Malaysian Registry of Intensive Care

Report for 2013

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REPORT SUMMARY

This is the report on all intensive care admissions to the 51 participating centres from 1st January to 31st December 2013.

The following are the main findings:

1. The total number of ICU beds in the 49 MOH participating units was 600 with a median bed occupancy rate of 90.2%.

2. The number of cases analysed was 37,436, an increase of 10.5% over the previous year.

3. The percentage of patients denied admission due to the unavailability of ICU beds had declined from 40% to 29% in the last five years.

4. The average age of the patients, excluding those below 18 years, was 50.3 years.

5. The average duration of ICU and hospital stay was 4.7 and 14.4 days respectively.

6. In MOH hospitals, 66% of ICU admissions were non-operative patients.

7. Direct admissions to MOH ICUs from the emergency department had increased more than three-fold over the past 10 years from 9% in 2004 to 30% in 2013.

8. The percentage of ICU admissions with single or no organ failure (within 24 hours of ICU admission) was 63.6%.

9. Sepsis, head injury and community-acquired pneumonia were the three most common diagnoses leading to ICU admission in MOH hospitals in 2013. The in-hospital mortality rates for this group of patients were 53.4%, 22.1% and 38.9% respectively.

10. The average SAPS II score was 36.5, which carries a predicted in-hospital mortality of 30.4%.

11. In MOH hospitals, 77% of patients received invasive ventilation with an average duration of 4.5 days.

12. The percentage of patients who received non-invasive ventilation increased almost six-fold from 3.7% in 2004 to 22.3% in 2013.

13. The incidence of ventilator-associated pneumonia in MOH ICUs had decreased by half, from 11.6 to 5.4 per 1000 ventilator days, in the last five years.

14. The incidence of central venous catheter-related bloodstream infection in MOH ICUs was 0.8 per 1000 catheter days.

15. The crude in-ICU and in-hospital mortality rates for MOH hospitals were 19.9% and 27.7% respectively.

16. The mean standardised mortality ratio was 0.72 (95% C.I. 0.51 – 1.00), 0.65 (95% C.I. 0.44 – 0.91) and 0.28 (95% C.I. 0.14 – 0.68) for MOH ICUs, UMMC and SJMC respectively.

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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

Clinical Research Centre

Malaysian Society of Intensive Care

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

FOREWORD

The MRIC report for 2013 is a comprehensive reference document for the Ministry of Health regarding Intensive Care Services provided in 51 participating hospitals in Malaysia. This registry has been in existence for the past 12 years and has provided evidence for the Ministry of Health to establish and maintain support in terms of equipment, manpower and other resources required in improving the critical care services in Malaysia.

This report provides an analysis of all admission to ICU from 1st January to 31st December 2013. There were a total of 600 ICU beds with a bed occupancy rate of 90%. There were a total of 37,436 cases admitted, and this was a 10.5% increase over the previous year. It was heartening to note that patients who were denied admission to ICU had declined from 40% to 29% over the past 5 years. The percentage of patients who received non invasive ventilation had increased almost six fold and this is in tandem with current practices. The incidence of ventilator associated pneumonia in MOH ICUs had decreased from 11.6 to 5.4 per 1000 ventilator days in the last 5 years. The mean standardized mortality was 0.72 for MOH ICU.

These findings are evident of great milestones achieved in the provision of intensive care services in our country. I take this opportunity to thank Dr Ng Siew Hian who started this registry and also the hardworking and committed team of intensivists who have painstakingly continued working on this registry. Dr Jenny Tong, Dr Tai Li Ling and Dr Tan Cheng Cheng have been pillars of support in the maintenance of quality intensive care services in Malaysia and I thank them for all their your unwavering support, not forgetting Dr Ahmad Shaltut, Dr Lim Chew Har and Dr As Niza.

I am especially thankful and feel privileged to write a caption in this report and I take this opportunity to acknowledge all the members who have helped in making this report a reality. I also want to express my thanks to the 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

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	Dr Amin Sah Ahmad Principal Assistant Director

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.	Subang Jaya Medical Centre	SJMC
24.	Hospital Sultan Haji Ahmad Shah Temerloh	TML
25.	Hospital Tuanku Ampuan Najihah Kuala Pilah	KP
26.	Hospital Sri Manjung	SMJ
27.	Hospital Batu Pahat	BP
28.	Hospital Tawau	TW
29.	Hospital Miri	MRI
30.	Hospital Kulim	KLM
31.	Hospital Serdang	SDG

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

CATEGORIES OF ICU

Based on the number of ICU admissions in 2013, for the purpose of MRIC 2013 report

Participating sites		Number of admissions
Participating sites with ≥ 1000 admissions		
1	Hospital Tengku Ampuan Rahimah Klang	2065
2	Hospital Sultanah Aminah Johor Bahru	1931
3	Hospital Sungai Buloh	1922
4	Hospital Kuala Lumpur	1905
5	Hospital Melaka	1673
6	Hospital Selayang	1507
7	Hospital Taiping	1348
8	Hospital Sultanah Bahiyah Alor Setar	1347
9	Hospital Raja Perempuan Zainab II Kota Bharu	1337
10	Hospital Raja Permaisuri Bainun Ipoh	1203
11	Hospital Sultanah Nur Zahirah Kuala Terengganu	1180
12	Hospital Pulau Pinang	1121
13	Hospital Queen Elizabeth Kota Kinabalu	1022
Participating sites with 500 - 999 admissions		
14	Hospital Sultan Ismail Johor Bahru	970
15	Hospital Duchess of Kent Sandakan	964
16	Hospital Umum Sarawak Kuching	950
17	Hospital Serdang	851
18	Hospital Tengku Ampuan Afzan Kuantan	837
19	Hospital Pakar Sultanah Fatimah Muar	675
20	Hospital Putrajaya	606
21	Hospital Sultan Haji Ahmad Shah Temerloh	599
22	Hospital Sultan Abdul Halim Sungai Petani	583
23	Hospital Ampang	566
24	Hospital Kulim	561
25	Hospital Wanita dan Kanak-Kanak Sabah	517
26	Hospital Sibu	506
Participating sites with < 500 admissions		
27	Hospital Miri	481

28	Hospital Tuanku Ja'afar Seremban	471
29	Hospital Sultanah Nora Ismail Batu Pahat	459
30	Hospital Tawau	449
31	Hospital Seberang Jaya	413
32	Hospital Teluk Intan	401
33	Hospital Tuanku Ampuan Najihah Kuala Pilah	394
34	Hospital Sri Manjung	376
35	Hospital Tuanku Fauziah Kangar	322
36	Hospital Kajang	321
37	Hospital Bintulu	260
38	Hospital Port Dickson	245
39	Hospital Lahad Datu	244
40	Hospital Kuala Krai	240
41	Hospital Slim River	225
42	Hospital Langkawi	180
43	Hospital Labuan	165
44	Hospital Keningau	161
45	Hospital Segamat	159
46	Hospital Bukit Mertajam	158
47	Hospital Tanah Merah	127
48	Hospital Kuala Lipis	116
49	Hospital Kemaman	105
Private hospital		
50	Subang Jaya Medical Centre	1335
University hospