.5)	17 (10.6)	26 (8.5)	22 (7.2)	44 (14.3)
KEM	12 (11.4)	4 (3.8)	6 (5.8)	5 (5.5)	4 (4.4)	8 (8.9)	23 (12.8)	12 (6.2)	13 (7.3)
KLP	10 (8.6)	3 (2.6)	21 (18.1)	10 (10.5)	2 (2.1)	10 (10.5)	4 (3.7)	1 (0.9)	28 (26.2)
LAB	28 (17.0)	23 (14.0)	25 (15.2)	46 (27.7)	70 (42.2)	42 (25.3)	32 (17.5)	31 (16.9)	49 (26.8)
KEN	31 (19.3)	6 (3.7)	36 (22.4)	36 (25.0)	5 (3.5)	39 (27.1)	22 (16.2)	4 (2.9)	27 (19.9)
BIN	96 (36.9)	4 2 (16.2)	43 (16.5)	188 (66.7)	68 (24.0)	70 (24.8)	73 (23.3)	54 (17.4)	79 (25.3)
LD	46 (19.2)	37 (15.4)	56 (23.2)	49 (22.7)	49 (22.7)	64 (29.5)	22 (14.7)	12 (8.0)	31 (20.8)
Total	**7171 (19.2)**	**3039 (8.1)**	**5129 (13.7)**	**7761 (20.0)**	**3406 (8.8)**	**5920 (15.2)**	**6932 (17.5)**	**2568 (6.5)**	**6077 (15.4)**

During the first 24 hours of ICU admission, 17.5%, 6.5% and 15.4% of patients had severe sepsis, acute respiratory distress syndrome and acute kidney injury respectively. The rates appear to follow a similar trend over the past three years.

In the Sepsis Occurrence in Acutely Ill Patients (SOAP) study, 24% of patients had sepsis on admission [5]. An Italian study in 2011 demonstrated that 42.7% of patients had AKI within 24 hours of ICU admission [6].

Table 21 : SAPS II score, by individual hospital 2011 – 2015

Hospital	SAPS II score mean (median)				
	2011	2012	2013	2014	2015
AS	39.4	40.1	39.4	41.0	38.0 (36.0)
PP	38.0	36.5	35.8	36.1	39.0 (37.0)
IPH	33.0	32.0	34.0	34.2	33.8 (31.0)
KL	38.3	38.9	40.4	36.8	37.6 (36.0)
SLG	34.5	36.0	35.7	34.2	29.8 (27.0)
KLG	38.2	36.9	35.3	33.1	33.3 (31.0)
SBN	39.2	39.2	37.3	35.0	32.6 (31.0)
MLK	33.4	36.8	31.8	33.5	34.4 (31.0)
JB	39.1	40.7	31.8	40.2	41.7 (40.0)
KTN	34.5	39.8	38.6	37.1	36.6 (35.0)
KT	39.0	41.5	42.0	40.2	40.8 (38.5)
KB	33.4	34.4	34.3	29.6	32.8 (31.0)
KCH	35.0	33.0	33.7	31.4	33.1 (29.0)
KK	36.4	33.2	35.1	40.6	43.9 (44.0)
SP	40.1	43.3	39.7	37.9	33.9 (31.0)
PJY	28.7	28.0	29.5	32.0	27.7 (23.0)
MUR	37.9	37.6	38.4	39.8	39.2 (37.0)
TI	41.7	41.1	43.7	43.0	37.2 (34.0)
TPG	42.2	40.4	39.7	39.4	41.0 (40.0)
SJ	40.3	38.9	41.9	38.3	43.7 (45.0)
KJG	36.0	31.7	32.9	31.7	28.4 (26.0)
KGR	33.9	35.3	36.6	30.9	31.3 (28.5)
SJMC	18.0	18.8	18.6	16.6	-
TML	37.3	34.5	31.5	33.7	33.9 (32.0)
KP	40.0	41.2	39.9	37.3	34.7 (32.0)
SMJ	38.8	40.0	40.5	39.8	36.7 (34.0)
BP	43.3	43.4	40.1	41.0	35.8 (33.0)
TW	40.0	41.4	38.8	33.1	33.1 (29.0)
MRI	34.9	35.5	35.6	35.6	37.1 (37.0)
KLM	42.8	42.7	44.6	45.0	44.6 (41.0)
SDG	37.6	41.9	40.8	40.9	39.8 (44.0)
SB	39.2	40.4	43.9	41.7	35.0 (33.0)
DKS	41.3	38.0	39.3	37.7	36.5 (34.0)
SI	38.3	38.1	38.4	33.2	34.0 (33.0)
SBL	37.6	39.1	31.5	34.4	38.3 (40.0)
AMP	46.5	48.6	45.9	45.9	44.6 (43.5)
LIK	21.6	21.1	15.2	15.5	21.3 (17.0)
UMMC	-	36.5	36.5	37.4	37.8 (35.0)
LKW	-	41.2	29.3	39.2	44.9 (45.0)
BM	-	42.8	47.5	54.4	54.7 (55.5)
SLR	-	47.9	38.8	46.5	46.1 (47.0)

PD	-	31.3	33.8	28.3	32.1 (27.0)
KKR	-	36.0	44.0	44.3	43.2 (39.0)
SGT	-	39.9	43.8	45.1	43.9 (40.0)
TM	-	25.3	35.9	39.6	41.4 (38.0)
KEM	-	39.2	38.7	38.3	38.8 (39.0)
KLP	-	8.4	26.9	29.7	30.9 (26.0)
LAB	-	40.0	45.7	56.3	43.7 (43.0)
KEN	-	44.9	34.3	37.3	32.6 (31.0)
BIN	-	33.5	32.4	36.6	39.4 (36.0)
LD	-	48.8	43.3	45.1	44.9 (45.0)
Total	**36.1**	**37.3**	**36.5**	**36.3**	**36.8 (35.0)**

The average SAPS II score has remained the same over the past five years. The average SAPS II score in MOH hospitals for 2015 was 36.8; which carries predicted in-hospital mortality of 30.4% [8].

Table 22 : Sequential Organ Failure Assessment (SOFA) [4] by individual hospital 2011 – 2015

Hospital	SOFA score Mean (Median)				
	2011	2012	2013	2014	2015
AS	7.3 (7)	7.3 (7)	7.1 (7)	7.4 (7)	6.8 (7.0)
PP	6.2 (5)	6.7 (6)	6.9 (6)	7.1 (7)	7.3 (7.0)
IPH	5.4 (5)	5.4 (5)	5.9 (5)	6.1 (5)	6.2 (5.0)
KL	6.5 (6)	7.0 (7)	7.2 (7)	6.9 (6)	7.1 (7.0)
SLG	6.5 (6)	6.7 (6)	6.8 (6)	6.6 (6)	6.3 (6.0)
KLG	7.5 (7)	7.4 (7)	7.0 (7)	6.7 (6)	6.7 (6.0)
SBN	7.1 (7)	7.0 (7)	7.3 (7)	6.7 (6)	6.8 (6.0)
MLK	5.6 (5)	6.1 (6)	5.1 (4)	4.6 (4)	4.9 (4.0)
JB	7.2 (7)	7.4 (7)	7.6 (7)	7.3 (7)	8.0 (8.0)
KTN	5.9 (5)	7.0 (7)	7.0 (6)	6.3 (6)	5.9 (5.0)
KT	6.1 (6)	6.6 (6)	6.8 (7)	6.6 (6)	7.0 (7.0)
KB	5.1 (4)	5.3 (4)	5.5 (5)	4.6 (4)	5.6 (5.0)
KCH	6.0 (5)	5.4 (4)	5.7 (5)	5.0 (4)	5.7 (5.0)
KK	6.0 (6)	5.7 (5)	6.2 (6)	6.7 (6)	7.2 (6.0)
SP	6.9 (6)	6.8 (6)	7.0 (6)	7.3 (7)	6.6 (6.0)
PJY	4.1 (3)	4.2 (3)	5.0 (4)	5.1 (4)	4.2 (3.0)
MUR	5.9 (6)	5.5 (5)	5.5 (5)	6.0 (5)	5.8 (5.0)
TI	7.3 (7)	7.4 (7)	7.8 (7)	8.1 (7)	7.9 (7.0)
TPG	7.6 (8)	7.1 (7)	6.8 (6)	7.0 (7)	7.5 (7.0)
SJ	6.6 (6)	6.2 (6)	7.3 (7)	6.2 (5)	6.3 (6.0)
KJG	7.3 (7)	5.6 (5)	6.1 (5)	6.1 (6)	6.0 (5.0)
KGR	5.5 (4)	5.5 (5)	5.6 (5)	4.7 (4)	4.9 (4.0)
SJMC	1.4 (0)	1.4 (0)	1.1 (0)	1.4 (1)	-
TML	6.2 (5)	6.1 (5)	5.1 (4)	5.9 (5)	6.3 (6.0)
KP	7.3 (7)	7.3 (7)	6.6 (6)	6.5 (6)	6.1 (6.0)
SMJ	6.9 (7)	7.3 (7)	7.1 (7)	7.4 (7)	7.2 (7.0)
BP	6.9 (6)	7.1 (7)	6.4 (6)	6.4 (6)	4.9 (4.0)
TW	7.2 (6)	7.2 (6)	7.4 (7)	6.2 (5)	6.4 (6.0)
MRI	5.5 (5)	5.9 (6)	5.8 (5)	5.0 (4)	6.9 (7.0)
KLM	8.5 (8)	7.8 (7)	7.3 (7)	7.1 (7)	7.5 (7.0)
SDG	6.5 (6)	7.2 (7)	7.2 (7)	7.6 (7)	8.3 (8.0)
SB	7.8(7)	7.6 (7)	7.3 (7)	7.3 (7)	6.1 (5.0)
DKS	6.5 (6)	5.8 (5)	5.5 (4)	5.2 (4)	6.0 (5.0)
SI	6.5 (6)	6.8 (6)	6.1 (5)	5.7 (5)	6.5 (6.0)
SBL	7.0 (8)	7.3 (8)	7.0 (7)	7.7 (7)	7.8 (8.0)
AMP	8.8 (9)	8.9 (9)	8.5 (8)	8.2 (8)	8.5 (8.0)
LIK	2.2 (1)	2.6 (1)	1.6 (0)	1.5 (0)	2.4 (1.0)
UMMC	-	7.6 (7)	7.4 (6)	7.0 (6)	7.1 (7.0)
LKW	-	5.7 (5)	3.4 (0)	5.0 (3)	6.9 (7.0)

BM	-	9.5 (10)	6.8 (6)	8.8 (8)	9.0 (9.0)
SLR	-	7.9 (8)	6.5 (6)	7.6 (8)	8.1 (8.0)
PD	-	4.7 (4)	4.9 (4)	4.1 (3)	5.5 (4.0)
KKR	-	6.8 (6)	7.5 (7)	6.6 (6)	4.6 (4.0)
SGT	-	6.4 (6)	6.6 (6)	7.2 (7)	8.5 (8.0)
TM	-	3.1 (3)	6.2 (5)	6.6 (6)	6.8 (6.0)
KEM	-	6.0 (5)	6.5 (6)	5.8 (4)	6.8 (6.0)
KLP	-	0.8 (1)	3.7 (3)	4.3 (3)	4.8 (4.0)
LAB	-	4.2 (2)	5.9 (6)	7.9 (8)	6.3 (6.0)
KEN	-	5.9 (5)	6.1 (6)	6.0 (6)	5.2 (4.0)
BIN	-	5.7 (5)	4.9 (4)	6.2 (5)	6.3 (6.0)
LD	-	8.7 (9)	7.5 (7)	8.0 (8)	6.8 (6.0)
Overall	**6.2 (6)**	**6.4 (6)**	**6.4 (6)**	**6.4 (6)**	**6.6 (6.0)**

The average SOFA score in 2015 was 6.6. BM had the highest score of 9.0 while LIK had the lowest score of 2.4.

SECTION C:

INTERVENTIONS

1. Non-invasive ventilation
2. Invasive ventilation
3. Reintubation
4. Tracheostomy
5. Renal replacement therapy
6. Withdrawal/Withholding therapy

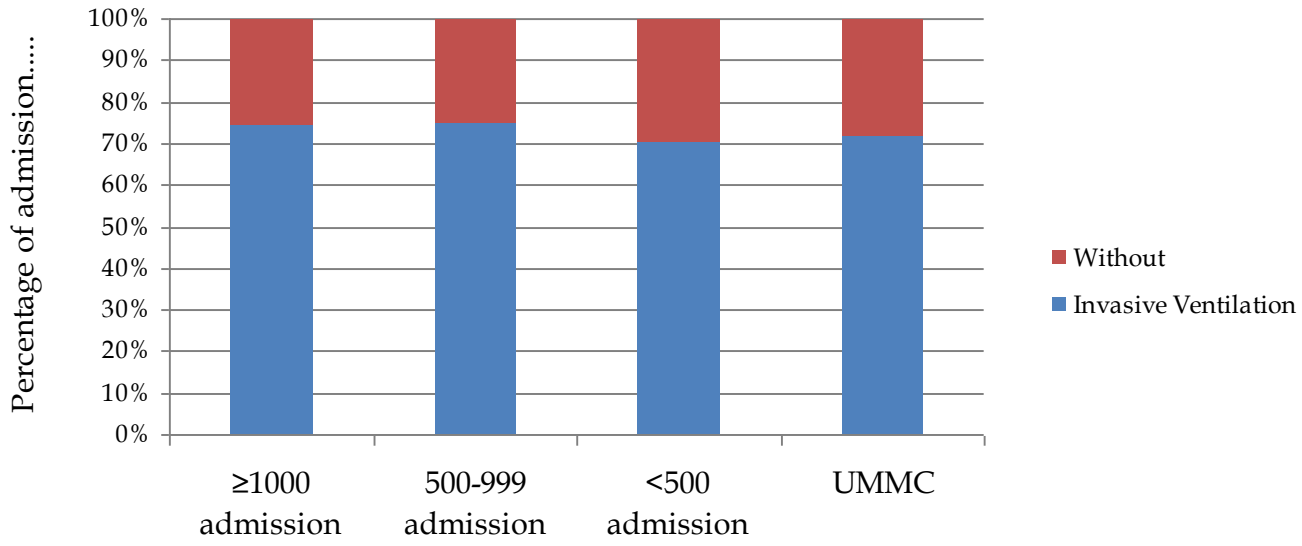
Table 23 : Invasive ventilation, non-invasive ventilation and reintubation, by category of ICU 2015

	ICUs				
	Adm ≥ 1000 n (%)	**Adm 500 - 999 n (%)**	**Adm < 500 n (%)**	**UMMC n (%)**	**Total n (%)**
Invasive ventilation	18366 (74.6)	5741 (75.2)	4264 (70.6)	929 (71.8)	**29300 (74.0)**
Non-invasive ventilation	4603 (18.7)	1645 (21.6)	887 (14.7)	388 (30.1)	**7523 (19.0)**
Reintubation	1237 (6.7)	354 (6.2)	200 (4.7)	85 (9.2)	**1876 (6.4)**

Non-invasive ventilation *Refers to the continuous use of a non-invasive ventilator for ≥ 1 hour during ICU stay*
Reintubation *Refers to reintubation after intended or accidental extubation*

The reintubation rate for MOH hospitals was 6.3 % in 2015.

Figure 14 : Invasive ventilation, by category of ICU 2015



75% and 72% of ICU admissions in MOH hospitals and UMMC received invasive mechanical ventilation respectively.

Figure 15 : Non-invasive ventilation, by category of ICU 2015

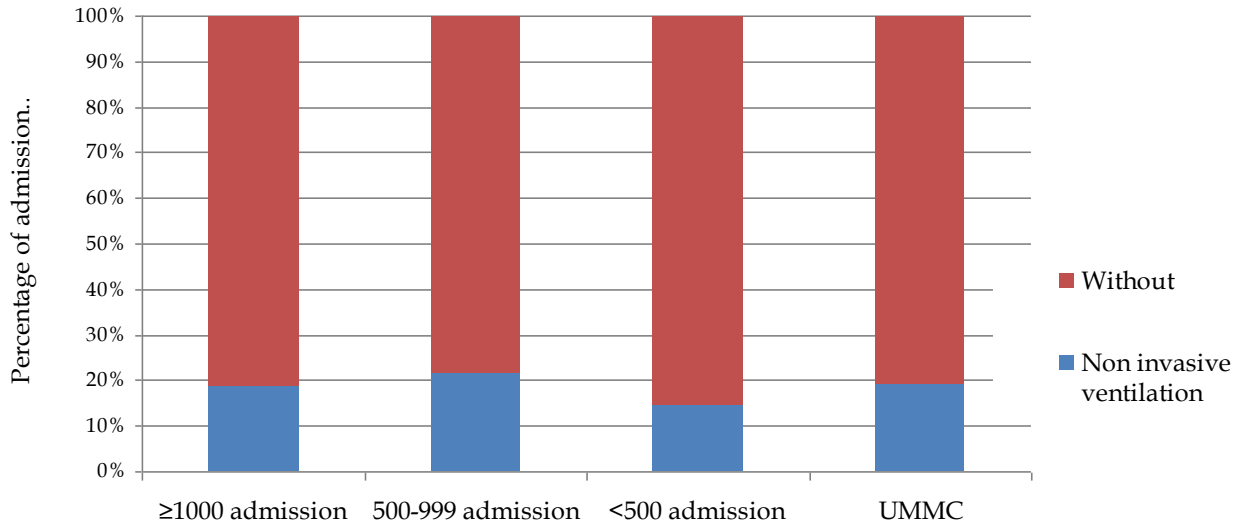
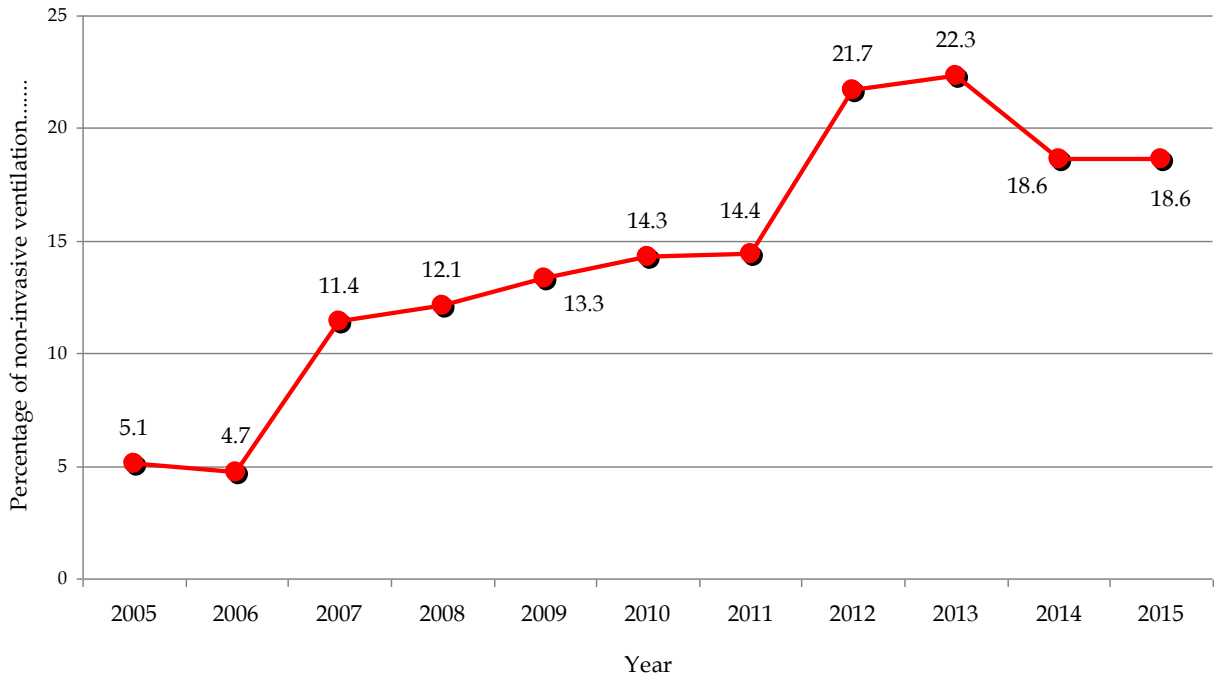


Figure 16 : Non-invasive ventilation, MOH hospitals 2005 – 2015



The percentage of patients receiving non-invasive ventilation in MOH ICUs increased by almost six fold from 3.7% in 2004 to 22.3% in 2013. This percentage decreased to 18.6% in 2014 and 2015.

30% of ICU admissions in UMMC received non-invasive ventilation.

Figure 17 : Reintubation, by category of ICU 2015

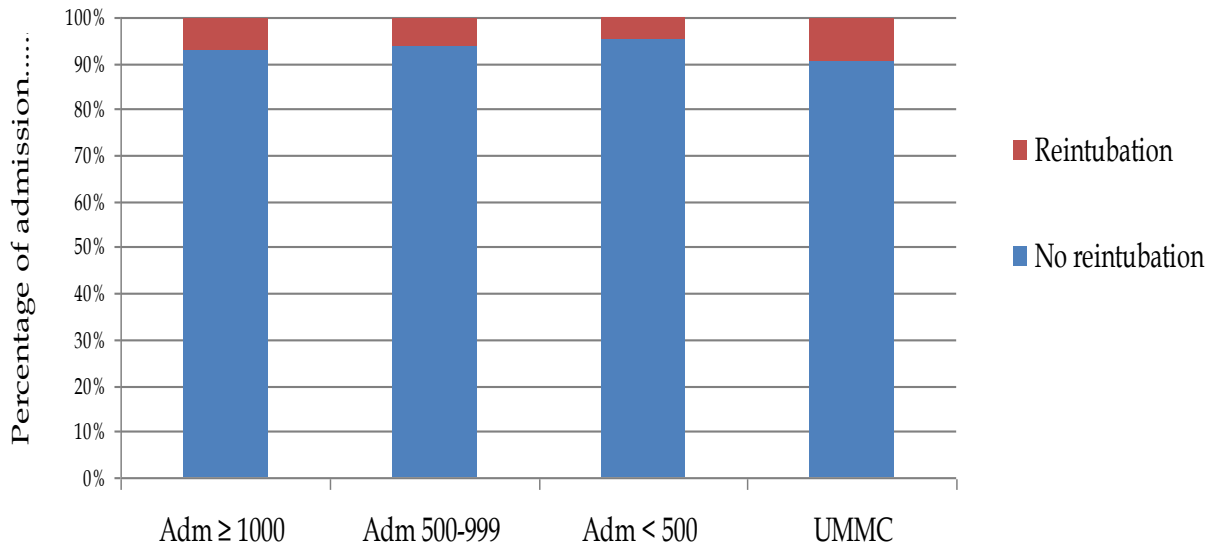
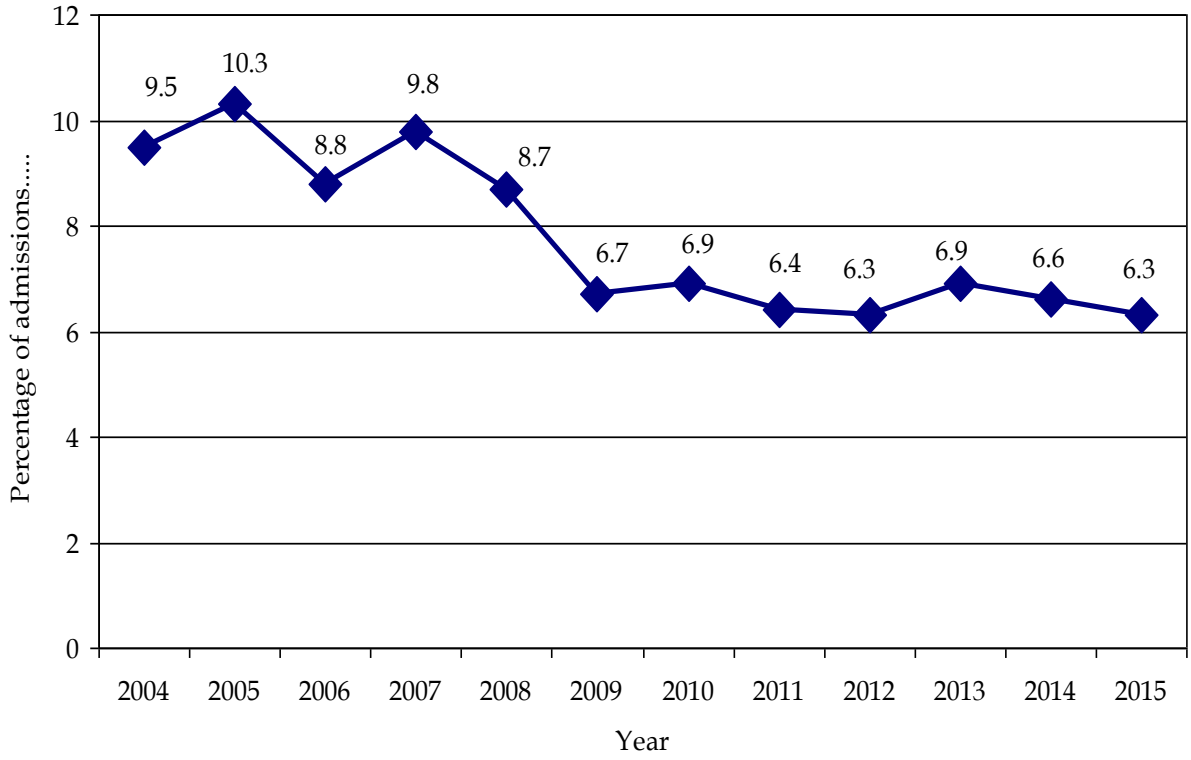


Figure 18 : Reintubation, MOH hospitals 2004 – 2015



The overall reintubation rate in MOH participating centres and UMMC in 2015 was 6.3% and 9.2% respectively.

Table 24 : Duration of invasive mechanical ventilation, by individual hospital 2011 – 2015

Hospital	Mean ± SD days				
	2011	2012	2013	2014	2015
AS	3.6 ± 4.8	4.8 ± 6.0	4.1 ± 5.5	3.9 ± 5.5	3.8 ± 5.0
PP	5.1 ± 7.1	5.2 ± 7.8	5.4 ± 7.0	5.5 ± 7.1	5.9 ± 8.4
IPH	5.3 ± 7.2	5.1 ± 6.7	5.2 ± 8.2	3.8 ± 6.4	5.7 ± 8.5
KL	3.9 ± 5.8	4.5 ± 7.1	4.4 ± 7.4	4.6 ± 7.1	5.2 ± 8.3
SLG	4.5 ± 6.3	4.9 ± 5.9	4.3 ± 5.4	4.8 ± 6.4	5.7 ± 9.0
KLG	2.9 ± 4.3	2.7 ± 4.5	2.5 ± 5.7	2.5 ± 3.9	3.0 ± 5.5
SBN	5.1 ± 7.4	4.9 ± 6.8	6.1 ± 8.9	5.1 ± 7.1	5.7 ± 7.5
MLK	4.0 ± 1.7	4.3 ± 5.7	4.6 ± 6.7	4.9 ± 6.9	4.4 ± 6.2
JB	4.8 ± 6.3	4.9 ± 6.2	4.3 ± 5.5	5.1 ± 6.6	5.1 ± 6.0
KTN	4.9 ± 7.1	5.6 ± 6.9	5.0 ± 6.5	5.1 ± 8.2	5.7 ± 8.7
KT	3.5 ± 4.6	3.4 ± 4.6	3.9 ± 4.9	3.8 ± 4.9	3.5 ± 5.8
KB	3.9 ± 7.3	3.6 ± 6.3	4.0 ± 6.6	3.8 ± 6.4	5.2 ± 11.2
KCH	5.4 ± 7.4	5.0 ± 7.2	4.4 ± 6.6	3.7 ± 6.2	4.1 ± 6.1
KK	5.2 ± 7.0	5.5 ± 7.2	5.9 ± 8.8	5.3 ± 9.0	6.3 ± 13.2
SP	3.9 ± 5.3	3.9 ± 4.0	4.3 ± 5.9	4.2 ± 6.2	4.1 ± 6.1
PJY	3.3 ± 5.5	3.1 ± 4.9	3.5 ± 5.4	3.6 ± 6.9	3.5 ± 5.6
MUR	5.1 ± 8.1	3.8 ± 6.8	2.9 ± 4.4	3.5 ± 5.1	3.2 ± 5.5
TI	3.7 ± 5.8	4.0 ± 8.0	2.5 ± 3.0	2.4 ± 3.0	1.8 ± 2.8
TPG	7.3 ± 9.6	5.2 ± 8.0	4.1 ± 5.3	4.6 ± 6.8	5.6 ± 7.4
SJ	4.0 ± 6.3	4.3 ± 7.2	6.4 ± 9.7	5.5 ± 2.6	5.0 ± 7.2
KJG	4.8 ± 15.3	4.9 ± 7.3	4.1 ± 5.0	4.5 ± 5.5	3.5 ± 4.8
KGR	3.5 ± 6.3	3.8 ± 6.5	3.6 ± 7.0	3.5 ± 5.2	3.7 ± 4.5
SJMC	2.9 ± 4.7	2.5 ± 4.1	4.8 ± 5.1	2.9 ± 3.2	-
TML	5.5 ± 8.9	4.9 ± 6.7	4.6 ± 8.2	4.7 ± 6.6	4.8 ± 6.3
KP	5.6 ± 8.2	5.0 ± 7.5	4.9 ± 7.0	4.3 ± 5.9	4.3 ± 6.4
SMJ	3.0 ± 4.9	3.2 ± 4.1	2.9 ± 4.3	2.6 ± 4.0	2.6 ± 4.9
BP	4.4 ± 6.1	5.2 ± 6.4	4.4 ± 6.0	4.4 ± 5.1	3.7 ± 4.5
TW	2.9 ± 3.9	3.2 ± 6.3	4.1 ± 6.3	4.1 ± 6.1	3.8 ± 7.0
MRI	4.6 ± 5.3	4.7 ± 5.4	4.4 ± 5.3	4.2 ± 5.5	4.8 ± 5.3
KLM	3.6 ± 5.6	3.3 ± 4.3	3.2 ± 4.8	3.2 ± 4.8	3.9 ± 5.4
SDG	4.6 ± 6.0	4.5 ± 5.4	4.3 ± 6.1	4.3 ± 6.9	5.4 ± 8.2
SB	5.1 ± 7.0	5.3 ± 9.1	5.5 ± 7.7	6.2 ± 6.8	4.4 ± 7.5
DKS	6.3 ± 11.2	5.2 ± 8.1	4.3 ± 6.2	3.3 ± 5.2	5.0 ± 8.1
SI	7.1 ± 13.6	5.9 ± 10.3	5.5 ± 8.7	4.9 ± 8.0	4.9 ± 8.1
SBL	6.2 ± 7.0	5.7 ± 6.3	5.8 ±7.6	5.4 ± 5.5	5.1 ± 5.7
AMP	5.1 ± 7.7	4.4 ± 5.9	4.8 ± 6.3	4.9 ± 6.6	4.0 ± 5.4
LIK	1.8 ± 2.2	3.6 ± 5.2	2.7 ± 3.8	3.2 ± 6.1	3.9 ± 8.1
UMMC	-	8.1 ± 11.4	6.0 ± 8.2	6.1 ± 8.8	6.4 ± 9.3
LKW	-	4.2 ± 7.6	4.2 ± 5.9	4.1 ± 4.5	3.6 ± 3.8

BM	-	-	6.2 ± 9.1	6.6 ± 6.4	4.9 ± 6.2
SLR	-	5.3 ± 6.3	5.7 ± 8.1	6.6 ± 10.0	7.5 ± 15.7
PD	-	2.8 ± 3.4	2.7 ± 3.0	3.9 ± 9.5	3.0 ± 3.6
KKR	-	4.8 ± 6.3	5.3 ± 7.6	5.4 ± 8.0	3.6 ± 5.1
SGT	-	4.3 ± 7.1	3.0 ± 4.0	2.5 ± 2.5	2.4 ± 2.5
TM	-	-	3.7 ± 4.6	4.7 ± 6.6	3.3 ± 4.3
KEM	-	-	3.1 ± 2.2	5.2 ± 6.1	2.9 ± 2.6
KLP	-	-	2.1 ± 4.0	3.3 ± 4.7	5.0 ± 8.5
LAB	-	4.6 ± 6.6	3.8 ± 5.2	4.3 ± 5.3	5.3 ± 6.2
KEN	-	-	6.7 ± 9.8	5.2 ± 5.7	4.2 ± 7.7
BIN	-	6.2 ± 8.3	4.3 ± 5.0	3.9 ± 4.6	3.8 ± 5.3
LD	-	5.2 ± 14.0	5.4 ± 6.7	5.1 ± 5.6	6.4 ± 9.7
Total	**4.6 ± 7.1**	**4.5 ± 6.8**	**4.5 ± 6.6**	**4.9 ± 6.6**	**4.7 ± 7.3**

The average duration of mechanical ventilation was 4.7 days in 2015.

TI had the shortest average duration of invasive mechanical ventilation at 1.8 days while SLR had the longest average duration at 7.5 days.

Table 25 : Renal replacement therapy and modalities of therapy, by category of ICU 2015

	ICUs				
	Adm ≥ 1000 **n (%)**	**Adm 500 - 999** **n (%)**	**Adm < 500** **n (%)**	**UMMC** **n (%)**	**Total** **n (%)**
Renal replacement therapy	3820 (15.5)	1199 (15.7)	656 (10.9)	316 (24.5)	**5991 (15.2)**
Intermittent haemodialysis	2662 (62.9)	933 (74.5)	554 (81.8)	93 (27.4)	**4242 (65.3)**
CRRT	1465 (34.6)	306 (24.4)	73 (10.8)	245 (72.3)	**2089 (32.1)**
Peritoneal dialysis	102 (2.4)	14 (1.1)	50 (7.4)	1 (0.3)	**167 (2.6)**
Total	**4229 (100)**	**1253 (100)**	**677 (100)**	**339 (100)**	**6498 (100)**

Figure 19 : Renal replacement therapy, by category of ICU 2015

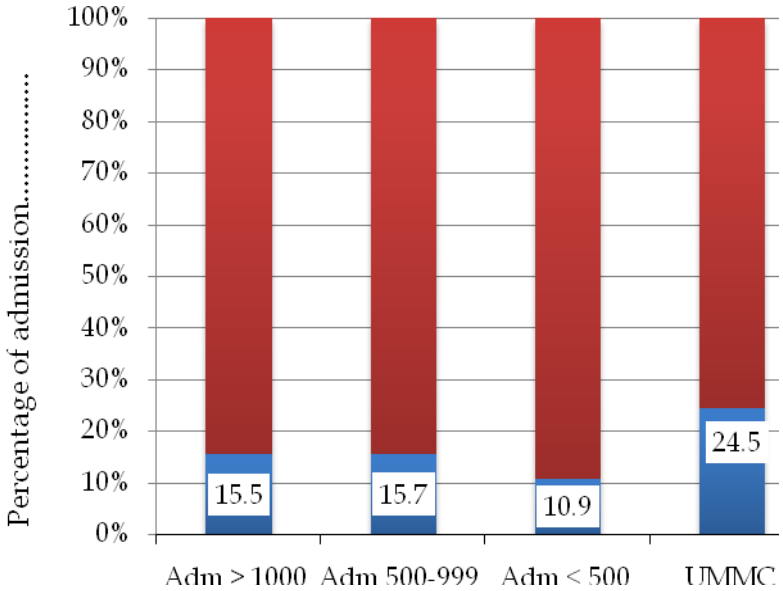
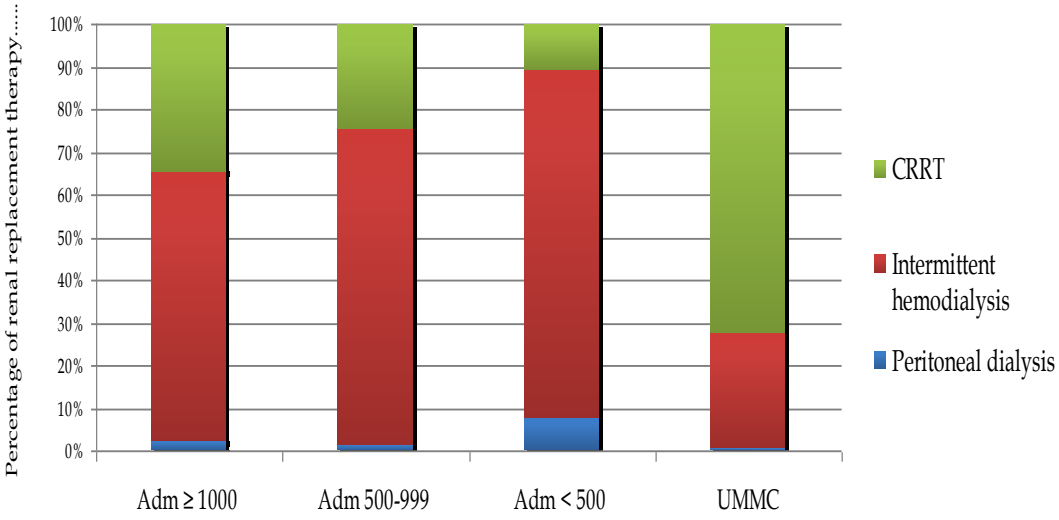


Figure 20 : Modalities of renal replacement therapy, by category of ICU 2015



In MOH ICUs, 14.8% of admissions received renal replacement therapy in 2015. These patients comprise of those with acute kidney injury and chronic kidney disease.

The worldwide prevalence of acute renal replacement therapy in ICUs is approximately 4% or two thirds of those with acute kidney injury [9]. Half of patients (49.3%) admitted with acute kidney injury underwent renal replacement therapy.

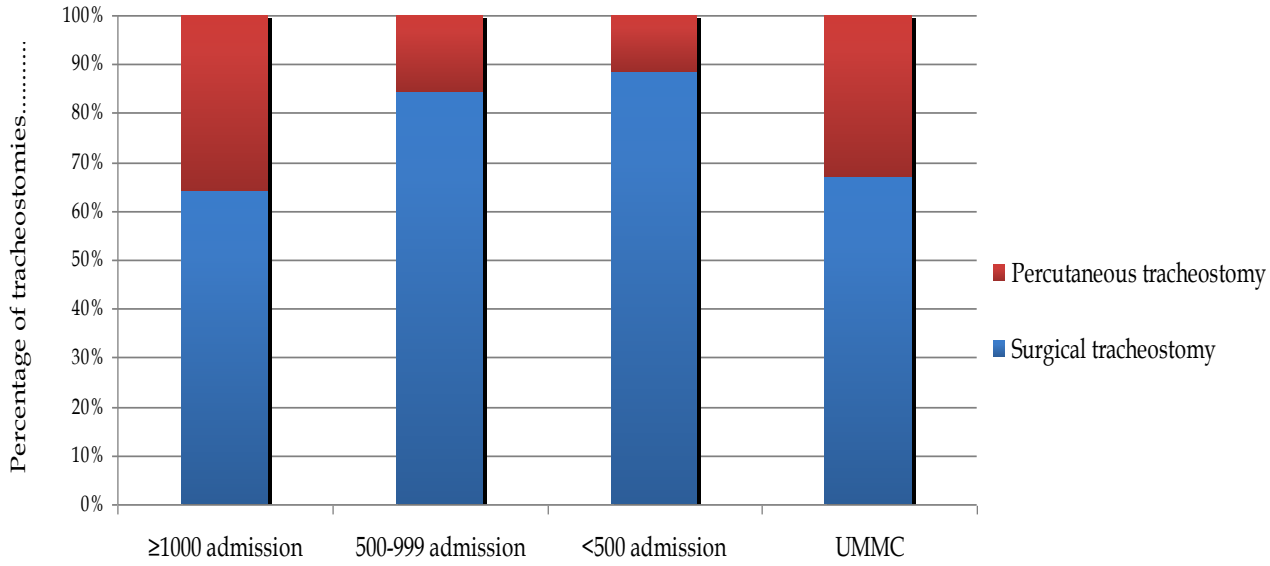
Intermittent haemodialysis and continuous renal replacement therapy were the most common modalities of renal replacement therapy performed in MOH ICUs and UMMC respectively

Table 26 : Tracheostomy, by category of ICU 2015

	ICUs				
	Adm ≥ 1000 n (%)	**Adm 500 - 999** n (%)	**Adm < 500** n (%)	**UMMC** n (%)	**Total** n (%)
Tracheostomy	1938 10.6%	455 7.9%	262 6.2%	85 9.2%	**2740** **9.4%**
Tracheostomy technique					
Surgical	1246 64.3%	384 84.4%	232 88.5%	57 67.1%	**1919** **70.0%**
Percutaneous	692 35.7%	71 15.6%	30 11.5%	28 32.9%	**821** **30.0%**

Tracheostomy: Refers to the procedure done during ICU stay

Figure 21 : Techniques of tracheostomy, by category of ICU 2015



In ICUs with more than 1000 admissions, 36% of tracheostomies were performed via the percutaneous technique.

In ICUs with 500 to 999 admissions and less than 500 admissions, the rates were 16% and 12% respectively.

UMMC had 33%of tracheostomies performed percutaneously.

Table 27 : Tracheostomy, by individual hospital 2015

Hospital	Tracheostomy performed n (%)	Tracheostomy in relation to days of ventilation mean (median)	Type of tracheostomy	
			Surgical n (%)	Percutaneous n (%)
AS	120 (9.6)	7.4 (6.2)	96 (80.0)	24 (20.0)
PP	151 (15.8)	9.0 (8.1)	52 (34.4)	99 (65.6)
IPH	150 (14.2)	9.4 (6.9)	89 (59.3)	61 (40.7)
KL	117 (8.7)	10.3 (8.4)	39 (33.3)	78 (66.7)
SLG	82 (8.4)	13.4 (11.9)	62 (75.6)	20 (24.4)
KLG	97 (7.4)	7.7 (5.9)	30 (30.9)	67 (69.1)
SBN	60 (15.3)	10.0 (8.9)	60 (100.0)	0 (0.0)
MLK	34 (3.8)	12.7 (12.9)	34 (100.0)	0 (0.0)
JB	234 (15.3)	7.7 (6.4)	71 (30.3)	163 (69.7)
KTN	98 (10.8)	13.0 (10.3)	91 (92.9)	7 (7.1)
KT	94 (8.5)	8.2 (5.4)	82 (87.2)	12 (12.8)
KB	46 (5.1)	18.7 (16.4)	17 (37.0)	29 (63.0)
KCH	92 (9.8)	8.6 (5.8)	72 (78.3)	20 (21.7)
KK	82 (11.7)	8.1 (5.8)	55 (67.1)	27 (32.9)
SP	54 (7.5)	11.2 (10.2)	54 (100.0)	0 (0.0)
PJY	34 (6.9)	11.0 (8.4)	34 (100.0)	0 (0.0)
MUR	26 (5.1)	6.8 (5.4)	26 (100.0)	0 (0.0)
TI	17 (5.4)	3.0 (2.5)	17 (100.0)	0 (0.0)
TPG	93 (11.1)	9.1 (7.8)	93 (100.0)	0 (0.0)
SJ	22 (5.7)	7.6 (8.0)	22 (100.0)	0 (15.0)
KJG	18 (5.8)	6.2 (4.9)	18 (100.0)	0 (0.0)
KGR	21 (8.4)	7.5 (5.5)	13 (61.9)	8 (38.1)
TML	51 (8.1)	9.8 (8.5)	50 (98.0)	1 (2.0)
KP	11 (2.8)	15.9 (14.6)	11 (100.0)	0 (0.0)
SMJ	12 (4.0)	9.8 (4.0)	1 (8.3)	11 (91.7)
BP	27 (6.1)	7.7 (6.4)	25 (92.6)	2 (7.4)
TW	36 (10.6)	10.6 (6.6)	36 (100.0)	0 (0.0)
MRI	28 (8.5)	10.1 (8.1)	26 (92.9)	2 (7.1)
KLM	46 (10.5)	7.2 (5.7)	44 (95.7)	2 (4.3)
SDG	43 (8.7)	12.3 (10.3)	43 (100)	0 (0.0)
SB	167 (16.4)	4.3 (3.4)	167 (100.0)	0 (0.0)
DKS	35 (5.1)	10.9 (10.2)	35 (100.0)	0 (0.0)
SI	80 (7.8)	11.4 (9.3)	75 (93.8)	5 (6.2)
SBL	229 (14.5)	9.5 (8.5)	122 (53.3)	107 (46.7)
AMP	40 (7.1)	9.0 (6.9)	1 (2.5)	39 (97.5)
LIK	4 (7.3)	11.3 (12.3)	4 (100.0)	0 (0.0)
UMMC	85 (9.2)	14.9 (11.9)	57 (67.1)	28 (32.9)
LKW	8 (5.0)	7.9 (6.1)	8 (100.0)	0 (0.0)
BM	21 (10.9)	7.7 (3.8)	21 (100.0)	0 (0.0)
SLR	6 (4.2)	11.7 (12.4)	5 (83.3)	1 (16.7)

PD	3 (3.9)	13.5 (16.6)	2 (66.7)	1 (33.3)
KKR	3 (1.2)	1.7 (0.0)	3 (100.0)	0 (0.0)
SGT	17 (7.4)	11.6 (4.1)	17 (100.0)	0 (0.0)
TM	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
KEM	12 (9.8)	5.4 (6.0)	12 (100.0)	0 (0.0)
KLP	1 (1.6)	47.0 (47.0)	1 (100.0)	0 (0.0)
LAB	6 (5.0)	13.5 (11.5)	6 (100.0)	0 (0.0)
KEN	9 (10.3)	5.5 (4.4)	4 (44.4)	5 (55.6)
BIN	8 (3.3)	13.1 (12.2)	7 (87.5)	1 (12.5)
LD	10 (7.8)	12.6 (9.9)	9 (90.0)	1 (10.0)
Total	**2740 (9.4)**	**9.4 (7.5)**	**1919 (70.0)**	**821 (30.0)**

Among all invasively ventilated patients, 9.4% had tracheostomies performed.

The mean duration between the initiation of invasive ventilation and tracheostomy was 9.4 days.

Table 28 : Total number of tracheostomies and percentage of percutaneous tracheostomies, by individual hospital 2011 – 2015

	Total number of tracheostomies (% percutaneous tracheostomies) n (%)				
	2011	**2012**	**2013**	**2014**	**2015**
AS	126 (23.0)	150 (23.3)	160 (23.1)	131 (28.2)	120 (20.0)
PP	199 (64.8)	210 (65.7)	196 (65.8)	196 (72.4)	151 (65.6)
IPH	140 (2.9)	109 (16.5)	141 (50.4)	161 (47.2)	150 (40.7)
KL	128 (75.0)	149 (75.8)	119 (74.8)	125 (82.4)	117 (66.7)
SLG	77 (18.2)	102 (28.4)	121 (28.1)	107 (18.7)	82 (24.4)
KLG	190 (73.7)	155 (76.1)	133 (75.9)	113 (80.5)	97 (69.1)
SBN	68 (1.5)	55 (0.0)	50 (0.0)	40 (0.0)	60 (0)
MLK	100 (1.0)	88 (0.0)	57 (0.0)	35 (0.0)	34 (0)
JB	465 (79.4)	332 (73.2)	238 (68.1)	207 (67.1)	234 (69.7)
KTN	80 (7.5)	112 (4.5)	115 (7.8)	117 (8.5)	98 (7.1)
KT	67 (50.7)	88 (37.5)	95 (38.9)	94 (19.1)	94 (12.8)
KB	29 (24.1)	27 (37.0)	40 (22.5)	38 (36.8)	46 (63.0)
KCH	63 (36.5)	71 (23.9)	76 (6.6)	65 (3.1)	92 (21.7)
KK	46 (8.7)	104 (25.0)	123 (14.6)	80 (10.0)	82 (32.9)
SP	23 (0)	11 (0.0)	30 (0.0)	46 (0.0)	54 (0)
PJY	21 (0)	26 (0.0)	19 (5.3)	20 (0.0)	34 (0)
MUR	36 (0)	40 (2.5)	29 (0.0)	23 (4.3)	26 (0)
TI	18 (0)	24 (0.0)	13 (0.0)	20 (0.0)	17 (0)
TPG	149 (0)	127 (0.8)	108 (0.0)	59 (0.0)	93 (0)
SJ	61 (37.7)	57 (22.8)	42 (69.0)	40 (15.0)	22 (0)
KJG	19 (5.3)	14 (0.0)	24 (0.0)	35 (0.0)	18 (0)

KGR	7 (0)	19 (0.0)	38 (2.6)	12 (0.0)	21 (38.1)
TML	38 (0)	29 (3.4)	39 (0.0)	50 (0.0)	51 (2.0)
KP	27 (0)	24 (0.0)	14 (0.0)	12 (0.0)	11 (0)
SMJ	9 (88.9)	16 (75.0)	10 (100.0)	12 (91.7)	12 (91.7)
BP	54 (0)	36 (0.0)	35 (0.0)	48 (0.0)	27 (7.4)
TW	21 (0)	25 (0.0)	34 (2.9)	42 (0.0)	36 (0)
MRI	8 (0)	33 (18.2)	22 (4.5)	16 (0.0)	28 (7.1)
KLM	55 (0)	78 (0.0)	46 (0.0)	32 (0.0)	46 (4.3)
SDG	52 (42.3)	56 (32.1)	64 (7.8)	48 (2.1)	43 (0)
SB	36 (0)	56 (3.6)	52 (0.0)	73 (0.0)	167 (0)
DKS	21 (76.2)	25 (80.0)	36 (88.9)	32 (12.5)	35 (0)
SI	64 (26.6)	66 (24.2)	72 (9.7)	60 (23.3)	80 (6.2)
SBL	262 (68.3)	206 (42.7)	197 (42.6)	192 (31.2)	229 (46.7)
AMP	55 (92.7)	59 (93.2)	55 (85.5)	51 (96.1)	40 (97.5)
LIK	1 (0)	5 (0.0)	6 (0.0)	2 (0.0)	4 (0)
UMMC		76 (21.1)	64 (18.8)	93 (20.4)	85 (32.9)
LKW		10 (0.0)	11 (0.0)	3 (0.0)	8 (0)
BM		11 (0.0)	17 (17.6)	12 (16.7)	21 (0)
SLR		5 (0.0)	7 (14.3)	16 (6.2)	6 (16.7)
PD		5 (0.0)	5 (0.0)	8 (0.0)	3 (33.3)
KKR		6 (0.0)	7 (0.0)	7 (0.0)	3 (0)
SGT		7 (0.0)	10 (0.0)	5 (0.0)	17 (0)
TM		-		0 (0.0)	0 (0)
KEM		1 (0.0)	1 (0.0)	6 (0.0)	12 (0)
KLP		-	1 (0.0)	1 (0.0)	1 (0)
LAB		6 (0.0)	14 (0.0)	2 (0.0)	6 (0)
KEN		-	9 (0.0)	7 (14.3)	9 (55.6)
BIN		12 (58.3)	12 (0.0)	12 (0.0)	8 (12.5)
LD		10 (80.0)	21 (23.8)	12 (8.3)	10 (10.0)
Total	**2821 (41.7)**	**2936 (35.8)**	**2831 (33.2)**	**2618 (31.7)**	**2740 (30.0)**

In 2015, 30.0% of all tracheostomies were performed percutaneously. The percentage of percutaneous tracheostomies had increased from 2002 until 2011. This however, decreased in trend since 2011.

Table 29 : Withdrawal / Withholding therapy, by individual hospital 2011 – 2015

Hospital	Withdrawal / Withholding of therapy n (%)				
	2011	2012	2013	2014	2015
AS	192 (66.2)	203 (64.2)	253 (71.5)	317 (84.3)	257 (74.5)
PP	105 (60.7)	191 (91.4)	133 (78.2)	85 (42.7)	139 (61.0)
IPH	0 (0.0)	7 (4.6)	48 (23.1)	39 (19.8)	149 (55.4)
KL	230 (73.5)	299 (83.8)	267 (80.4)	250 (81.4)	248 (69.5)
SLG	6 (2.9)	42 (20.9)	110 (54.7)	71 (37.0)	150 (62.2)
KLG	162 (58.9)	206 (63.2)	137 (49.5)	164 (54.1)	286 (83.6)
SBN	58 (49.2)	61 (52.6)	36 (38.7)	48 (42.9)	43 (43.4)
MLK	38 (10.4)	22 (5.7)	58 (15.4)	146 (52.5)	33 (11.2)
JB	270 (72.8)	278 (75.7)	332 (79.8)	234 (83.0)	294 (84.5)
KTN	4 (3.8)	9 (5.8)	11 (6.0)	12 (6.4)	10 (4.5)
KT	82 (32.5)	54 (21.5)	48 (19.2)	23 (9.5)	15 (5.8)
KB	3 (1.5)	48 (23.8)	33 (17.5)	23 (12.7)	83 (50.6)
KCH	1 (0.7)	8 (5.4)	7 (4.2)	18 (11.2)	38 (19.7)
KK	29 (17.9)	43 (22.8)	60 (30.9)	121 (72.5)	102 (70.8)
SP	1 (1.1)	0 (0.0)	5 (3.9)	21 (10.0)	9 (5.1)
PJY	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	19 (17.8)
MUR	4 (3.1)	33 (22.4)	38 (29.0)	43 (30.7)	43 (30.9)
TI	0 (0.0)	1 (1.5)	3 (3.7)	2 (2.2)	27 (29.3)
TPG	56 (24.1)	108 (43.2)	100 (43.1)	105 (46.3)	45 (18.8)
SJ	53 (36.3)	67 (48.9)	40 (37.0)	13 (14.3)	17 (20.2)
KJG	5 (8.6)	4 (7.7)	1 (2.0)	0 (0.0)	0 (0.0)
KGR	-	1 (1.8)	0 (0.0)	11 (19.3)	12 (17.9)
SJMC	2 (2.3)	4 (6.5)	0 (0.0)	0 (0.0)	-
TML	2 (1.9)	4 (6.3)	9 (9.6)	11 (7.1)	1 (0.6)
KP	21 (17.2)	19 (20.2)	43 (39.8)	41 (28.5)	40 (30.8)
SMJ	31 (33.3)	27 (28.7)	17 (17.2)	21 (18.4)	5 (6.2)
BP	13 (13.4)	11 (9.2)	28 (26.9)	11(12.0)	2 (2.3)
TW	7 (16.3)	8 (14.8)	4 (6.0)	0 (0.0)	5 (6.4)
MRI	2 (2.3)	9 (10.6)	7 (7.8)	7 (10.8)	27 (30.0)
KLM	59 (44.4)	66 (54.5)	70 (52.6)	53 (40.8)	56 (46.7)
SDG	53 (34.0)	0 (0.0)	3 (1.9)	1 (0.7)	0 (0.0)
SB	63 (46.3)	58 (54.2)	51 (42.1)	31 (26.7)	160 (80.4)
DKS	10 (7.1)	5 (3.9)	4 (1.7)	23 (12.6)	3 (1.7)
SI	21 (15.2)	11 (5.6)	11 (5.5)	9 (4.1)	68 (24.0)
SBL	185 (83.3)	198 (74.2)	212 (63.9)	262 (63.0)	232 (56.0)
AMP	8 (4.2)	146 (69.2)	46 (26.7)	21 (9.4)	3 (1.3)
LIK	1 (9.1)	0 (0.0)	3 (14.3)	0 (0.0)	6 (60.0)
UMMC	-	63 (66.3)	89 (62.7)	156 (67.0)	194 (80.5)
LKW	-	11 (25.0)	8 (25.8)	3 (7.5)	47 (87.0)
BM	-	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.9)

SLR	-	2 (3.4)	0 (0.0)	4 (5.8)	4 (5.6)
PD	-	7 (26.9)	19 (50.0)	1 (2.6)	5 (14.3)
KKR	-	8 (38.1)	24 (42.9)	5 (9.1)	9 (16.7)
SGT	-	1 (3.8)	3 (10.0)	4 (14.8)	5 (8.5)
TM	-	0 (0.0)	1 (3.7)	19 (55.9)	24 (53.3)
KEM	-	3 (33.3)	6 (40.0)	4 (33.3)	4 (22.2)
KLP	-	-	1 (10.0)	1 (9.1)	0 (0.0)
LAB	-	5 (16.7)	0 (0.0)	1 (1.50	6 (15.4)
KEN	-	0 (0.0)	1 (9.1)	0 (0.0)	0 (0.0)
BIN	-	6 (16.7)	6 (18.2)	0 (0.0)	0 (0.0)
LD	-	2 (4.2)	2 (4.3)	7 (13.0)	0 (0.0)
Total		**1778 (30.8)**	**2359 (36.9)**	**2388 (35.1)**	**2926 (39.4)**

Withdrawal or withholding of therapy : refers to the discontinuation/not initiating any of the following: vasoactive drugs, renal replacement therapy, mechanical ventilation, surgery, cardiopulmonary resuscitation

Therapy was withheld or withdrawn in 39.4% of deaths in ICU. There was a wide variability of this practice ranging from 0% (KJG, SDG, KLP, KEN, BIN, LD) to 87% (LKW).

In a retrospective audit of all deaths in two major tertiary ICUs in New South Wales, Australia in 2008, 34% had treatments withheld and another 47% had withdrawal of life-sustaining therapy [10].

In a prospective observational study of the end-of-life practices in 37 ICUs in 17 European countries from January 1, 1999, to June 30, 2000, 72.6% of those who died had life-limiting treatment [11].

SECTION D:

COMPLICATIONS

1. Ventilator-associated pneumonia
2. Unplanned extubation
3. Pressure ulcers

Table 30 : Incidence of ventilator-associated pneumonia, by individual hospital 2010 – 2015

Hospital	VAP per 1000 ventilator days					
	2010	2011	2012	2013	2014	2015
AS	9.6	7.5	3.0	1.3	0.6	1.5
PP	12.9	10.1	6.9	4.2	4.4	3.2
IPH	12.3	3.7	7.2	8.8	4.4	4.7
KL	15.2	13.6	13.5	7.5	6.0	3.3
SLG	13.5	8.4	4.6	5.6	3.8	7.0
KLG	3.5	3.8	3.6	9.2	3.1	0.4
SBN	8.7	4.4	2.4	3.4	2.5	1.7
MLK	8.5	9.1	7.0	1.6	0.9	1.1
JB	9.0	5.4	4.3	0.9	0.5	0.0
KTN	3.3	1.6	2.7	1.2	0.4	0.2
KT	8.7	4.1	7.2	2.9	0.8	1.3
KB	4.1	5.6	9.2	7.5	4.2	0.0
KCH	5.0	2.4	6.3	0.0	2.1	2.1
KK	0.4	-	0.8	2.4	3.2	2.7
SP	23.4	23.6	8.3	4.3	7.2	1.0
PJY	14.4	9.3	3.8	8.6	2.6	2.1
MUR	4.9	1.7	0.6	0.7	0.6	0.6
TI	8.8	1.4	2.0	0.0	4.1	7.1
TPG	3.0	0.6	1.1	0.0	0.2	1.3
SJ	14.7	5.4	3.5	3.3	5.6	2.9
KJG	10.9	6.0	10.3	14.3	4.8	6.1
KGR	10.8	8.7	21.0	11.8	8.6	6.6
TML	4.0	0.5	0	1.6	4.2	6.3
KP	2.2	0.7	0.8	1.9	2.9	1.1
SMJ	37.3	3.2	2.9	0.0	1.2	1.2
BP	2.3	0.7	1.7	0.6	0.6	0.0
TW	8.7	4.3	8.3	8.9	5.4	0.0
MRI	2.8	1.8	3.2	3.5	8.4	2.7
KLM	36.7	24.7	28.3	8.6	10.3	4.2
SDG	13.5	13.4	9.3	7.7	2.8	1.5
SB	7.7	10.4	11.3	6.2	7.7	3.3
DKS	7.0	0.4	1.6	0.0	2.2	2.5
SI	11.1	12.5	16.6	8.3	5.0	0.4
SBL	22.7	9.9	7.1	7.6	4.2	4.0
AMP	18.4	33.0	35.0	14.5	6.6	2.5
LIK	0.0	0.0	4.1	0.0	1.6	0.0
LKW	-	-	16.2	0.0	0.0	0.1
BM	-	-	-	0.7	0.8	1.3
SLR	-	-	24.9	13.3	11.2	4.8
PD	-	-	17.5	3.0	3.1	2.6
KKR	-	-	9.5	22.2	18.0	5.7
SGT	-	-	16.8	5.1	6.5	0.9
TM	-	-	-	0.0	0.0	1.7
KEM	-	-	-	0.0	0.0	0.0

KLP	-	-	-	0.0	0.0	0.0
LAB	-	-	3.6	2.0	11.1	12.4
KEN	-	-	-	2.3	0.0	1.3
BIN	-	-	22.4	11.2	0.3	2.4
LD	-	-	3.2		1.0	0.0
MOH hospitals	**10.1**	**6.8**	**7.2**	**5.4**	**3.6**	**2.4**
UMMC			**8.5**	**6.0**	**7.3**	**7.1**

VAP: Defined as nosocomial pneumonia developing in a patient after 48 hours of mechanical ventilation with radiological evidence of new or progressive infiltrates with or without the presence of a positive bacteriological culture

Table 31 : Onset of VAP from initiation of invasive ventilation, by individual hospital 2011 – 2015

Hospital	Interval from initiation of ventilation to VAP Mean (Median) days				
	2011	**2012**	**2013**	**2014**	**2015**
AS	7.9	11.0 (9.0)	19.6 (15.0)	11.9 (10.3)	4.3 (4.3)
PP	11.0	11.2 (7.8)	14.0 (13.2)	16.9 (15.8)	11.8 (10.2)
IPH	7.7	9.1 (7.7)	7.1 (5.7)	7.7 (7.1)	7.6 (6.4)
KL	11.8	10.3 (8.9)	13.3 (11.0)	13.6 (12.1)	10.2 (8.7)
SLG	11.2	11.4 (8.0)	12.0 (11.5)	13.3 (11.7)	15.9 (14.5)
KLG	11.0	12.9 (12.0)	7.3 (5.8)	12.0 (11.6)	11.3 (11.3)
SBN	15.4	7.7 (8.3)	15.2 (7.3)	9.0 (7.1)	5.4 (3.4)
MLK	7.2	7.8 (5.5)	20.0 (8.6)	30.3 (31.0)	10.2 (10.2)
JB	8.4	10.5 (5.7)	9.3 (6.5)	7.6 (5.6)	7.6 (10.2)
KTN	9.5	11.5 (10.9)	11.8 (6.6)	20.4 (20.4)	-
KT	8.6	10.9 (10.0)	11.7 (11.2)	15.3 (15.3)	10.6 (10.6)
KB	11.9	13.6 (11.3)	12.0 (10.7)	16.7 (16.4)	-
KCH	11.4	9.3 (6.6)	12.6 (12.1)	6.4 (7.6)	10.6 (7.6)
KK	*	7.7 (7.1)	10.0 (7.3)	13.4 (8.9)	8.8 (7.5)
SP	7.0	6.5 (6.5)	9.6 (7.9)	8.0 (6.6)	8.9 (8.9)
PJY	13.9	12.3 (10.9)	8.1 (7.7)	12.7 (8.6)	10.5 (9.9)
MUR	12.2	-	-	13.3 (13.3)	12.8 (12.8)
TI	19.5	16.8 (16.8)	12.2 (12.2)	9.6 (10.4)	5.4 (3.9)
TPG	9.6	16.3 (13.1)	-	-	14.5 (8.2)
SJ	9.3	12.0 (10.3)	14.6 (7.9)	9.5 (10.0)	13.8 (13.8)
KJG	6.2	7.6 (6.7)	7.9 (6.6)	6.4 (5.8)	12.1 (8.4)
KGR	3.9	9.6 (7.2)	9.1 (7.4)	8.5 (6.3)	3.3 (3.3)
SJMC	5.4	-	3.9 (3.9)	-	-
TML	9.0	-	6.8 (6.8)	10.2 (8.3)	9.2 (7.8)
KP	20.3	21.3 (21.3)	5.1 (5.1)	15.2 (15.2)	2.9 (2.9)
SMJ	13.2	12.6 (12.6)	3.7 (3.7)	7.4 (7.4)	6.6 (6.6)
BP	7.1	32.0 (32.0)	10.1 (10.1)	8.2 (8.2)	-
TW	10.1	5.6 (4.1)	5.7 (4.2)	11.8 (10.5)	-
MRI	4.0	6.8 (6.8)	12.9 (7.5)	8.0 (8.0)	7.3 (7.5)
KLM	7.6	6.4 (4.6)	7.6 (8.0)	8.0 (6.1)	11.5 (12.3)
SDG	7.9	12.4 (12.1)	9.6 (8.2)	13.3 (10.8)	12.6 (13.3)

SB	6.0	10.6 (7.2)	9.1 (8.6)	8.4 (7.6)	7.8 (7.3)
DKS	7.1	7.0 (5.5)	6.6 (5.6)	6.4 (6.4)	11.6 (11.9)
SI	12.1	11.5 (10.0)	9.7 (7.5)	10.3 (9.1)	4.2 (3.4)
SBL	10.7	9.6 (7.8)	7.9 (6.3)	9.5 (9.2)	7.8 (5.8)
AMP	8.5	6.5 (5.3)	8.6 (7.9)	7.6 (7.1)	20.5 (16.9)
LIK	-	3.0 (3.0)	-	20.7 (20.7)	10.0 (10.0)
UMMC	-	15.2 (10.8)	8.2 (7.8)	11.2 (8.0)	11.8 (7.1)
LKW	-	6.0 (4.4)	9.4 (3.9)	-	-
BM	-	2.2 (2.2)	-	6.2 (6.2)	8.4 (3.7)
SLR	-	8.5 (5.9)	10.0 (7.8)	11.5 (10.3)	8.1 (8.1)
PD	-	9.5 (9.5)	11.5 (11.5)	-	-
KKR	-	8.8 (9.5)	13.3 (9.4)	7.4 (6.9)	-
SGT	-	10.0 (7.3)	6.3 (6.3)	7.0 (8.2)	-
TM	-	-	6.4 (6.5)	-	16.7 (16.7)
KEM	-	-	-	-	-
KLP	-	-	-	-	-
LAB	-	10.1 (10.1)	15.9 (15.9)	9.3 (9.3)	4.9 (4.1)
KEN	-	-	-	2.5 (2.5)	-
BIN	-	12.2 (11.2)	8.5 (9.2)	8.2 (8.2)	10.0 (4.3)
LD	-	10.5 (10.5)	7.6 (5.6)	6.3 (6.3)	-
Total	**9.7**	**10.1 (7.8)**	**10.0 (7.9)**	**10.8 (8.8)**	**10.3 (8.1)**

Figure 22 : Ventilator-associated pneumonia, per 1000 ventilator days 2004 – 2015

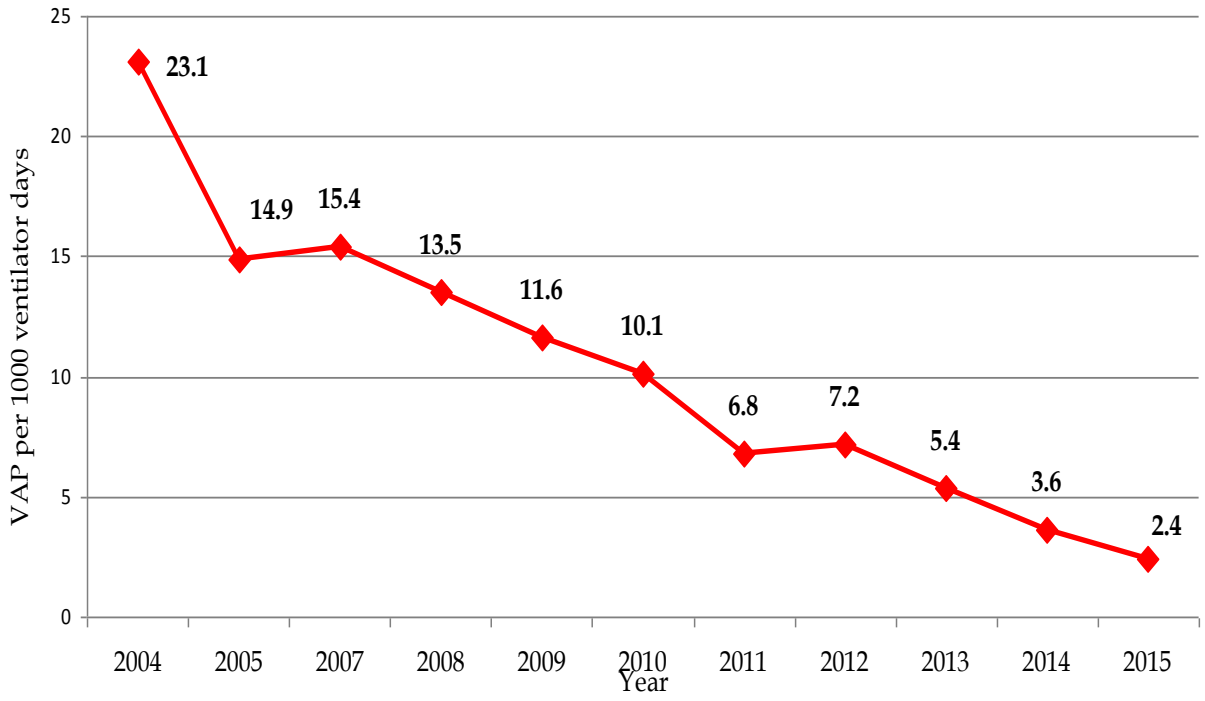
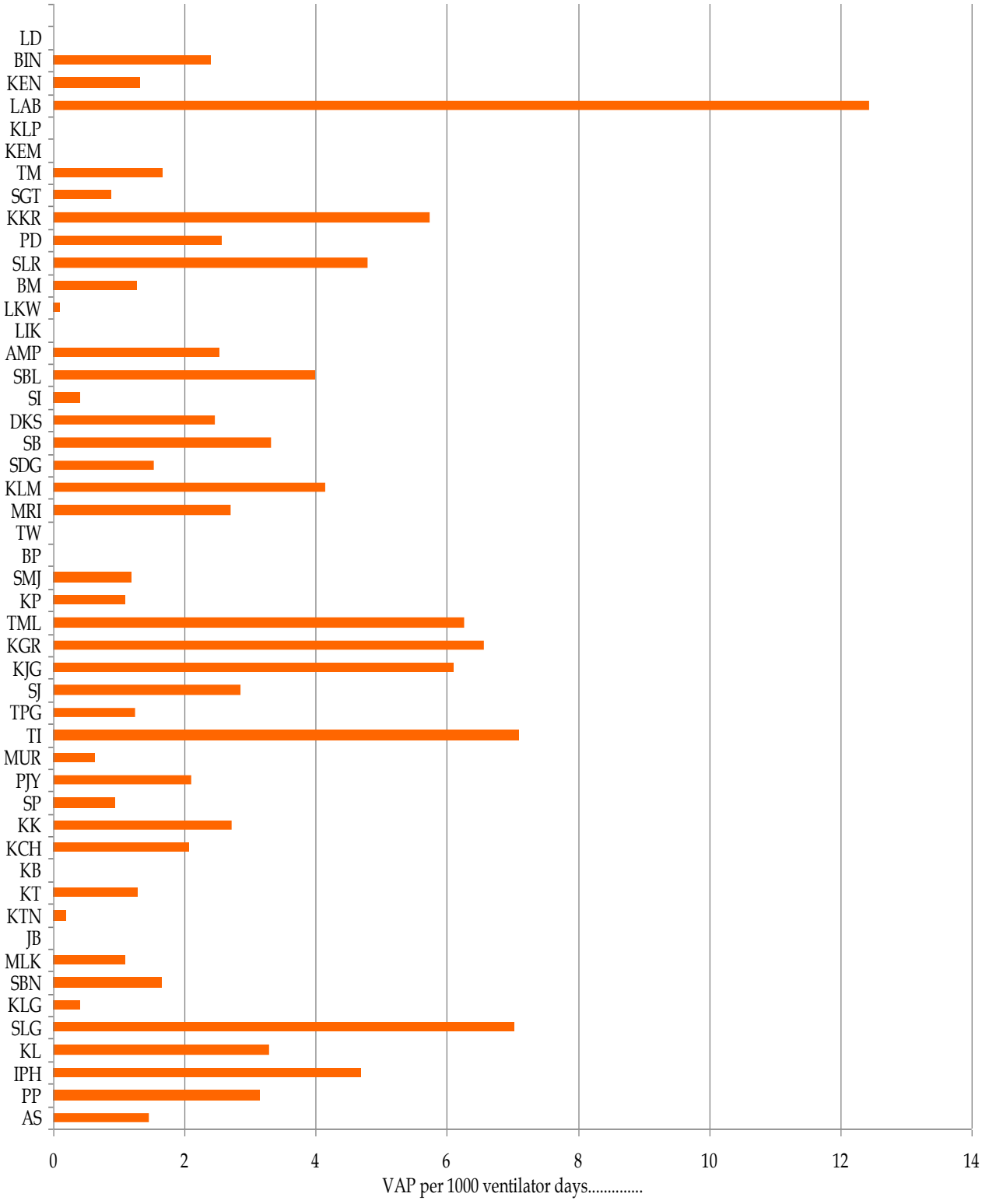


Figure 23 : Ventilator-associated pneumonia, per 1000 ventilator days, by individual hospital 2015



National Healthcare Safety Network (NHSN) report, data summary for 2012 [12]							
Types of ICU	**Ventilator utilisation ratio**	**VAP per 1000 ventilator days**					
		Pooled mean	**Percentile**				
			10th	**25th**	**50th**	**75th**	**90th**
Mixed medical/ surgical > 15 beds	0.34	0.9	0.0	0.0	0.4	1.3	2.8
Mixed medical/ surgical ≤ 15 beds	0.24	1.1	0.0	0.0	0.0	1.2	3.6
Neurosurgical	0.30	2.1	0.0	0.0	1.5	2.9	3.8
Surgical	0.34	2.0	0.0	0.0	0.9	2.8	5.9
Trauma	0.47	3.6	0.0	0.8	2.6	6.0	9.4

In January 2013, the National Healthcare Safety Network (NHSN) in US introduced new surveillance criteria for ventilator-associated events (VAEs) which include ventilator-associated condition (VAC), infection-related ventilator-associated complication (IVAC) and possible or probable VAP [31]. This was done to capture common complications of ventilator care (i.e. VAC, IVAC and VAP) and improve objectivity of surveillance VAP to allow comparisons across centres.

These new criteria involve a three-tiered approach that can be explained simply as below:

- Tier 1 assesses for VAC from worsening oxygenation status that necessitates increased fractional inspired oxygen (FiO2) or positive end-expiratory pressure (PEEP), or both
- Tier 2 assesses for IVAC with objective changes in temperature and/or white blood cell (WBC) counts along with new antibiotic treatment.
- Tier 3 assesses for possible or probable VAP, as determined by respiratory specimens for microbiologic tests e.g. Gram stain and cultures.

We have adopted these criteria as surveillance diagnosis of VAP in our ICUs from beginning of the year (2015). It is important to note that the VAE definition algorithm is for use in surveillance. It is not a clinical definition algorithm and is not intended for use in the clinical management of patients.

The incidence of VAP had decreased steadily over the past 9 years. In 2007, the VAP rate was 15.4 per 1000 ventilator days. It had decreased by around five times to 3.6 per 1000 ventilator days in 2014 and 2.4 per 1000 ventilator days in 2015.

The mean rate of VAP (2.4 per 1000 ventilator days) in our ICUs was much higher when benchmarked with that of US National Healthcare Safety Network (NHSN) [12]; as shown in the table above. The definition for VAP by NHSN has a more stringent inclusion criterion (resulting in fewer cases being defined as VAP) compared to ours.

However, the rate of VAP in our ICUs was lower compared with the pooled VAP rate of 15.8 per 1000 ventilator days as reported by Rosenthal et. al.[13] in ICUs in 36 countries in Latin America, Asia, Africa and Europe between 2004 to 2009.

Ventilator usage is a significant risk factor for developing VAP and the exposure to this risk is measured by ventilator utilisation ratio, which is calculated by dividing the number of ventilator

days to number of patient days. Ventilator utilisation ratio in our ICUs in 2015 was 0.7, which is more than two times higher than the ICUs in US.

The onset of VAP was 10.3 days from the initiation of invasive ventilation. Onset of VAP in most centres except AS (4.3 days), KGR (3.3 days), KP (2.9 days), SI (4.2 days) and LAB (4.9 days) exceeded 5 days of ventilation, indicating that VAPs in MOH and UMMC ICUs were mostly of late onset.

Table 32 : Bacteriological cultures in VAP, by category of ICU 2015

Organisms	ICUs				
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	UMMC n (%)	Total n (%)
Acinetobacter spp.	80 (47.9)	31 (39.7)	28 (42.4)	15 (44.1)	**154 (44.6)**
MRO	73 (91.3)	29 (93.5)	18 (64.3)	14 (93.3)	134 (87.0)
Non-MRO	7 (8.7)	2 (6.5)	10 (35.7)	1 (6.7)	20 (13.0)
Klebsiella spp.	34 (20.4)	19 (24.4)	9 (13.6)	8 (23.5)	**70 (20.3)**
ESBL	25 (73.5)	15 (78.9)	6 (66.7)	3 (37.5)	49 (70.0)
CRE	1 (2.9)	0	0	1 (12.5)	2 (2.9)
Non MRO	8 (23.5)	4 (21.1)	3 (33.3)	4 (50.0)	19 (27.1)
Pseudomonas aeruginosa	23 (13.8)	12 (15.4)	10 (15.2)	7 (20.6)	**52 (15.1)**
MRO	5 (21.7)	1 (8.3)	2 (20.0)	2 (28.6)	10 (19.2)
Non-MRO	18 (78.3)	11 (91.7)	8 (80.0)	5 (71.4)	42 (80.8)
Staphylococcus aureus	16 (9.6)	3 (3.8)	10 (15.2)	0	**29 (8.4)**
MSSA	1 (6.2)	2 (66.7)	3 (30.0)	0	6 (20.7)
MRSA	15 (93.8)	1 (33.3)	6 (60.0)	0	22 (75.9)
VRSA	0	0	1 (10.0)	0	1 (3.4)
Enterobacter spp	5 (3.0)	1 (1.3)	6 (9.1)	1 (2.9)	**13 (3.8)**
ESBL	1 (20.0)	0	6 (100.0)	0	7 (53.8)
CRE	0	0	0	1	1 (7.7)
Non MRO	4 (80.0)	1 (100.0)	0	0	5 (38.5)
Stenotrophomonas maltophilia	1 (0.6)	4 (5.1)	0 (0)	0 (0)	**5 (1.4)**
Escherichia coli	2 (1.2)	2 (2.6)	0	0	**4 (1.2)**
ESBL	0	1 (50.0)	0	0	1 (0.25)
CRE	0	0	0	0	0
Non MRO	2 (100.0)	1 (50.0)	0	0	3 (0.75)
Other MRO	0	1 (1.3)	1 (1.5)	0	**2 (0.6)**
Other Non- MRO	6 (3.6)	5 (6.4)	2 (3.0)	3 (8.8)	**16 (4.6)**
Total	**167 (100.0)**	**78 (100.0)**	**66 (100.0)**	**34 (100.0)**	**345 (100.0)**

MRSA : Methicillin-resistant Staphylococcus aureus
MSSA : Methicillin-sensitive Staphylococcus aureus
VRSA : Vancomycin-resistant Staphylococcus aureus
ESBL : Extended spectrum beta-lactamases
CRE : Carbapenem-resistant Enterobacteriaceae

Figure 24 : Bacteriological cultures in VAP 2015

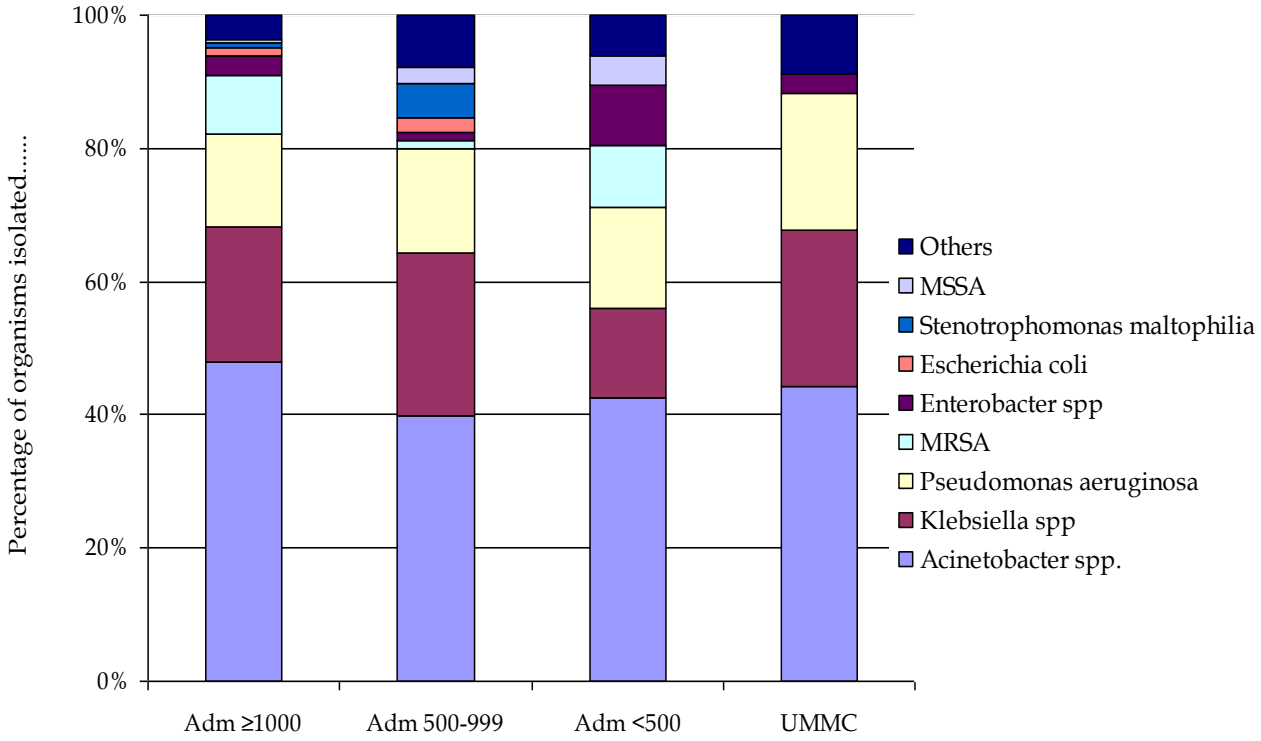
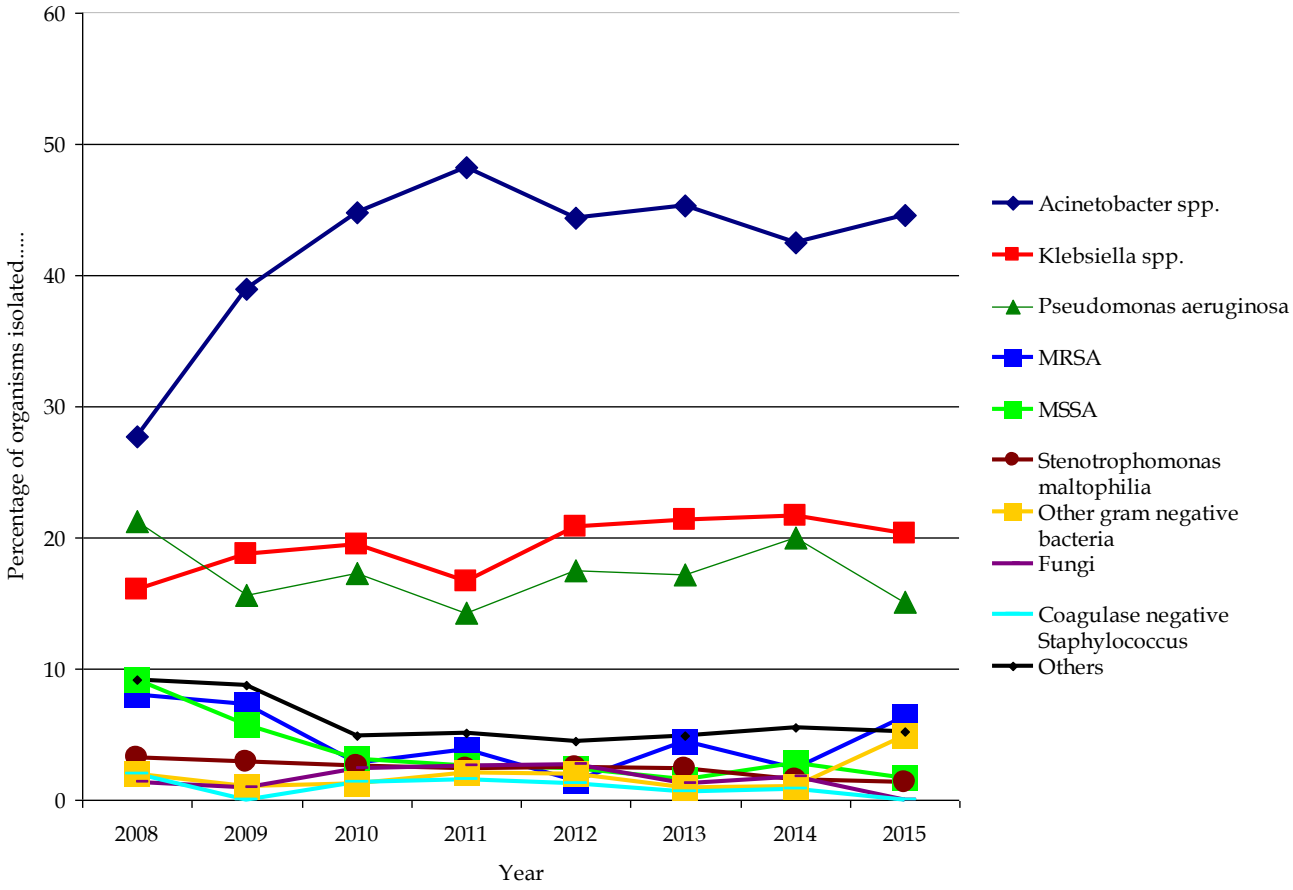


Table 33 : Bacteriological cultures in VAP 2009 – 2015

Organisms	2009 n (%)	2010 n (%)	2011 n (%)	2012 n (%)	2013 n (%)	2014 n (%)	2015 n (%)
Acinetobacter spp.	267 (39.0)	350 (44.8)	377 (48.2)	351 (44.4)	315 (45.3)	215 (42.5)	154 (44.6)
Klebsiella spp.	128 (18.7)	152 (19.5)	131 (16.7)	165 (20.8)	149 (21.4)	110 (21.7)	70 (20.3)
Pseudomonas aeruginosa	107 (15.6)	135 (17.3)	112 (14.3)	139 (17.5)	120 (17.2)	101 (20.0)	52 (15.1)
MRSA	50 (7.3)	22 (2.8)	31 (3.9)	12 (1.5)	31 (4.5)	12 (2.4)	22 (6.4)
MSSA	39 (5.7)	24 (3.1)	21 (2.6)	19 (2.4)	11 (1.6)	14 (2.8)	6 (1.7)
Stenotrophomonas maltophilia	20 (2.9)	20 (2.6)	19 (2.4)	20 (2.5)	17 (2.4)	8 (1.6)	5 (1.4)
Other gram negative bacteria	7 (1.0)	10 (1.3)	17 (2.1)	16 (2.0)	6 (0.9)	5 (1.0)	17 (4.9)
Fungi	6 (0.9)	19 (2.4)	21 (2.6)	22 (2.7)	9 (1.3)	9 (1.8)	0 (0)
Coagulase negative *Staphylococcus*	-	11 (1.4)	13 (1.6)	10 (1.2)	4 (0.6)	4 (0.8)	0 (0)
Others	60 (8.8)	38 (4.9)	40 (5.1)	36 (4.5)	34 (4.9)	28 (5.5)	18 (5.2)

Figure 25 : Common bacteriological cultures in VAP 2008 – 2015



For MOH ICUs in 2015, gram-negative organisms accounted for 90.7% of the causative organisms in VAP. Over the last 8 years, the most common causative organisms were *Acinetobacter spp.*, *Klebsiella spp*. and *Pseudomonas aeruginosa*. *Acinetobacter spp*. have been the leading causative organism in VAP since 2007, accounting for 44.6% of all organisms in 2015.

Sixty percent of the causative organisms in VAP in MOH ICUs were of multi-drug resistant strains. *Acinetobacter spp, Klebsiella spp* and *Pseudomonas aeuroginosa* constituted 65.0%, 24.8% and 4.9% of multi-drug resistant strains respectively. *Methicillin-resistant Staphyloccus aureus* accounted for 75.9% of all *Staphyloccus aureus* isolated. This figure was higher compared to previous years.

In UMMC, gram-negative organisms accounted for 100% of all causative organisms in VAP. Sixty two percent of the causative organisms were of multi-drug resistant strains.

In the INICC report [12], 66.3% of Acinetobacter spp isolates in patients with VAP were carbapenem-resistant , 68.9% of *Klebsiella pneumonia* isolates were cephalosporin-resistant and 73.2% of *Staphyloccus aureus* isolates were methicillin-resistant.

Table 34 : Extra length of mechanical ventilation, ICU stay and Crude in-hospital mortality in patients with VAP 2013-2015

	2013	2014	2015
Extra length of mechanical ventilation	15.1 days, RR 1.12 (95% CI 1.11-1.13)	13.5 days, RR 1.09 (95% CI 1.09-1.10)	13.9 days, RR 1.06 (95% CI 1.05-1.06)
Extra length of ICU stay	18.3 days, RR 1.11 (95% CI 1.10-1.12)	16.4 days, RR 1.08 (95% CI 1.07-1.09)	15.4 days, RR 1.06 (95% CI 1.04-1.06)
Extra crude mortality	26%, RR 1.54 (95% CI 1.43-1.68)	13.9% , RR 1.79 (95% CI 1.47-2.10)	17.3%, RR 1.40 (95% CI 1.22-1.60)

Patients with VAP stay longer on the ventilator for an additional 14 days in 2015. Their ICU length of stay was prolonged by an average of 15 days. They also had an excess mortality of 17%.

Table 35 : Unplanned extubation per 100 intubated days, by individual hospital 2011– 2015

Hospital	Unplanned extubation per 100 intubated days				
	2011	2012	2013	2014	2015
AS	0.3	0.3	0.3	0.2	0.3
PP	0.2	0.3	0.1	0.2	0.3
IPH	0.4	0.3	0.3	0.4	0.3
KL	1.0	0.6	0.7	0.8	0.4
SLG	0.6	0.3	0.4	0.5	0.3
KLG	0.2	0.1	0.3	0.1	0.1
SBN	0.8	0.5	0.8	1.2	0.5
MLK	0.8	0.5	0.3	0.3	0.1
JB	1.2	0.7	0.9	1.0	1.0
KTN	0.1	0.0	0.2	0.0	0.0
KT	0.6	0.3	0.1	0.3	0.4
KB	0.1	0.1	0.0	0.0	0.0
KCH	0.1	0.1	0.0	0.1	0.0
KK	0.2	0.1	0.1	0.0	0.3
SP	0.5	0.0	0.5	0.6	0.2
PJY	0.1	0.2	0.1	0.0	0.0
MUR	0.0	0.0	0.1	0.0	0.0
TI	0.2	0.0	0.0	0.0	0.1
TPG	0.5	0.3	0.3	0.0	0.1
SJ	0.4	0.2	0.5	0.1	0.1
KJG	0.0	0.0	0.8	0.4	0.0
KGR	0.0	0.1	0.0	0.1	0.0
TML	0.2	0.5	0.3	0.4	0.1
KP	0.3	0.3	0.2	0.1	0.1
SMJ	0.0	0.0	0.3	0.0	0.0
BP	0.1	0.2	0.1	0.1	0.1
TW	0.0	0.5	0.3	0.1	0.1
MRI	0.1	0.0	0.1	0.0	0.3
KLM	0.6	0.6	0.3	0.5	0.1
SDG	0.4	0.4	0.2	0.5	0.1
SB	0.1	0.0	0.2	0.0	0.0
DKS	0.0	0.0	0.3	0.6	0.2
SI	0.4	0.7	0.8	1.2	0.2
SBL	0.0	0.0	0.1	0.2	0.2
AMP	1.0	0.9	1.0	1.1	0.6
LIK	0.0	0.3	0.0	0.0	0.2
LKW		0.8	0.6	0.2	0.2
BM		0.0	0.0	0.0	0.0
SLR		0.1	0.0	0.2	0.0

PD		0.0	0.7	0.0	0.0
KKR		0.0	0.4	0.2	0.0
SGT		0.2	0.3	0.0	0.0
TM		0.0	0.0	0.0	0.0
KEM		0.0	0.0	0.0	0.4
KLP		0.0	1.9	0.0	0.0
LAB		0.0	0.5	0.0	0.3
KEN		0.0	0.2	0.8	0.2
BIN		0.2	0.5	0.6	0.0
LD		0.1	0.1	0.1	0.3
Total MOH			**0.3**	**0.4**	**0.2**
UMMC		0.8	0.9	1.2	0.4
Total	**0.4**	**0.3**	**0.3**	**0.4**	**0.2**

The rate of unplanned extubation has remained fairly similar over the past 5 years with a rate of 0.2 per 100 intubated days in 2015. 17 centres did not report unplanned extubation rates in 2015.

Figure 26 : Unplanned extubation, by individual hospital 2015

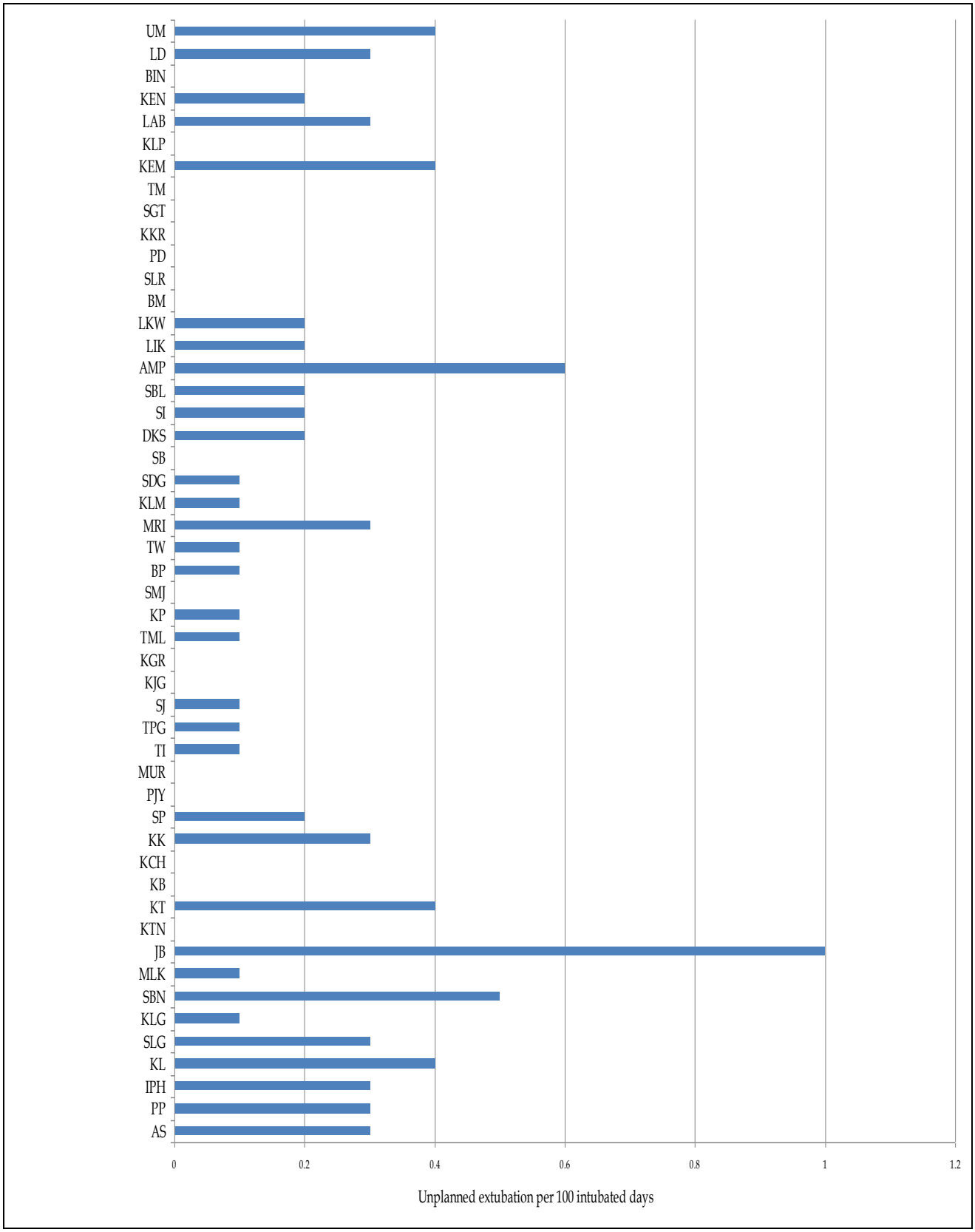


Table 36 : Pressure ulcer, by individual hospital 2011 – 2015

Hospital	Pressure ulcer per 1000 ICU days				
	2011	2012	2013	2014	2015
AS	15.2	8.6	10.4	4.5	4.1
PP	3.4	6.0	8.4	3.3	11.6
IPH	6.4	8.0	5.2	4.4	6.7
KL	7.9	7.1	9.7	7.3	4.7
SLG	14.4	11.3	16.6	17.8	10.1
KLG	5.6	6.1	6.5	2.3	3.0
SBN	1.1	2.8	4.2	1.9	1.1
MLK	3.8	2.5	1.3	1.9	1.2
JB	6.9	6.7	6.9	13.1	15.9
KTN	0.8	4.2	8.4	10.0	13.1
KT	2.5	1.8	1.3	0.0	0.0
KB	3.2	3.4	1.5	3.0	3.7
KCH	5.0	5.1	7.8	5.6	7.6
KK	5.1	9.8	5.8	5.3	10.2
SP	2.7	3.2	2.2	6.6	7.6
PJY	1.7	4.2	3.2	0.8	1.4
MUR	1.3	0.9	0.5	0.9	1.1
TI	1.6	1.3	0.8	0.8	1.7
TPG	5.4	1.6	1.3	0.7	2.1
SJ	3.2	2.8	10.1	5.3	3.0
KJG	14.5	5.9	2.0	5.2	1.1
KGR	2.9	13.4	14.1	13.3	2.8
TML	0.7	2.4	1.0	1.5	1.2
KP	5.7	11.2	3.7	4.9	7.6
SMJ	0.0	0.0	2.2	0.0	0.7
BP	10.1	3.9	1.9	1.5	1.5
TW	11.2	15.9	21.1	8.5	9.5
MRI	12.2	5.7	12.5	23.2	18.3
KLM	11.0	13.0	7.7	9.8	5.0
SDG	4.5	3.0	6.2	5.5	4.5
SB	9.3	10.0	17.8	13.3	5.3
DKS	0.0	2.1	6.7	2.8	4.4
SI	9.7	13.5	10.7	16.3	7.9
SBL	2.2	8.4	8.7	18.4	13.5
AMP	7.2	7.4	8.5	2.5	3.1
LIK	1.0	5.8	1.7	2.7	17.8
LKW	-	15.0	1.4	4.9	1.1
BM	-	3.7	4.2	4.9	11.8
SLR	-	2.7	2.8	11.8	2.4
PD	-	9.8	2.8	0.0	1.9
KKR	-	6.5	3.7	3.3	5.7
SGT	-	8.5	3.8	0.0	4.5

TM	-	0.0	4.1	1.5	1.7
KEM	-	2.5	2.0	15.4	0.0
KLP	-	0.0	11.8	3.5	1.4
LAB	-	10.4	9.7	5.9	8.8
KEN	-	0.0	4.5	9.0	1.7
BIN	-	1.9	5.0	0.0	4.1
LD	-	4.5	3.4	5.4	13.`1
Total MOH			**6.5**	**6.9**	**6.5**
UMMC	-	27.0	7.5	5.3	5.2
Total	**5.8**	**6.8**	**6.6**	**6.8**	**6.5**

Pressure ulcer: A circumscribed area in which cutaneous tissue has been destroyed and there is progressive destruction of underlying tissue caused by interference with circulation and nutrition to the area. Signs include blisters or broken skin or sore formation over pressure areas

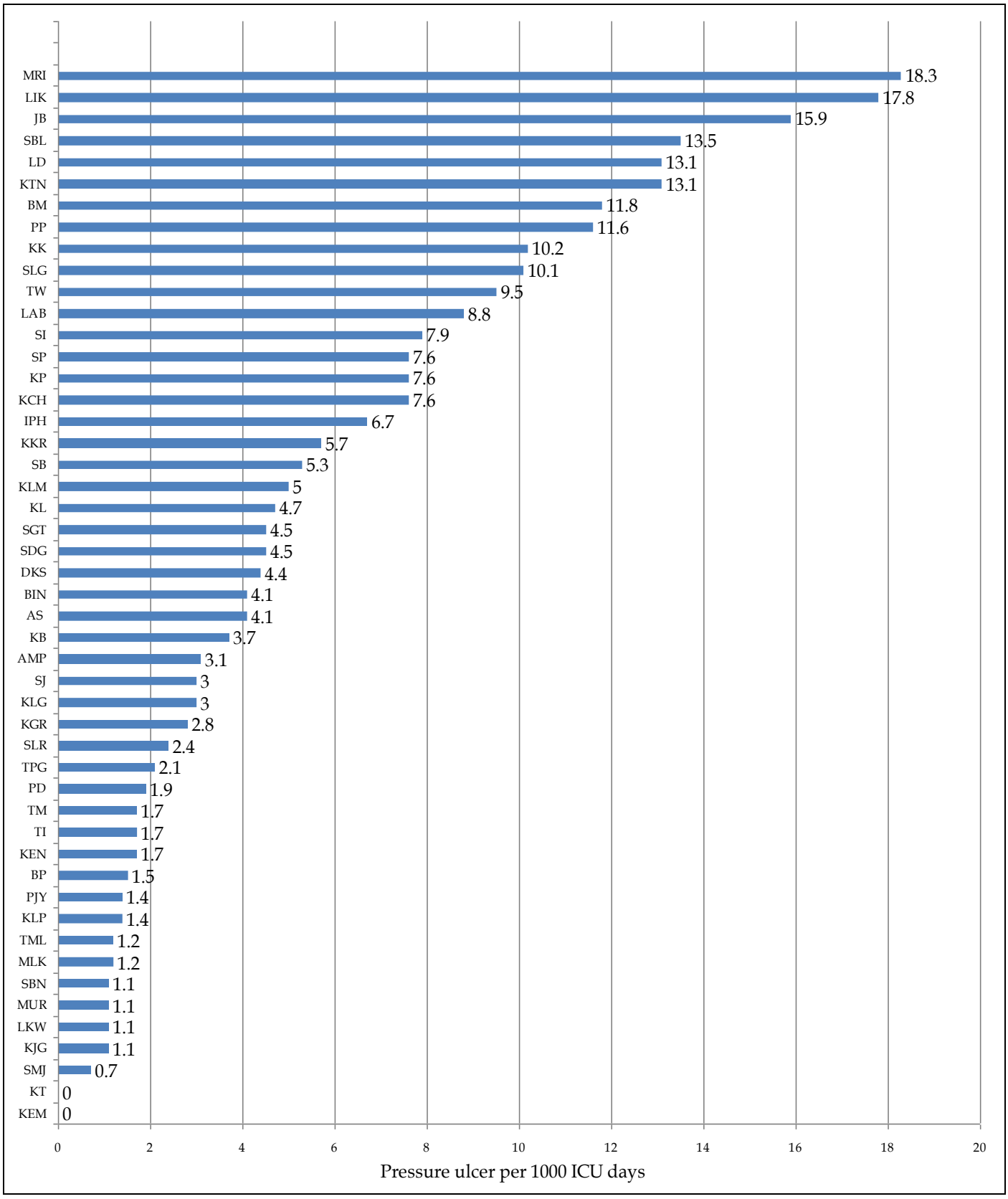
The incidence of pressure ulcers ranged from 0.0 to 18.3 per 1000 ICU days with a mean of 6.5.

For MOH hospitals, the average incidence of pressure ulcers was 6.5 per 1000 ICU days.

Comparisons of rate of pressure ulcers with international standards to describe performance of individual units are not without limitations. Incidence or prevalence rates are frequently used to describe the frequency of pressure ulcers. Prevalence is a measure of the number of cases of pressure ulcers at a specific time, providing a description of the total burden of the disease, while incidence describes the number of new pressure ulcers. Incidence density describes number of new pressure ulcers per 1,000 days rather than per patient. Also the definition of pressure ulcers does vary between studies; some consider all pressure ulcers while others only include stage 2 and above ulcers.

Interventions used in ICUs are sometimes contradictory to good skin care practices. For prevention of ventilator-associated pneumonia, it is recommended that the head of bed is raised to 45^0. However, maintaining the head of a bed that high predisposes the patient to sliding down the bed, causing shearing and friction, and leading to development of pressure ulcers. As a compromise, it is now recommended to nurse critically ill patients with head of bed elevated at 30^0. Hypotension predisposes to skin breakdown, yet haemodynamic instability prevents the staff from turning patients at the recommended frequency of every 2 hours.

Figure 27 : Pressure ulcers, by individual hospital 2015



SECTION E:

MORTALITY OUTCOMES

1. ICU outcome
2. Hospital outcome
3. Crude in-ICU mortality
4. Crude in-hospital mortality
5. Standardised mortality ratio

Crude mortality rates are convenient measures of outcome. However, they are poor indicators of performance of intensive care as they do not take into account variations in patient characteristics such as case mix and the severity of illness.

A better measure of ICU performance is standardised mortality ratio (SMR), comparing the observed to the predicted mortality, using a severity scoring system. SMR stratifies patients according to the severity of illness. SMR of more than one indicates that the actual number of deaths is more than the predicted number of deaths and vice versa.

When interpreting SMR values, one must take into consideration factors which affect the severity scoring system used to predict mortality. These include interval between onset of illness to ICU admission (lead time bias), post-ICU care and small sample size. Lead-time bias refers to the erroneous estimation of risk at the time of admission to the ICU due to the results of therapeutic actions taken previously.

Table 37 : ICU outcome, by category of ICU 2015

ICU outcome	ICUs				
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	UMMC n (%)	Total n (%)
Alive	19812 (80.5)	5923 (77.6)	4745 (78.6)	1038 (80.2)	**31518 (79.6)**
Died	4474 (18.2)	1511 (19.8)	1009 (16.7)	241 (18.6)	**7235 (18.3)**
Discharged with grave prognosis	171 (0.7)	83 (1.1)	93 (1.5)	11 (0.9)	**358 (0.9)**
Transfer to another hospital	169 (0.7)	120 (1.6)	191 (3.2)	4 (0.3)	**484 (1.2)**
Total	**24626 (100)**	**7637 (100)**	**6038 (100)**	**1294 (100)**	**39595 (100)**

Table 38 : Hospital outcome, by category of ICU 2015

Hospital outcome	ICUs				
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	UMMC n (%)	Total n (%)
Alive	17365 (70.5)	5217 (68.3)	4385 (72.6)	923 (71.3)	**27890 (70.4)**
Died	6167 (25.0)	2009 (26.3)	1276 (21.1)	333 (25.7)	**9785 (24.7)**
Discharged with grave prognosis	314 (1.3)	108 (1.4)	120 (2.0)	33 (2.6)	**575 (1.5)**
Transfer to another hospital	780 (3.2)	303 (4.0)	257 (4.3)	5 (0.4)	**1345 (3.4)**
Total	**24626 (100.0)**	**7637 (100)**	**6038 (100)**	**1294 (100)**	**39595 (100)**

Table 39 : Crude in-ICU and in-hospital mortality rate, by individual hospital 2011 – 2015

Hospital	Crude in-ICU mortality (in-hospital mortality) %				
	2011	2012	2013	2014	2015
AS	24.1 (34.4)	26.7 (44.5)	27.3 (37.3)	28.9 (39.7)	25.4 (41.7)
PP	14.4 (23.3)	16.5 (26.9)	15.6 (25.0)	18.3 (25.7)	19.7 (29.6)
IPH	22.4 (30.0)	16.5 (25.5)	18.5 (25.6)	16.7 (24.7)	20.1 (29.2)
KL	17.0 (24.7)	18.4 (27.0)	17.5 (25.8)	14.3 (21.9)	18.1 (25.2)
SLG	17.9 (25.8)	16.5 (27.1)	17.2 (24.5)	15.7 (20.8)	16.2 (21.0)
KLG	17.1 (25.1)	15.5 (22.9)	13.6 (21.7)	13.3 (19.3)	15.7 (20.2)
SBN	21.3 (30.0)	22.1 (30.4)	19.7 (25.7)	21.1 (27.9)	18.5 (26.4)
MLK	23.6 (32.7)	13.5 (32.1)	19.9 (28.2)	20.0 (27.7)	20.0 (26.5)
JB	22.3 (31.4)	21.4 (30.0)	22.2 (29.9)	17.4 (25.5)	20.3 (28.2)
KTN	17.2 (24.3)	24.1 (34.9)	22.2 (32.2)	17.8 (25.5)	21.3 (28.6)
KT	20.9 (27.2)	18.5 (28.1)	22.0 (32.0)	21.0 (30.0)	17.9 (25.3)
KB	17.8 (24.4)	16.0 (22.6)	15.0 (21.3)	11.6 (16.1)	13.1 (23.5)
KCH	22.1 (29.1)	17.4 (24.3)	18.0 (24.0)	13.9 (17.7)	16.4 (23.2)
KK	20.5 (27.3)	21.7 (34.0)	19.5 (25.3)	17.2 (22.5)	15.7 (23.0)
SP	32.6 (42.2)	26.9 (38.4)	23.3 (32.6)	22.8 (30.4)	17.6 (24.5)
PJY	18.4 (21.9)	16.9 (19.3)	19.9 (22.9)	15.9 (19.6)	14.4 (17.9)
MUR	20.9 (29.2)	24.1 (33.8)	20.7 (24.7)	24.2 (26.2)	22.4 (28.8)
TI	22.4 (35.1)	17.7 (31.9)	21.9 (34.6)	23.4 (34.7)	21.9 (27.4)
TPG	27.0 (43.4)	21.4 (35.3)	19.3 (30.1)	20.9 (28.8)	20.0 (31.8)
SJ	25.2 (35.2)	23.2 (35.5)	29.3 (40.2)	24.2 (28.4)	17.7 (19.6)
KJG	19.6 (27.0)	15.0 (23.8)	15.9 (26.8)	12.0 (21.1)	13.9 (21.0)
KGR	18.1 (25.8)	16.3 (22.1)	18.0 (24.5)	17.0 (17.3)	18.4 (21.3)
TML	19.7 (23.0)	14.7 (21.0)	16.0 (22.5)	19.1 (25.7)	20.1 (27.5)
KP	34.3 (47.1)	28.9 (42.4)	28.7 (38.0)	`30.5 (37.1)	25.8 (33.5)
SMJ	24.5 (33.2)	24.3 (29.6)	27.6 (32.7)	30.1 (36.1)	17.9 (25.1)
BP	21.4 (32.6)	29.8 (40.7)	22.7 (31.0)	20.0 (34.6)	16.1 (28.0)
TW	15.7 (27.0)	13.7 (24.3)	17.8 (29.6)	16.3 (23.7)	15.2 (21.2)
MRI	22.6 (29.6)	18.3 (24.1)	18.7 (22.0)	15.4 (16.8)	24.7 (25.9)
KLM	30.9 (40.2)	21.0 (32.5)	25.8 (39.0)	26.5 (40.0)	23.7 (34.9)
SDG	18.0 (22.9)	17.7 (25.9)	18.3 (26.3)	16.6 (22.6)	18.7 (23.6)
SB	24.3 (31.8)	22.8 (30.2)	24.9 (39.5)	27.1 (35.3)	16.0 (24.3)
DKS	27.8 (30.2)	25.5 (26.8)	26.9 (31.3)	22.3 (31.5)	18.6 (25.1)
SI	22.1 (28.7)	24.6 (28.6)	21.2 (26.5)	20.2 (26.1)	19.1 (26.2)
SBL	18.0 (28.5)	17.2 (25.2)	18.6 (26.9)	18.7 (24.1)	18.0 (24.5)
AMP	35.1 (43.9)	37.9 (47.8)	31.1 (42.1)	35.6 (44.0)	33.9 (43.7)
LIK	2.9 (3.7)	5.6 (6.5)	4.1 (6.0)	2.3 (4.0)	6.5 (7.3)
LKW	-	28.6 (36.2)	17.8 (22.3)	26.1 (33.3)	25.9 (31.9)
BM	-	13.2 (21.1)	29.8 (34.8)	19.9 (22.2)	23.9 (35.1)
SLR	-	42.8 (52.6)	27.6 (31.1)	32.7 (39.0)	35.3 (42.9)
PD	-	14.6 (18.4)	15.9 (23.0)	15.5 (20.0)	15.5 (17.0)
KKR	-	15.0 (24.4)	23.7 (28.7)	21.5 (21.5)	13.7 (15.9)

SGT	-	24.5 (30.4)	21.4 (34.5)	18.0 (25.3)	19.1 (23.5)
TM	-	5.9 (11.8)	23.7 (24.4)	22.5 (24.4)	15.1 (18.2)
KEM	-	9.9 (12.6)	15.3 (17.1)	13.2 (23.1)	10.2 (18.9)
KLP	-	0 (0)	8.6 (11.2)	12.5 (14.6)	7.1 (9.2)
LAB	-	29.7 (34.3)	35.7 (40.0)	40.4 (43.4)	20.9 (24.8)
KEN	-	11.4 (20.0)	6.8 (12.4)	9.7 (12.5)	6.0 (10.4)
BIN	-	17.8 (27.7)	12.7 (17.7)	14.5 (19.8)	13.7 (22.3)
LD	-	29.8 (38.1)	23.0 (35.3)	29.5 (40.6)	15.4 (28.8)
MOH Hospitals	**21.2 (29.5)**	**19.4 (27.9)**	**19.9 (27.7)**	**19.0 (25.7)**	**18.7 (26.0)**
UMMC	**-**	20.3 (31.8)	16.7 (24.8)	18.4 (25.8)	18.8 (26.5)

The overall in-ICU and in-hospital mortality rates for MOH hospitals in 2015 were 18.7% and 26.0% respectively.

UMMC had fairly similar in-ICU and in-hospital mortality rates of 18.8% and 26.5% respectively.

KEN had the lowest in-ICU mortality rate (6.0%). LIK had the lowest in-hospital mortality rate (7.3%).

Figure 28 : Crude In-ICU and In-hospital mortality rates, by individual hospital 2015

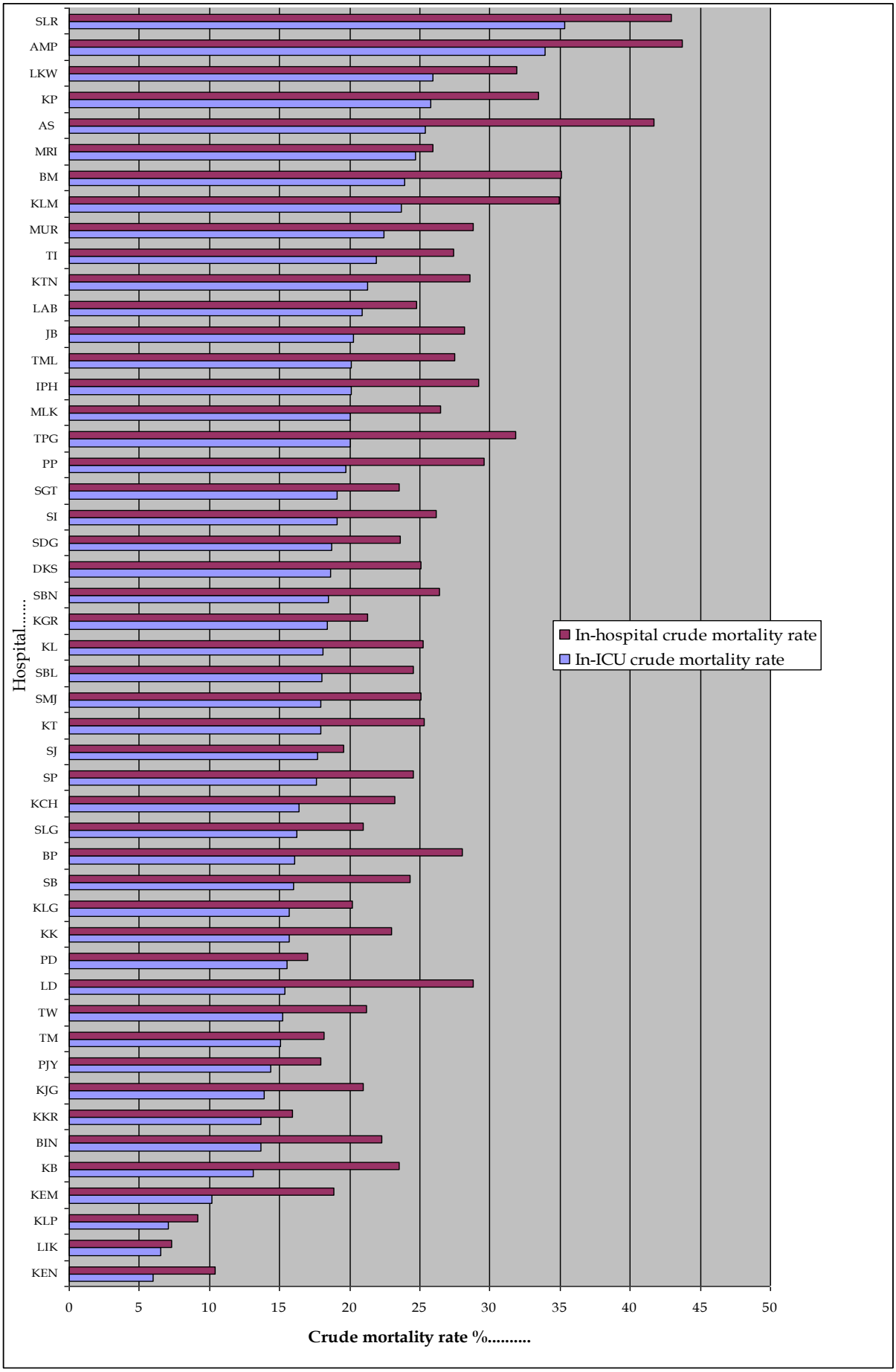


Table 40 : Ten most common diagnoses leading to ICU admission in MOH hospitals and observed in-hospital mortality 2010 – 2015

Diagnosis	Mortality (%)					
	2010	2011	2012	2013	2014	2015
Dengue infection	8.6	6.4	5.6	5.6	7.1	8.9
Sepsis	59.3	58.9	54.4	53.4	52.8	51.2
Head injury	27.4	25.2	23.1	22.1	22.2	22.0
Community-acquired pneumonia	42.6	40.6	39.0	38.9	36.2	33.5
Cerebral vascular disease	-	41.9	40.5	45.5	41.1	42.8
Chronic lower respiratory disease	26.2	24.9	23.6	22.1	18.8	18.7
Bronchial asthma	7.8	10.9	7.5	8.1	7.6	6.1
Non-cardiogenic pulmonary oedema	29.5	22.3	18.9	21.4	21.6	17.5
Infection/gangrene of limb (include osteomyelitis, necrotising fasciitis)	39.1	41.8	39.6	37.7	36.9	37.0
DKA/HHS	-	-	-	21.1	19.3	16.9

In-hospital mortality for dengue infection increased slightly in 2015 compared to the previous years. In-hospital mortality for patients with sepsis, community-acquired pneumonia, and acute exacerbation of chronic lower respiratory disease had steadily improved over the past five years.

Table 41 : Severe sepsis, ARDS and AKI within 24hrs of ICU admission and observed in-hospital mortality 2012 - 2015

	In-hospital Mortality (%)			
	2012	2013	2014	2015
Severe sepsis	43.1	41.6	35.5	41.1
ARDS	37.3	36.6	35.9	33.3
AKI	41.4	43.9	38.0	38.5
Severe sepsis + ARDS	67.1	60.3	62.7	58.2
Severe sepsis + AKI	61.3	59.3	61.5	59.5
Severe sepsis + ARDS + AKI	80.4	73.4	73.7	77.5

The in-hospital mortality for severe sepsis within 24 hours of ICU admission increased to 41.1 in 2015. It is higher when compared with the in-ICU mortality of the Sepsis Occurrence in Acutely Ill Patient (SOAP) study. The in-ICU mortality was 27% in patient with sepsis on ICU admission [5].

Reported mortality in ICU patients with AKI varies considerably between studies depending on definition of AKI, patient population (e.g., sepsis, trauma, cardiothoracic surgery) and severity of AKI. Patients with maximum RIFLE class R, class I and class F had hospital mortality rates of 8.8%, 11.4% and 26.3%, respectively [14]. Payen et al reported that patients with acute kidney injury had higher mortality rates than patients without acute kidney injury among patients enrolled in the SOAP study (60-day mortality 35.7% versus 16.4%; $P < 0.01$) [15].

Table 42 : Standardised mortality ratio, by individual hospital 2011 – 2015

Hospital	Standardised mortality ratio (95% CI)				
	2011	2012	2013	2014	2015
AS	0.82 (0.60-1.11)	1.07 (0.81-1.39)	1.01 (0.76-1.32)	0.91 (0.68-1.20)	1.06 (0.80-1.40)
PP	0.67 (0.47-0.96)	0.74 (0.51-1.01)	0.71 (0.49-0.99)	0.69 (0.49-0.98)	0.72 (0.52-1.00)
IPH	0.96 (0.67-1.35)	0.83 (0.58-1.17)	0.74 (0.51-1.04)	0.75 (0.52-1.05)	0.87 (0.61-1.18)
KL	0.61 (0.43-0.87)	0.63 (0.44-0.88)	0.60 (0.42-0.84)	0.58 (0.39-0.82)	0.63 (0.44-0.89)
SLG	0.75 (0.52-1.05)	0.75 (0.54-1.05)	0.68 (0.48-0.97)	0.63 (0.43-0.91)	0.77 (0.53-1.11)
KLG	0.62 (0.43-0.87)	0.60 (0.41-0.86)	0.54 (0.37-0.80)	0.57 (0.38-0.84)	0.59 (0.40-0.87)
SBN	0.77 (0.55-1.04)	0.73 (0.50-1.03)	0.71 (0.51-0.99)	0.79 (0.56-1.10)	0.77 (0.54-1.09)
MLK	0.98 (0.71-1.33)	0.81 (0.58 –1.10)	0.86 (0.61-1.21)	0.82 (0.59-1.15)	0.75 (0.53-1.06)
JB	0.78 (0.56-1.05)	0.71 (0.51-0.97)	0.66 (0.47-0.91)	0.61 (0.42-0.85)	0.63 (0.44-0.87)
KTN	0.72 (0.50-1.01)	0.84 (0.62-1.21)	0.82 (0.58-1.09)	0.69 (0.49-0.97)	0.77 (0.54-1.05)
KT	0.67 (0.48-0.94)	0.65 (0.46-0.89)	0.72 (0.53-0.98)	0.73 (0.54-1.00)	0.58 (0.41-0.82)
KB	0.76 (0.52-1.07)	0.67 (0.46-0.95)	0.62 (0.44-0.92)	0.60 (0.39-0.91)	0.78 (0.54-1.10)
KCH	0.82 (0.58-1.13)	0.75 (0.51-1.06)	0.69 (0.47-0.98)	0.56 (0.36-0.84)	0.72 (0.49-1.02)
KK	0.71 (0.50-1.00)	1.00 (0.70-1.38)	0.8 (0.55-1.14)	0.51 (0.36-0.74)	0.49 (0.34-0.70)
SP	1.00 (0.75-1.30)	0.77 (0.57-1.03)	0.75 (0.54-1.02)	0.79 (0.56-1.07)	0.72 (0.47-1.06)
PJY	0.76 (0.50-1.10)	0.69 (0.45-1.03)	0.80 (0.54-1.14)	0.59 (0.40-0.88)	0.70 (0.47-1.06)
MUR	0.78 (0.56-1.06)	0.89 (0.63-1.23)	0.55 (0.37-0.79)	0.63 (0.44-0.88)	0.68 (0.46-0.98)
TI	0.77 (0.57-1.05)	0.72 (0.53-0.99)	0.65 (0.46-0.88)	0.74 (0.53-1.00)	0.67 (0.46-0.94)
TPG	0.92 (0.69-1.20)	0.80 (0.58-1.07)	0.64 (0.45-0.89)	0.68 (0.49-0.95)	0.72 (0.52-0.98)
SJ	0.84 (0.61-1.12)	0.87 (0.64-1.17)	0.95 (0.73-1.25)	0.70 (0.49-0.95)	0.40 (0.25-0.62)
KJG	0.79 (0.57-1.11)	0.85 (0.55-1.14)	0.88 (0.61-1.20)	0.73 (0.50-1.05)	0.85 (0.57-1.20)
KGR	0.72 (0.51-1.04)	0.62 (0.42-0.89)	0.64 (0.44-0.90)	0.61 (0.40-0.91)	0.77 (0.51-1.08)
TML	0.59 (0.41-0.85)	0.64 (0.43-0.90)	0.80 (0.56-1.15)	0.83 (0.59-1.15)	0.82 (0.57-1.12)
KP	1.06 (0.79-1.37)	0.95 (0.72-1.25)	0.95 (0.71-1.26)	0.98 (0.74-1.33)	0.98 (0.71-1.32)
SMJ	0.78 (0.57-1.07)	0.70 (0.51-0.97)	0.69 (0.49-0.95)	0.82 (0.60-1.10)	0.64 (0.44-0.90)
BP	0.69 (0.50-0.94)	0.87 (0.65-1.14)	0.69 (0.47-0.97)	0.79 (0.58-1.06)	0.75 (0.54-1.05)
TW	0.72 (0.51-0.98)	0.67 (0.47-0.93)	0.76 (0.53-1.03)	0.65 (0.43-0.93)	0.77 (0.54-1.10)
MRI	0.89 (0.62-1.25)	0.65 (0.42-0.96)	0.62 (0.43-0.89)	0.50 (0.32-0.73)	0.62 (0.43-0.88)
KLM	0.83 (0.62-1.11)	0.69 (0.50-0.94)	0.75 (0.56-1.00)	0.79 (0.58-1.04)	0.72 (0.53-0.97)
SDG	0.61 (0.42-0.86)	0.61 (0.44-0.85)	0.65 (0.46-0.90)	0.57 (0.41-0.81)	0.57 (0.40-0.81)
SB	0.88 (0.64-1.17)	0.75 (0.54-1.01)	0.87 (0.65-1.14)	0.78 (0.56-1.04)	0.73 (0.51-1.03)
DKS	0.76 (0.55-1.02)	0.74 (0.52-1.01)	0.76 (0.52-1.06)	0.83 (0.61-1.14)	0.69 (0.48-0.96)
SI	0.77 (0.56-1.07)	0.73 (0.52-1.01)	0.78 (0.55-1.10)	0.78 (0.55-1.11)	0.80 (0.57-1.13)
SBL	0.74 (0.53-1.03)	0.63 (0.45-0.90)	0.92 (0.65-1.28)	0.67 (0.48-0.97)	0.61 (0.40-0.85)
AMP	0.92 (0.71-1.20)	0.90 (0.69-1.17)	0.89 (0.69-1.15)	0.9 (0.69-1.17)	0.93 (0.71-1.22)
LIK	0.19 (0.10-0.45)	0.27 (0.14-0.57)	0.58 (0.30-1.08)	0.28 (0.11-0.57)	0.43 (0.19-0.86)
LKW	-	0.96 (0.71-1.25)	0.74 (0.48-1.08)	0.84 (0.61-1.12)	0.68 (0.49-0.91)
BM	-	0.54 (0.36-0.79)	0.58 (0.41-0.79)	0.33 (0.22-0.48)	0.54 (0.39-0.72)
SLR	-	0.98 (0.76-1.26)	0.71 (0.51-0.99)	0.80 (0.59-1.04)	0.88 (0.66-1.15)
PD	-	0.60 (0.40-0.92)	0.74 (0.51-1.05)	0.75 (0.48-1.08)	0.56 (0.36-0.82)
KKR	-	0.68 (0.47-0.96)	0.64 (046-0.88)	0.40 (0.27-0.60)	0.35 (0.23-0.54)

SGT	-	0.74 (0.51-1.03)	0.73 (0.54-0.99)	0.50 (0.35-0.71)	0.51 (0.34-0.71)
TM	-	0.76 (0.49-1.13)	0.68 (0.46-0.96)	0.60 (0.41-0.84)	0.41 (0.27-0.61)
KEM	-	0.30 (0.17-0.46)	0.44 (0.28-0.65)	0.67 (0.48-0.94)	0.49 (0.32-0.70)
KLP	-	0 (0)	0.53 (0.31-0.83)	0.65 (0.43-0.96)	0.30 (0.17-0.52)
LAB	-	0.87 (0.64-1.16)	0.94 (0.72-1.23)	0.83 (0.64-1.06)	0.55 (0.39-0.77)
KEN	-	0.55 (0.39-0.77)	0.41 (0.25-0.63)	0.33 (0.20-0.51)	0.42 (0.27-0.68)
BIN	-	1.15 (0.84-1.51)	0.6 (0.40-0.87)	0.60 (0.42-0.87)	0.61 (0.43-0.86)
LD	-	0.68 (0.5-0.9)	0.77 (0.54-1.06)	0.90 (0.67-1.17)	0.62 (0.44-0.84)
Total MOH			**0.72 (0.51-1.00)**	**0.69 (0.48-0.95)**	**0.69 (0.47-0.95)**
UMMC	**-**	**0.83 (0.60-1.14)**	**0.65 (0.44-0.91)**	**0.65 (0.44-0.90)**	**0.68 (0.45-0.98)**

The pooled standardized mortality ratio for MOH ICUs in 2015 was 0.69 (95% CI 0.47–0.95).

It is observed that the SMR has been steadily decreasing over the years. However, risk-adjusted severity scoring systems are known to drift in calibration over time and this may result in lower SMR over the years.

SECTION F:

QUALITY IMPROVEMENT ACTIVITIES

1. Ventilator Care Bundle
2. Central Venous Catheter Care Bundle
3. Early Mobility in ICU
4. SSKIN Care Bundle

VENTILATOR CARE BUNDLE

Table 43 : Ventilator Care Bundle Compliance, by individual hospital 2011 - 2015

Hospital	% Compliance Year				
	2011	2012	2013	2014	2015
AS	95.85	97.6	100.0	100.00	100.00
PP	94.79	92.8	93.5	92.74	94.83
IPH	98.65	98.5	97.8	97.02	96.43
KL	94.70	96.6	96.2	96.19	95.75
SLG	96.38	96.8	96.1	96.20	92.00
KLG	94.46	95.3	97.4	99.07	98.84
SBN	100.00	99.4	100.0	100.00	100.00
MLK	98.36	100	99.3	99.23	100.00
JB	98.97	99.2	99.5	99.42	97.79
KTN	98.13	98.4	100.0	99.32	99.84
KT	98.71	97.9	100.0	100.00	100.00
KB	100.00	100	100.0	100.00	100.00
KCH	92.08	97.2	96.1	96.41	99.72
KK	72.41	100	98.5	99.7	100.00
SP	100.00	100	100.0	92.96	96.00
PJY	100.00	100	100.0	100.00	100.00
MUR	100.00	100	99.1	100.00	100.00
TI	91.04	100	100.0	100.00	100.00
TPG	98.11	98.4	97.9	100.00	99.24
SJ	98.70	100	100.0	100.00	100.00
KJG	100.00	100	100.0	100.00	100.00
KGR	100.00	100	100.0	100.00	100.00
TML	97.60	97.2	99.0	96.82	93.66
KP	95.31	98.1	100.0	99.28	100.00
SMJ	96.15	98.5	100.0	100.00	100.00
BP	95.31	96.7	99.5	97.55	100.00
TW	94.44	100	100.0	100.00	100.00
MRI	87.61	100	100.0	100.00	100.00
KLM	86.77	93.9	94.7	96.85	97.14
SDG	96.04	100	100.0	100.00	100.00
SB	-	95.9	97.2	100.00	100.00
DKS	-	100	100.0	100.00	100.00
SI	-	91.3	92.9	90.00	98.95
SBL	-	99.8	100.0	98.97	100.00
AMP	-	95.0	94.4	93.62	96.40
LIK	-	100	100.0	100.00	100.00
UMMC			100.0	100.00	100.00
LKW	-	74.2	90.4	100.00	100.00
BM	-	100	100.0	97.85	100.00

SLR	-	92.0	89.4	93.33	100.00
PD	-	100	100.0	100.00	100.00
KKR	-	100	100.0	100.00	100.00
SGT	-	100	91.7	100.00	97.50
TM			100.0	100.00	100.00
KEM	-	100	100.0	100.00	100.00
LAB	-	100	100.0	100.00	100.00
KEN	-	100	100.0	100.00	100.00
BIN	-	97.6	95.7	100.00	100.00
LD	-	100	98.8	100.00	100.00
Total	**96.00**	**97.5**	**98.2**	**99.05**	**98.70**

The overall VCB compliance rate for 2015 was 98.7%. VCB compliance is one of the key performance indicators for the Anaesthesia program in MOH. All centres had VCB compliance rates above 85%, which is the target set for this indicator.

Figure 29 : Ventilator care bundle compliance and ventilator-associated pneumonia rates 2007 – 2015

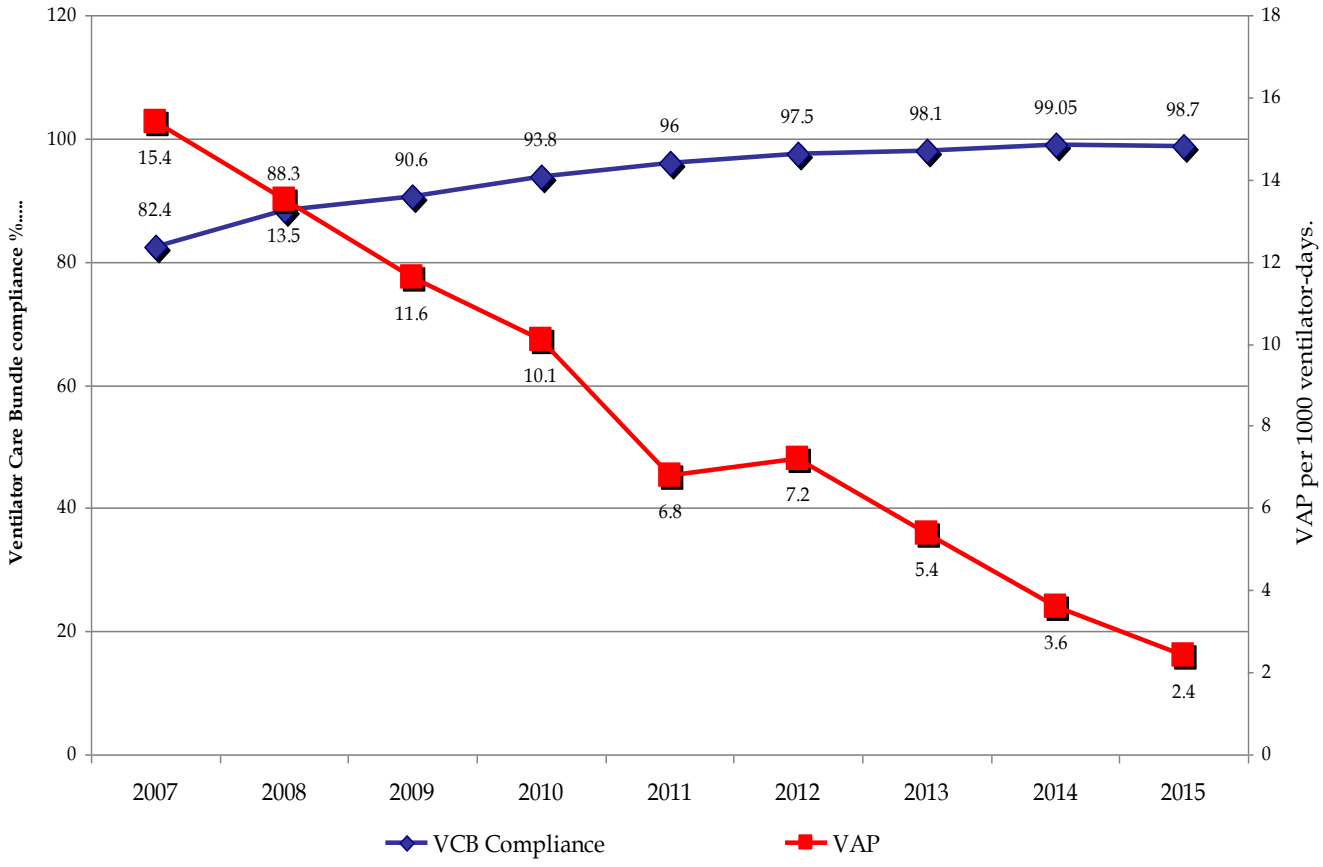


Table 44 : Ventilator Utilisation Ratio, Ventilator Care Bundle Compliance and Incidence of Ventilator–associated Pneumonia (VAP), by individual hospital 2015

Hospitals	Ventilator utilisation ratio	Ventilator care bundle compliance	Incidence of VAP per 1000 ventilator-days
AS	0.77	100.0	1.46
PP	0.78	94.8	3.16
IPH	0.72	96.4	4.69
KL	0.72	95.8	3.29
SLG	0.78	92.0	7.03
KLG	0.40	98.8	0.40
SBN	0.82	100.0	1.65
MLK	0.60	100.0	1.09
JB	0.84	97.8	0.00
KTN	0.81	99.8	0.20
KT	0.70	100.0	1.29
KB	0.69	100.0	0.00
KCH	0.83	99.7	2.07
KK	0.68	100.0	2.72
SP	0.64	96.0	0.95
PJY	0.59	100.0	2.11
MUR	0.85	100.0	0.63
TI	0.48	100.0	7.11
TPG	0.81	99.2	1.25
SJ	0.81	100.0	2.86
KJG	0.62	100.0	6.10
KGR	0.64	100.0	6.57
TML	0.73	93.7	6.27
KP	0.74	100.0	1.09
SMJ	0.52	100.0	1.19
BP	0.82	100.0	0.00
TW	0.62	100.0	0.00
MRI	0.83	100.0	2.71
KLM	0.85	97.1	4.15
SDG	0.64	100.0	1.53
SB	0.89	100.0	3.32
DKS	0.79	100.0	2.47
SI	0.79	99.0	0.41
SBL	0.68	100.0	4.00
AMP	0.71	96.4	2.54
LIK	0.43	100.0	0.00
LKW	0.65	100.0	0.11
BM	0.73	100.0	1.28
SLR	0.87	100.0	4.79
PD	0.21	100.0	2.57
KKR	0.46	100.0	5.74
SGT	0.61	97.5	0.89
TM	0.48	100.0	1.67
KEM	0.66	100.0	0.00

KLP	0.43	100.0	0.00
LAB	0.70	100.0	12.44
KEN	0.60	100.0	1.32
BIN	0.75	100.0	2.40
LD	0.90	100.0	0.00
MOH Hospitals	**0.71**	**98.6**	**2.38**
UMMC	0.77	100.0	7.1

Ventilator care bundle was initiated in 18 General Intensive Care Units (GICUs) in MOH hospitals in December 2006. It was extended to another 12 GICUs in August 2007 and finally to all participating ICUs by January 2012. This evidence-based practice, advocated by the Institute for Healthcare Improvement 100,000 Lives Campaign, has been shown to reduce ventilator associated pneumonia (VAP) if the compliance to the practice is good [30].

Since then, monitoring ventilator care bundle compliance and ventilator associated pneumonia has been part of the quality initiative activities to improve care of critically ill patients on ventilator.

However, the use of ventilator-days in calculating incidence of VAP may pose high standard error of an individual rate measurement if the denominator for the surveillance period is small. In addition, use of ventilator-days does not adjust fully for the difference of patient case mix. Ventilator utilization ratio can be used to better reflect different case mix. It is calculated by the number of patient-days divided by number of ventilator-days.

Ventilator utilisation ratio varies by type of ICU due to patient case mix. It is dependent on patient disease severity, which affects the need to ventilate a patient. It is also a reflection on weaning practice or policy in the unit.

It can be expected that ICUs with low ventilator utilization ratio and high ventilator care bundle compliance have low incidence of VAP.

CENTRAL VENOUS CATHETER (CVC) CARE BUNDLE

Central venous catheter (CVC) care bundle was initiated in ICUs in MOH hospitals in 2008. This evidence-based practice has been implemented in many units worldwide following landmark studies that demonstrated substantial reduction in CVC-BSI [20], [21].

In the NAICU Report 2007, 66.2% of ICU admissions had central venous catheters in-situ. The incidence of CVC-BSI can be used as a measure of the safety of clinical practice processes within an ICU. CVC care bundle compliance rate and incidence of CVC-BSI are monitored in ICUs in MOH hospitals since October 2012.

Measurement of CVC-BSI as a performance indicator may pose some problems. The clinical decision to obtain blood cultures directly impacts CVC-BSI rates. ICUs that obtain more blood cultures will inevitably document more CVC-BSI. In addition, the definition of CVC-BSI stipulates absence of other sources of infection to explain positive blood cultures. The degree to which an alternate source of infection could explain a positive blood culture, however, also involves subjective judgment.

The denominator used in measurement of CVC-BSI is catheter-days. The catheter-day denominator adjusts for the number of patients with catheters when CVC-BSI rates are compared between units. It is also important to realise that unless the catheter-day denominator for the surveillance period is large, the standard error of an individual rate measurement is high.

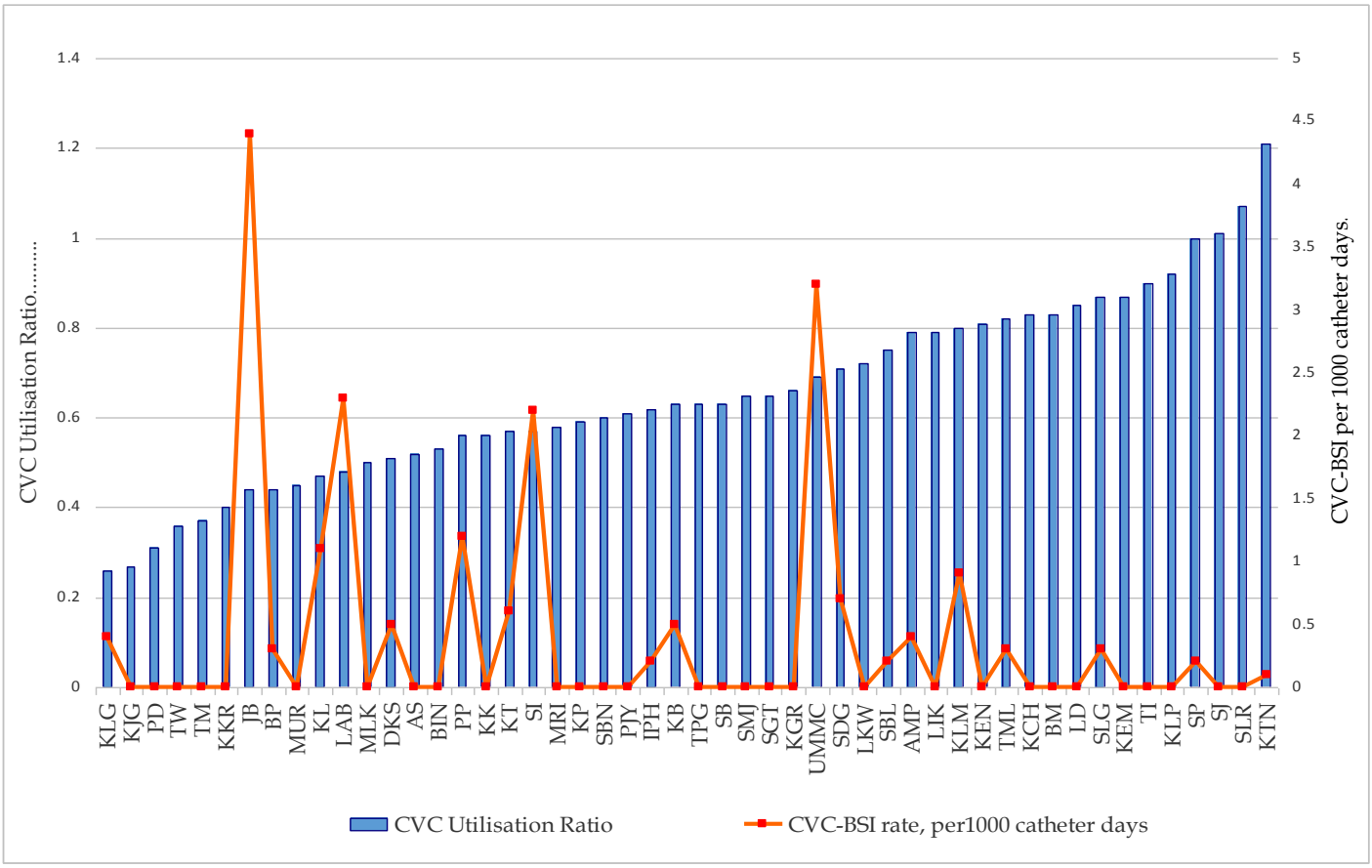
The need for placement of CVC is dependent on patient disease severity. However, the use of catheter-days does not adjust fully for the difference of patient case mix. Catheter utilisation ratio can be measured to overcome this problem. It is defined as the ratio of the number of CVC-days divided by the number of patient days during a specific surveillance period. Catheter utilisation ratio varies by type of ICU due to patient case mix. It is dependent on patient disease severity, which affects the need to insert the catheter. It is also a reflection on the catheter removal practice or policy in the unit.

Table 45 : Catheter Utilisation Ratio, Central Venous Catheter Care Bundle Compliance and incidence of central venous catheter-related blood stream infection (CVC-BSI), by individual hospital 2013 – 2015

Hospitals	Central Venous Catheter utilisation ratio			CVC care bundle compliance			Incidence of CVC-BSI per 1000 catheter days		
	2013	2014	2015	2013	2014	2015	2013	2014	2015
AS	0.46	0.57	0.52	100.0	100.0	100.0	0.0	0.0	0.0
PP	0.80	0.62	0.56	100.0	100.0	100.0	2.6	3.5	1.2
IPH	0.48	0.46	0.62	95.7	90.3	91.7	0.3	0.0	0.2
KL	0.49	0.46	0.47	100.0	100.0	99.6	1.5	0.2	1.1
SLG	0.91	0.86	0.87	90.8	92.1	98.0	0.0	0.0	0.3
KLG	0.27	0.27	0.26	100.0	100.0	100.0	0.0	0.0	0.4
SBN	0.42	0.52	0.60	99.5	100.0	100.0	0.9	0.7	0.0
MLK	0.62	0.42	0.50	99.1	93.8	96.9	0.0	0.0	0.0
JB	0.32	0.44	0.44	96.3	93.8	89.6	16.4	11.3	4.4
KTN	1.23	1.29	1.21	100.0	100.0	100.0	0.0	0.0	0.1

KT	0.54	0.67	0.57	100.0	100.0	100.0	0.3	0.3	0.6
KB	0.73	0.56	0.63	100.0	97.5	100.0	0.4	0.3	0.5
KCH	0.78	0.79	0.83	100.0	100.0	100.0	0.0	0.0	0.0
KK	0.71	0.57	0.56	95.1	97.0	95.1	0.2	0.0	0.0
SP	1.54	0.84	1.00	100.0	100.0	100.0	0.0	0.0	0.2
PJY	0.71	0.74	0.61	100.0	100.0	100.0	0.7	0.5	0.0
MUR	0.36	0.41	0.45	100.0	100.0	100.0	0.0	0.0	0.0
TI	0.75	0.21	0.90	100.0	100.0	100.0	0.0	0.0	0.0
TPG	0.53	0.55	0.63	100.0	100.0	100.0	0.0	0.0	0.0
SJ	0.77	1.14	1.01	100.0	100.0	100.0	0.0	1.0	0.0
KJG	0.34	0.35	0.27	100.0	100.0	100.0	0.0	0.0	0.0
KGR	0.80	0.62	0.66	100.0	100.0	100.0	0.0	0.0	0.0
TML	0.95	0.74	0.82	100.0	100.0	100.0	0.4	0.0	0.3
KP	0.61	0.52	0.59	100.0	97.0	100.0	0.0	0.0	0.0
SMJ	0.54	0.72	0.65	100.0	100.0	100.0	2.7	0.0	0.0
BP	0.46	0.55	0.44	91.1	93.3	100.0	2.1	0.0	0.3
TW	0.53	0.42	0.36	86.8	96.1	100.0	0.0	0.0	0.0
MRI	0.33	0.36	0.58	100.0	100.0	100.0	0.0	0.0	0.0
KLM	0.93	0.87	0.80	95.5	95.4	98.5	0.0	0.0	0.9
SDG	0.41	0.70	0.71	100.0	100.0	100.0	0.0	0.0	0.7
SB	0.89	1.05	0.63	92.9	100.0	100.0	0.0	0.3	0.0
DKS	0.58	0.40	0.51	100.0	100.0	100.0	0.0	0.0	0.5
SI	0.80	0.67	0.57	97.1	95.5	96.2	0.0	0.0	2.2
SBL	0.87	0.89	0.75	100.0	100.0	100.0	0.4	0.9	0.2
AMP	0.92	0.84	0.79	82.4	86.6	92.8	0.0	0.0	0.4
LIK	0.36	0.38	0.79	100.0	100.0	100.0	0.0	0.0	0.0
LKW	0.73	0.26	0.72	100.0	100.0	100.0	0.0	0.0	0.0
BM	0.80	0.57	0.83	93.1	96.9	100.0	0.0	0.0	0.0
SLR	1.00	1.20	1.07	100.0	100.0	100.0	0.0	0.0	0.0
PD	0.31	0.36	0.31	100.0	100.0	100.0	0.0	0.0	0.0
KKR	0.59	0.60	0.40	99.1	100.0	100.0	1.2	0.0	0.0
SGT	0.85	1.06	0.65	85.0	90.1	92.6	2.2	0.0	0.0
TM	0.64	0.52	0.37	77.6	100.0	100.0	0.0	0.0	0.0
KEM	0.16	0.74	0.87	100.0	100.0	100.0	0.0	0.0	0.0
KLP	0.72	1.37	0.92	100.0	100.0	100.0	0.0	0.0	0.0
LAB	0.50	0.64	0.48	100.0	100.0	100.0	0.0	0.0	2.3
KEN	0.08	0.63	0.81	100.0	100.0	100.0	0.0	0.0	0.0
BIN	0.60	0.39	0.53	100.0	100.0	100.0	0.0	0.0	0.0
LD	0.70	0.60	0.85	100.0	100.0	100.0	0.0	0.0	0.0
MOH Hospitals	**0.64**	**0.63**	**0.63**	**97.5**	**98.4**	**98.9**	**0.8**	**0.7**	**0.4**
UMMC	0.39	0.64	0.69	100.0	100.0	100.0	0.0	0.4	3.2

Figure 30 : Catheter Utilisation Ratio and Incidence of central venous catheter-related blood stream infection (CVC-BSI), by hospital 2015



National Healthcare Safety Network (NHSN) report, data summary for 2013 [23]							
Types of ICU	**Catheter utilisation ratio**	**CVC-BSI per 1000 catheter days**					
		Pooled mean	**Percentile**				
			10th	**25th**	**50th**	**75th**	**90th**
Mixed medical/ surgical > 15 beds	0.49	0.8	0.0	0.0	0.6	1.2	2.0
Mixed medical/ surgical ≤ 15 beds	0.37	0.8	0.0	0.0	0.0	1.0	2.4
Neurosurgical	0.43	0.9	0.0	0.0	0.7	1.4	2.2
Surgical	0.55	0.9	0.0	0.0	0.7	1.4	2.5
Trauma	0.53	1.4	0.0	0.5	1.2	2.1	3.4

Table 46 : Bacteriological cultures in CVC-BSI 2013 - 2015

Organisms	2013 n (%)	2014 n (%)	2015 n (%)
Klebsiella spp. MRO Non-MRO	**25 (34.2)** **8** **17**	**30 (39.0)** **23** **7**	**25(19.4)** **17** **8**
Acinetobacter spp. MRO Non-MRO	**12 (16.4)** **5** **7**	**20 (26.0)** **18** **2**	**22(17.1)** **15** **7**
Pseudomonas aeruginosa MRO Non-MRO	**15 (20.5)** **0** **15**	**14 (18.2)** **2** **12**	**19(14.7)** **2** **17**
Enterobacter spp. MRO Non- MRO	**0 (0.0)** **0** **0**	**6 (7.8)** **3** **3**	**3(2.3)** **2** **1**
Stenotrophomonas maltophilia	**3 (4.1)**	**0 (0)**	**3(2.3)**
Other gram negative bacteria MRO Non-MRO	**5 (6.8)** **2** **3**	**1 (1.3)** **0** **1**	**16(12.4)** **8** **8**
Staphylococcus aureus MRSA MSSA VRSA	**7 (9.6)** **7** **0**	**3 (3.9)** **2** **1**	**11(8.5)** **4** **6** **1**
Coagulase negative *Staphylococcus* Methicillin resistant Methicillin sensitive	**3 (4.1)** **2** **1**	**1 (1.3)** **1** **0**	**24(18.6)** **11** **13**
Enterococcus faecium	**0 (0)**	**1 (1.3)**	**1(0.8)**
Fungal	**3 (4.1)**	**1 (1.3)**	**5(3.9)**
Total	**73 (100.0)**	**77 (100)**	**129(100)**

The mean compliance rate to CVC care bundle in MOH ICUs in 2015 was 98.9%. The incidence of CVC-BSI was 0.4 per 1000 catheter days (compare with 0.7 in 2014). This was comparable when benchmarked with that of US National Healthcare Safety Network (NHSN) [23]; as shown in the table above. However, there was a high possibility of under diagnosis and under reporting in many MOH ICUs.

The pooled catheter utilization ratio was 0.63, which was higher than the benchmark.

Gram-negative organisms accounted for 92% and 68% of causative organisms for CVC-BSI in 2014 and 2015 respectively. The predominant organisms isolated were *Klebsiella pneumonia* followed by *Acinetobacter sp*. and *Pseudomonas aeruginosa* for both years.

In 2015, gram-positive organisms and fungus accounted for 28% and 4% of causative organisms for CVC-BSI respectively. Coagulase-negative staphylococcus and methicillin-

resistant staphylococcus aureus accounted for 67% and 11% respectively among among gram-positive organisms.

Majority of CRBSIs are associated with CVCs, and in prospective studies, the relative risk for CRBSI is up to 64 times greater with CVCs than with peripheral venous catheters.

The risk of CRBSI is considerably higher in the ICU population than in the non-ICU population. One of the main reasons for this was the frequent insertion of multiple catheters. Moreover the catheters may have been placed in emergency circumstances, repeatedly accessed each day, and often needed for extended periods.

Meta-analytical study done at the Johns Hopkins University showed that bloodstream infections were the third leading cause of hospital-acquired infections. These infections have an attributable mortality rate of 12% to 25%. Individuals counteract 250,000 bloodstream infections each year in the United States and over 80,000 of these appeared in ICUs. These infections were associated with increased length of hospital stay from 10 to 20 days and increased in the cost of care [25]. 60% of CRBSIs were caused by micro-organisms from the patient's skin. 64% of the pathogens causing CRBSI were gram-positive and 36% were gram-negative.

In a recent meta-analysis of CRBSIs, gram-positive cocci constituted 27% of isolates and gram-negative bacilli contributed 56%. The proportion of gram-negative CRBSI was much higher than that reported in western hospitals [22].

Pronovost's Michigan Health and Hospital Association (MHA) Keystone Center for Patient Safety and Quality Keystone ICU project is one of the most successful recent collaborative efforts to reduce CRBSIs. The Keystone Project involved the contribution and analysis of data from 103 ICUs in 67 hospitals. These hospitals implemented five evidence-based procedures (hand washing, use of full-barrier precautions during CVC insertion, skin cleaning with chlorhexidine, avoiding the use of the femoral site and removal of unnecessary catheters) and were able to reduce the median rate of CRBSI infections per 1000 catheter-days from 2.7 infections at baseline to 0 infection at 3 months after implementation of the study intervention ($p \leq 0.002$) [21].

In the UK, CRBSI accounts for 10% to 20% of hospital-acquired infections and is associated with both increased ICU stay and mortality [21].

EARLY MOBILITY IN ICU

A high proportion of patients who survive intensive care suffer from significant physical disabilities secondary to neuromuscular weakness from critical illness, prolonged bed rest, and immobility. Evidence suggests that early mobilisation in mechanically ventilated patients mitigates the physical, cognitive and psychological complications of critical illness [26]. Early mobilisation has also been shown to decrease the duration of mechanical ventilation and hospital length of stay [27], [28].

Early mobility therapy is a quality improvement initiative introduced in the ICUs in MOH hospitals in the second half of the year 2013. This is a multi-disciplinary team effort involving the clinicians, nurses and physiotherapists to ensure that early mobility becomes a routine part of care for all patients admitted to the intensive care unit. The Early Mobility Protocol consists of 4 levels of physical activity and progression from one level to another depends on the conscious state and functional ability of the patient. Activities in this protocol include body positioning, passive and active range of limb motions, sitting to walking.

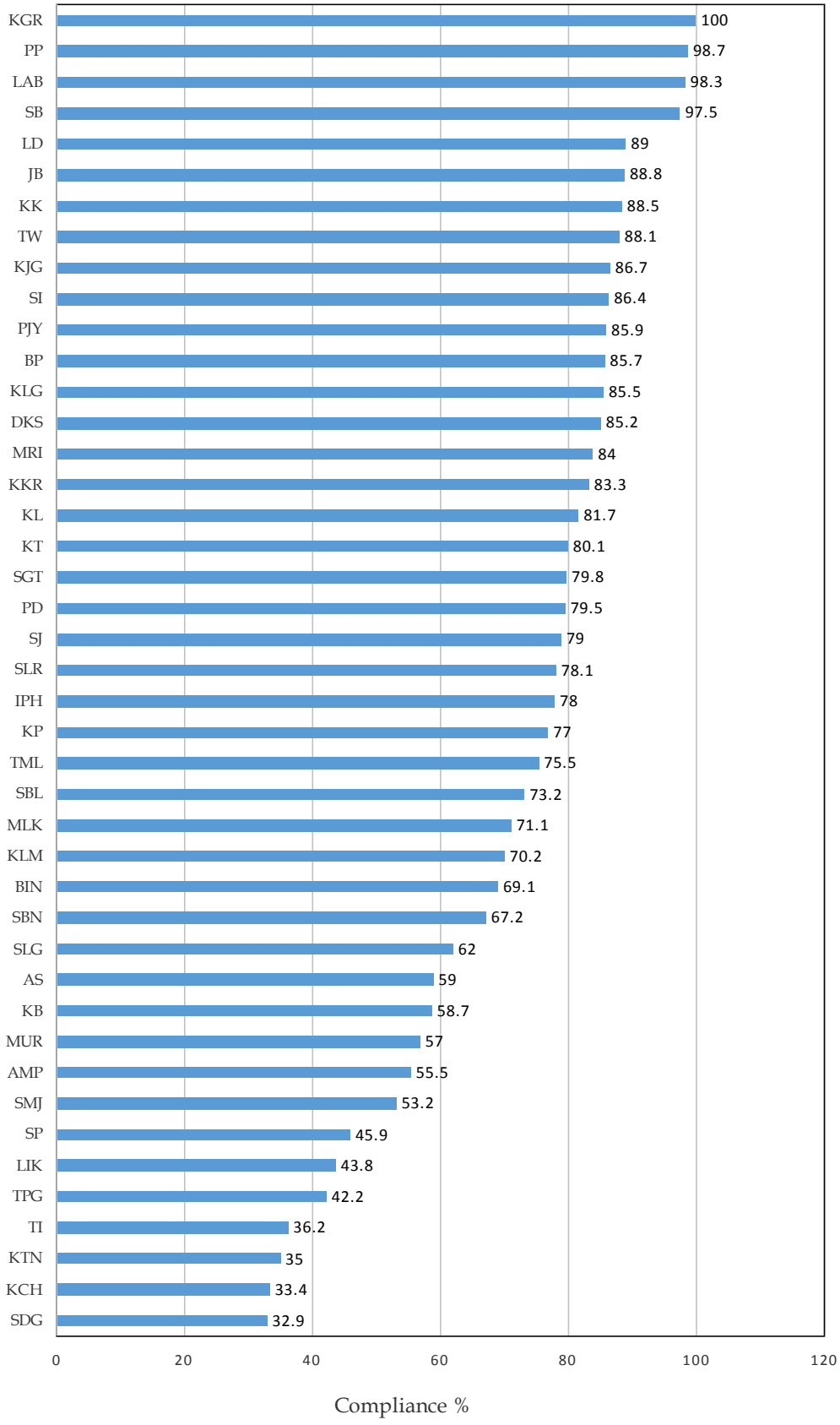
Compliance to the protocol is calculated as the percent of actual number of activities performed against the expected to be performed for the highest level of mobility for all patients in the ICU.

In 2015, 43 MOH hospitals (compared with 40 in 2014) reported their compliance rate to the Early Mobility Protocol. The compliance rate ranged from 32.9% to 100%, with an average of 71.5%. Some of the barriers identified to the implementation of the protocol included concerns on the safety of mobilisation of ventilated patients, lack of resources (both staff and equipment) and excessive sedation and delirium.

LGW did not report their compliance rates to the protocol in 2014 and 2015.

5 hospitals (KLP, KEN, KEM, TM, BM) did not receive training in the Early Mobility in ICU workshops due to logistical reasons. These centres were not obliged to report compliance rates to this protocol

Figure 31 : Compliance to Early Mobility in ICU protocol, by hospital 2015



SSKIN CARE BUNDLE

Critically ill patients are at high risk for development of pressure ulcers. Haemodynamic instability and presence of multiple medical devices contributes to inability to position patients, hence increase the risk of pressure ulcer development. These patients are also at risk of medical device related pressure ulcers.

Due to the huge impact of pressure ulcers on patients and healthcare costs, it is imperative that effective measures are taken to prevent the development of pressure ulcers in these high risk patients.

The SSKIN care bundle was introduced to MOH ICUs as one of the means to prevent pressure ulcers in 2014.

In October 2014, 25 MOH ICUs received training in the SSKIN care bundle. By November 2015, 49 ICUs in MOH hospitals have received training in this bundle.

SSKIN care bundle identifies five key aspects of care that are:

S	**Surface**	Ensure patients have the right surface support
S	**Skin Inspection**	Inspect skin regularly to detect any changes and institute early interventions
K	**Keep Moving**	Position patients regularly
I	**Incontinence**	Promote good skin care by keeping skin clean and well moisturised
N	**Nutrition**	Ensure adequate nutrition and hydration

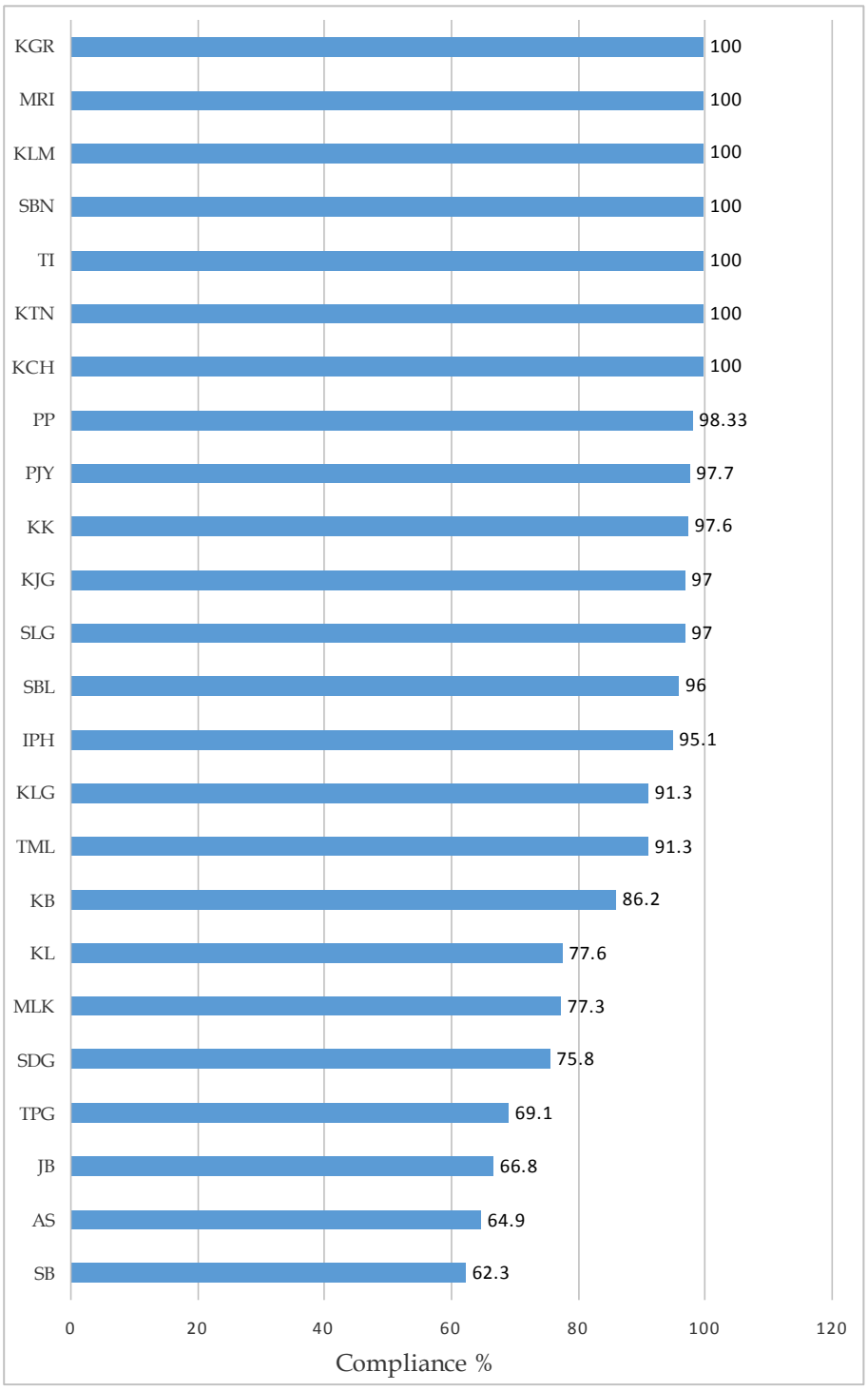
Audit of compliance with the SSKIN care bundle is carried out monthly. Compliance with the bundle is measured by assessment of the completion of all components over the same period of time, an "all or none" strategy.

In 2015, 24 ICUs (LIK, SP, SMJ, AMP, MUR, BIN, KP, SLR, SJ, PD, SGT, KKR, DKS, BP, SI, TW, LD, LAB, LGW, TM, KEN, BM, KLP and KEM) did not report on compliance with SSKIN care bundle as it was introduced only towards the end of 2015 in these units.

The compliance rate for 24 ICUs varied from 62.3% to 100% between units with a mean of 89.8%.

KT did not report on compliance with this bundle in 2015.

Figure 32 : Compliance to SSKIN Bundle, by hospital 2015



SECTION G:

REPORT ON
DENGUE INFECTION
IN MOH ICUs
2010 - 2015

Report on patients with dengue infection who were admitted to the intensive care units in the Ministry of Health hospitals from 2010 - 2015

The year 2015 was characterized by large dengue outbreaks worldwide. In Malaysia, the number of dengue cases reported by the Ministry of Health Malaysia has increased remarkably over the last two years. The number of dengue cases was 120,836 in 2015 [29], an increase of 11.2% from 108,698 in 2014. The number of cases in 2014 was actually a 151% increase from 43,346 in 2013 [19] [24]. The number of dengue cases in 2012, 2011 and 2010 were 21,900, 19,884 and 46,171 respectively [16] [17] [18].

Admissions with dengue infection to ICU had also increased in tandem with the increase in the number of dengue cases reported by the Ministry of Health. The percentage of dengue admission to ICU was 6.1 in 2010, 2.7 in 2011, 2.7 in 2012, 4.1 in 2013, 8.4 in 2014 and 9.1 in 2015. Dengue infection was the most common diagnosis leading to ICU admission for two years now.

Demographics for the patients who were admitted to ICU had not varied much over the last 6 years. However, the crude in-hospital mortality increased over the years from 5.6% in 2011 to 8.9% in 2015. The SMR also increased from 0.50 in 2011 to 0.80 in 2015.

The majority of patients admitted to ICU with dengue infection were young, with a median age of 31.7 years in 2015. The median interval from hospital to ICU admission was short, being further shortened to 8 hours compared to 9.6 hours in the previous year.

The median length of ICU stay for dengue patients had been short (1.9 to 2 days) over the 6 years, shorter than that of all ICU admissions (2.4 to 2.6 days), except in year 2014 when it was longer.(2.8 days compared to 2.5 days). The median length of hospital stay for dengue admissions was shorter compared with that of all ICU admissions all these years.

The median length of mechanical ventilation for dengue admissions was longer than that of all ICU admissions all these years. It was also longer than the median length of ICU stay. This could be explained by the fact that only less than 20% of the dengue patients were ventilated.

Patients with dengue infection had a much lower SAPS II score on ICU admission compared with the rest of the ICU admissions (mean SAPS II score of 19.3 vs. 35.0).

Haematological failure remained the main organ failure on ICU admission over the past 6 years.

The number of patients with dengue infection who also had associated co-morbid diseases has increased over the years. It made up 26.4% of the dengue patients admitted to ICU.

Table 47 : General comparison for Dengue infection MOH ICUs 2010 – 2015

	Dengue Infection 2010 n = 1643	Dengue Infection 2011 n = 798	Dengue Infection 2012 n = 906	Dengue Infection 2013 n=1550	Dengue Infection 2014 n=3261	Dengue Infection 2015 n=3601
Age, years median (IQR)	28.8 (22.5 – 47.3)	29.5 (21.0 – 44.1)	32.8 (21.5-41.8)	31.3 (21.7-46.1)	34.6 (22.0-45.4)	31.7 (22.3-47.8)
Interval from hospital to ICU admission, days median (IQR)	Not available	0.5 (0.1 – 1.3)	0.5 (0.1-1.3)	0.5 (0.1-1.4)	0.4 (0.1-1.2)	0.3 (0.1-0.9)
Length of ICU stay, days median (IQR)	1.9 (1.9 – 9.6)	2.0 (1.3 – 3.0)	1.9 (1.2-2.7)	1.9 (1.3-2.9)	2.8 (1.3-3.1)	2.0 (1.3-3.1)
Length of hospital stay, days median (IQR)	5.5 (3.4 – 17.5)	5.8 (4.1 – 8.3)	5.2 (3.9-7.2)	5.3 (3.9-7.2)	7.1 (3.8-7.2)	5.1 (3.7-7.2)
Length of mechanical ventilation, days median (IQR)	3.8 (1.4 – 7.2)	3.6 (1.6 - 7.9)	4.2 (1.0-5.0)	2.9 (1.2-6.2)	5.0 (1.5-6.5)	2.6 (1.3-5.7)
Total SAPS II score, mean +/-SD Median (IQR)	19.0 ± 14.1	19.6 ± 16.0	17.4 ± 13.0	18.6 ± 13.2	18.6 ± 15.0 15.0 (10.0-23.0)	19.3± 13.9 16.0 (10.0-24.0)
% Invasive mechanical ventilation	18.6	13.8	9.5	11.2	12.1	15.3
% Co-morbid diseases	18.1	22.3	18.3	25	22.9	26.4
Main organ failure %						
Without organ failure	32.2	27.3	35.2	36.3	32.4	30.5
Respiratory failure	4.7	3.0	3.3	2.9	5.9	3.7
Cardiovascular failure	7.1	7.2	6.9	6.1	6.0	6.1
Neurological failure	0.6	0.4	0.1	0.7	0.4	0.4
Renal failure	0.9	0.7	0.8	1.1	1.2	1.8
Hepatic failure	0.4	0.1	0.1	0.3	0.4	0.3
Haematological failure	54.0	40.9	53.4	52.5	53.6	57.1
SMR (95% CI)	0.75 (0.42-1.20)	0.50 (0.26 – 0.86)	0.51 (0.26 - 0.94)	0.50 (0.28-0.95)	0.57 (0.33-1.05)	0.80 (0.43-1.30)

Table 48 : Dengue infection by individual hospital and crude all-cause in-hospital mortality 2011-2015

Hospital	Year									
	2011		2012		2013		2014		2015	
	ICU admission n (%)	All-cause In-hospital mortality n (%)	ICU admission n (%)	All-cause In-hospital mortality n (%)	ICU admission n(%)	All-cause In-hospital mortality n(%)	ICU admission n(%)	All-cause In-hospital mortality n(%)	ICU admission n(%)	All-cause In-hospital mortality n(%)
AS	14 (1.2)	0 (0.0)	20 (1.7)	0 (0.0)	18 (1.3)	1 (5.6)	9 (0.7)	1 (11.1)	13 (1.1)	1 (7.7)
PP	73 (6.1)	1 (1.4)	14 (1.1)	1 (7.1)	53 (4.7)	5 (9.4)	77 (6.8)	10 (13.0)	109 (9.7)	17 (15.6)
IPH	26 (2.3)	3 (11.5)	18 (1.9)	2 (11.1)	57 (4.7)	3 (5.3)	87 (7.1)	9 (10.3)	89 (7.4)	19 (21.3)
KL	71 (3.9)	2 (2.8)	127 (6.4)	2 (1.6)	141 (7.4)	4 (2.8)	429 (20.0)	23 (5.4)	395 (20.6)	24 (6.1)
SLG	40 (3.5)	1 (2.5)	19 (1.5)	0 (0.0)	76 (5.0)	2 (2.6)	196 (13.7)	12 (6.1)	196 (14.4)	26 (13.3)
KLG	98 (6.1)	6 (6.1)	186 (8.7)	10 (5.4)	190 (9.2)	9 (4.8)	456 (20.0)	34 (7.5)	378 (18.3)	29 (7.7)
SBN	15 (2.7)	3 (20.0)	11 (2.0)	1 (9.1)	24 (5.1)	1 (4.8)	40 (7.4)	5 (12.5)	68 (13.1)	9 (13.2)
MLK	48 (3.0)	4 (8.3)	38 (2.2)	3 (7.9)	212 (12.7)	14 (6.6)	123 (8.6)	7 (5.7)	151 (11.0)	9 (6.0)
JB	22 (1.3)	3 (13.6)	23 (1.3)	2 (8.6)	83 (4.3)	17 (20.5)	75 (4.4)	14 (18.7)	102 (6.3)	19 (18.6)
KTN	11 (1.8)	1 (9.1)	3 (0.5)	0 (0.0)	23 (2.7)	2 (8.6)	26 (2.4)	2 (7.7)	63 (6.1)	11 (17.5)
KT	30 (2.5)	4 (13.3)	24 (1.8)	1 (4.2)	19 (1.6)	1 (5.3)	52 (4.4)	4 (7.7)	89 (6.4)	9 (10.1)
KB	13 (1.2)	1 (7.7)	3 (0.2)	0 (0.0)	25 (1.9)	2 (8.0)	286 (17.8)	20 (7.0)	110 (9.5)	7 (6.4)
KCH	10 (1.6)	1 (10.0)	13 (1.5)	1 (7.7)	25 (2.6)	3 (12.0)	31 (2.7)	2 (6.5)	17 (1.5)	1 (5.9)
KK	19 (2.3)	0 (0.0)	12 (1.3)	0 (0.0)	23 (2.3)	2 (8.7)	31 (3.1)	1 (3.2)	75 (9.1)	3 (4.0)
SP	5 (1.9)	0 (0.0)	11 (6.9)	0 (0.0)	21 (3.6)	1 (4.8)	42 (4.4)	8 (19.0)	91 (9.3)	9 (9.9)
PJY	11 (2.0)	1 (9.1)	10 (1.7)	1 (10.0)	29 (4.8)	1 (3.4)	56 (8.6)	4 (7.1)	80 (10.8)	3 (3.8)
MUR	2 (0.4)	0 (0.0)	4 (0.6)	0 (0.0)	15 (2.2)	1 (6.7)	9 (1.5)	0 (0.0)	21 (3.5)	4 (19.0)
TI	6 (1.9)	0 (0.0)	4 (1.0)	1 (25.0)	6 (1.5)	0 (0.0)	5 (1.2)	1 (20.0)	23 (5.7)	3 (13.0)
TPG	26 (3.0)	2 (7.7)	43 (3.6)	4 (9.5)	32 (2.4)	1 (3.1)	52 (4.4)	3 (5.8)	36 (3.4)	6 (16.7)
SJ	3 (0.5)	0 (0.0)	1 (0.2)	0 (0.0)	5 (1.2)	0 (0.0)	6 (1.5)	0 (0.0)	13 (2.9)	0 (0)
KJG	17 (5.0)	2 (11.8)	23 (6.2)	1 (4.3)	27 (8.4)	0 (0.0)	55 (19.4)	9 (16.4)	145 (32.0)	13 (9.0)
KGR	1 (0.3)	0 (0.0)	6 (1.7)	1 (16.7)	11 (3.4)	1 (9.1)	14 (4.1)	0 (0.0)	23 (6.7)	1 (4.3)
TML	28 (5.2)	3 (10.7)	8 (1.8)	0 (0.0)	15 (2.5)	1 (6.7)	90 (10.8)	6 (6.7)	83 (10.7)	8 (9.6)
KP	3 (0.8)	1 (33.3)	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	21 (4.1)	1 (4.8)	50 (9.9)	6 (12.0)
SMJ	7 (1.8)	1 (14.3)	13 (3.2)	4 (30.8)	5 (1.3)	0 (0.0)	11 (2.5)	1 (9.1)	46 (11.3)	2 (4.3)
BP	9 (2.0)	0 (0.0)	6 (1.4)	0 (0.0)	21 (4.6)	2 (9.5)	14 (3.1)	1 (7.1)	21 (4.1)	2 (9.5)
TW	2 (0.7)	0 (0.0)	9 (2.1)	0 (0.0)	37 (8.2)	2 (5.4)	50 (10.0)	1 (2.0)	23 (6.0)	1 (4.3)
MRI	0 (0.0)	0 (0.0)	5 (1.0)	3 (60.0)	16 (3.3)	1 (6.2)	15 (3.5)	1 (6.7)	8 (2.2)	0 (0.0)
KLM	8 (1.6)	1 (12.5)	9 (1.5)	1 (11.1)	4 (0.7)	1 (25.0)	20 (3.6)	2 (10.0)	25 (5.1)	4 (16.0)
SDG	50 (5.7)	6 (12.0)	33 (3.8)	0 (0.0)	63 (7.4)	6 (9.5)	158 (18.9)	9 (5.7)	187 (25.2)	16 (8.6)
SB	1 (0.2)	0 (0.0)	9 (1.8)	1 (11.1)	8 (1.6)	1 (12.5)	13 (3.0)	2 (15.4)	45 (3.6)	2 (4.4)
DKS	19 (3.6)	2 (10.5)	5 (1.0)	0 (0.0)	15 (1.6)	1 (6.7)	15 (1.6)	1 (6.7)	51 (6.0)	5 (9.8)
SI	24 (3.7)	3 (12.5)	23 (2.9)	3 (13.0)	96 (9.9)	1 (1.0)	119 (10.5)	8 (6.7)	289 (20.0)	17 (5.9)
SBL	62 (4.9)	3 (4.8)	95 (6.0)	4 (4.2)	74 (3.9)	3 (4.1)	451 (19.7)	24 (5.3)	274 (12.1)	12 (4.4)
AMP	19 (3.4)	0 (0.0)	4 (0.7)	2 (50.0)	12 (2.1)	1 (8.3)	38 (6.0)	3 (7.9)	29 (4.4)	11 (37.9)
LIK	5 (1.3)	0 (0.0)	2 (0.7)	0 (0.0)	3 (0.6)	0 (0.0)	2 (0.6)	0 (0.0)	2 (1.3)	0 (0.0)
UMMC	-	-	3 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	69 (5.5)	4 (5.8)
LKW			0 (0.0)		0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

BM	-	-	0 (0.0)	-	1 (0.6)	0 (0.0)	3 (2.1)	0 (0.0)	3 (1.5)	0 (0.0)
SLR	-	-	2 (1.3)	0 (0.0)	4 (1.8)	0 (0.0)	8 (3.6)	0 (0.0)	13 (7.1)	1 (7.7)
PD	-	-	4 (2.0)	0 (0.0)	12 (4.9)	0 (0.0)	19 (7.2)	0 (0.0)	20 (9.7)	2 (10.0)
KKR	-	-	0 (0.0)	0 (0.0)	3 (1.3)	0 (0.0)	12 (4.6)	1 (8.3)	13 (3.5)	1 (7.7)
SGT	-	-	1 (0.8)	0 (0.0)	1 (0.6)	0 (0.0)	2 (1.3)	1 (50.0)	7 (2.5)	3 (42.9)
TM	-	-	0 (0.0)	0 (0.0)	8 (6.3)	0 (0.0)	5 (3.1)	0 (0.0)	26 (8.9)	1 (3.8)
KEM			0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	11 (6.7)	0 (0.0)
KLP	-	-	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	3 (3.1)	0 (0.0)	8 (8.2)	0 (0.0)
LAB	-	-	1 (0.9)	1 (100.0)	3 (1.8)	0 (0.0)	2 (1.2)	1 (50.0)	0 (0.0)	0 (0.0)
KEN	-	-	1 (1.2)	0 (0.0)	9 (5.6)	0 (0.0)	7 (4.9)	0 (0.0)	6 (4.5)	1 (16.7)
BIN	-	-	2 (0.9)	1 (50.0)	13 (5.0)	1 (7.7)	6 (2.1)	0 (0.0)	3 (1.0)	0 (0.0)
LD	-	-	4 (2.4)	0 (0.0)	13 (5.3)	0 (0.0)	12 (5.5)	1 (8.3)	2 (1.4)	0 (0.0)
Total	**798 (2.9)**	**55 (6.4)**	**852 (2.6)**	**51 (5.6)**	**1553 (4.3)**	**92 (5.9)**	**3253 (8.6)**	**233 (7.1)**	**3601 (9.6)**	**322 (8.9)**

SUMMARY

1. The total number of ICU beds in the 49 MOH participating centres was 660, with a median bed occupancy of 91.6%.

2. The number of cases analysed for year 2015 was 39,595 an increase of 1.7% over the previous year.

3. The percentage of patients denied admission due to the unavailability of ICU beds was 32% in 2015.

4. The average age of patients excluding those below 18 years was 49.5 years.

5. In MOH hospitals, foreigners constituted 6% of all ICU admissions.

6. The average lengths of ICU and hospital stay were 4.8 and 14.4 days respectively.

7. In MOH hospitals, 69% of admissions were non-operative patients, an increase of 7% in the last five years.

8. Direct admission to MOH ICUs from the emergency department had steadily increased over the past 10 years from 10% in 2005 to 33% in 2015.

9. In MOH ICUs, cardiovascular failure (38%) was the most common organ failure during the first 24 hours of ICU admission, followed by respiratory (24%), neurological (18%), renal (10%), haematological (9%) and hepatic (1%).

10. Dengue infection, sepsis and head injury were the three most common diagnoses leading to ICU admission. The in-hospital mortality for this group of patients was 8.9%, 51.2% and 22.0%respectively.

11. During the first 24 hours of ICU admission, 18%, 7% and 15% of patients had severe sepsis, acute respiratory distress syndrome and acute kidney injury respectively.

12. The average SAPS II score was 36.8, which carries a predicted risk of in-hospital mortality of 30.4%.

13. The average Sequential Organ Failure Assessment (SOFA) score was 6.6 in 2015.

14. 75%of patients in MOH ICUs and 72% of patients in UMMC ICU received invasive ventilation with an average duration of 4.7 days.

15. The percentage of patients who received non-invasive ventilation increased from 5.1% in 2005 to 18.6% in 2015.

16. In MOH hospitals, 14.8% of ICU admissions received renal replacement therapy, with intermittent haemodialysis being the most common modality of therapy.

17. Among patients who were invasively ventilated, 9.4% had tracheostomy performed, with the median time from initiation of ventilation to tracheostomy being 7.5 days.

18. The decision to withdraw or withhold therapy was made in 39.4% of patients who died in ICU.

19. The incidence of VAP had decreased by more than half from 6.8 to 2.4 per 1000 ventilator days over the last five years.

20. Gram-negative organism accounted for 91% and 100% of causative organisms for VAP in MOH and UMMC ICUs respectively. *Acinetobacter spp.*, *Klebsiella spp.*, and *Pseudomonas spp*. remained the 3 most common organisms causing VAP over the last 8 years in MOH ICUs. 60% of causative organisms causing VAP in MOH ICUs were multi-drug resistant strains.

21. The ventilator care bundle compliance rates for MOH hospitals improved from 96% in 2011 to 98.7% in 2015.

22. The unplanned extubation rate was 0.2 and 0.4 per 100 intubated days in MOH and UMMC ICUs respectively.

23. The mean incidence of pressure ulcers was 6.5 and 5.2 per 1000 ICU days in MOH and UMMC ICUs respectively.

24. The incidence of central venous catheter-related bloodstream infection in MOH and UMMC ICUs was 0.4 and 3.2 per 1000 catheter days respectively.

25. 68%, 28% and 4% of the organisms isolated for CVC-BSI were gram-negative, gram-positive and fungal respectively.

26. The predominant organisms causing CVC-BSI were *Klebsiella pneumonia* followed by *Acinetobacter spp*. and *Pseudomonas aeruginosa.*

27. The crude in-ICU and in-hospital mortality rates for MOH ICUs were 18.7% and 26.0% respectively.

28. The mean standardised mortality ratio was 0.69 [95%C.I. 0.47–0.95] and 0.68 [95%C.I.0.45 – 0.98] for MOH and UMMC ICUs respectively.

29. The average compliance rate to the Early Mobility in ICU protocol was 71.5% in 2015.

30. The average compliance rate to the SSKIN care bundle was 89.8% with a range of 62.3 to 100%).

31. The average all cause in-hospital mortality rate for patients admitted for dengue infection in MOH ICUs had increased from 6.4% in 2011 to 8.9% in 2015.

REFERENCES

1.	Sydney E. S. Brown1, Sarah J Ratcliffe, Jeremy M Kahn and Scott D Halpern. The Epidemiology of Intensive Care Unit Readmissions in the United States. January 26, 2012, doi: 10.1164/rccm.201109-1720OC *Am J Respir Crit Care Med.*
2	Clinical Markers in Intensive care. In: Determining the Potential to Improve the Quality of Care in Australian Health Care Organizations. Australian Council on Healthcare Standards. Health Services Research Group, University of Newcastle. 2000; 52-4
3	Garrousle-Orgeas M et al. Predictors of intensive care unit refusal in French intensive care units: a multi-centre study. *Crit Care Med* 2005; 33(4):750-755
4.	Vincent JL, Moreno R, Takala J, et al. The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. *Intensive Care Med* 1996;22:707-710
5.	Vincent JL et al. Sepsis in European intensive care units: Results of the SOAP study. *Crit Care Med* 2006;34(2):344-353
6.	Piccinni P et al. Prospective multicentre study on epidemiology of acute kidney injury in the ICU: a critical care nephrology Italian collaborative effort (NEFROINT) *Minerva Anestesiologie* 2011 Nov 77(11):1072-83
7.	Le Gall JR, Lemeshow S, Saulnier F. A New Simplified Acute Physiology Score (SAPS II) based on a European/North American Multi-centre Study *JAMA* 1993;270(24):2957-2963
8.	Tai LL et al . Validation and recustomisation of Simplified Acute Physiologic score II (SAPS II) in patients in Malaysian ICU. *Poster presentation at the 13th Western Pacific Association of Critical Care Medicine Conference, Seoul 2004*
9.	Uchino S et al. Acute renal failure in critically ill patients. A multinational, multicenter study. *JAMA* 2005;294(7):813-818
10.	Brieva JL et al. Withholding and withdrawal of life-sustaining therapies in intensive care: An Australian experience. *Crit Care Med* 2009;11(4):266-268
11	Sprung CL et al End-of-life practices in European intensive care units: the Ethicus Study. *JAMA* 2003 Aug 13;290(6):790-7
12.	Dudeck MA et al. National Healthcare Safety Network (NHSN) Report, Data Summary for 2012, Device-associated Module. *Am J Infection Control* 2013;41:1148-66
13.	Rosenthal VD et al. International Nosocomial Infection Control Consortium (INICC) report, data summary for 36 countries from 2004-2009. *Am J Infection Control* 2012; 40:396-407
14.	Hoste EA, Clermont G, Kersten A. RIFLE criteria for acute kidney injury are associated with hospital mortality in critically ill patients: a cohort analysis. *Crit Care*. 2006;10(3): R73. Epub 2006 May 12

15.	Payen D, de Pont AC, Sakr Y. A positive fluid balance is associated with a worse outcome in patients with acute renal failure. *Crit Care*.2008;12:R74. Epub 2008 June 4
16.	Situasi Semasa Demam Denggi Di Malaysia Bagi Minggu 52/2011 (25 hingga 31 Dis 2011). http://www.moh.gov.my
17.	Situasi Semasa Demam Denggi Dan Chikungunya Di Malaysia Bagi Minggu 52/2010 (26 Dis 2010 hingga 01 Jan 2011). http://www.moh.gov.my
18.	Situasi Demam Denggi Di Malaysia Bagi Minggu 52/2012 (23 - 29 Dis 2012) http://www.moh.gov.my/press_releases/357
19.	Situasi Demam Denggi Di Malaysia Bagi Minggu 52/2013 (22 - 28 Dis 2013) http://www.moh.gov.my/index.php/database_stores/store_view_page/17/458
20.	Berenholtz SM, Pronovost PJ, Lipset PA, et al. Eliminating catheter-related bloodstream infection in the intensive care unit. *Crit Care Med*. 2004 ; 32: 2014 - 2020.
21.	Pronovost PJ, Needham DM, Berenholtz SM et al. An intervention to decrease catheter-related bloodstream infections in the ICU. *N Engl J Med*. 2006; 355(26):2725-32.
22.	Gahlot R et al. Catheter-related bloodstream infections. International J of Critical Illness & Injury Science 2014;4(2):162-167
23	Dudeck MA et al. National Healthcare Safety Network (NHSN) Report, Data Summary for 2013, Device-associated Module. *Am J Infection Control* 2015; 43:206-221
24	http://reliefweb.int/report/malaysia/dengue-situation-update-456-13-january-2015
25	Maki DG, Kluger DM, Crnich CJ. The risk of bloodstream infection in adults with different intravascular devices: a systematic of 200 published prospective studies. *Mayo Clin Proc*. 2006;81(9):1159–1171
26	Hopkins RO, Jackson JC: Short and long term cognitive outcomes in intensive care unit survivors. *Clin Chest Med* 2009; 30: 143A153.
27	Schweickert WD, Pohlman MC, Pohlman AS, et al. Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomized controlled trial. *Lancet* 2009;373(9678):1874–1882.
28	Needham DM, Korupolu R, Zanni JM, et al. Early physical medicine and rehabilitation for patients with acute respiratory failure: a quality improvement project. *Arch Phys Med Rehabil* 2010;91(4):!536A542.
29	https://kpkesihatan.com/2016/01/11/kenyataan-akhbar-kpk-11-jan-2016-situasi-semasa-demam-denggi-di-malaysia-bagi-minggu-12016-3-januari-hingga-9-januari-2016/
30	Berwick DM, Calkins DR, McCannon CJ et al. The 100,000 Lives Campaign: setting a goal and a deadline or improving health care quality. JAMA. 2006; 295: 324 – 327.

31	National Healthcare Safety Network (NHSN) July 2013 CDC/NHSN Protocol Clarifications 2013. [http://www.cdc.gov/nhsn/PDFs/pscManual/10-VAE_FINAL.pdf]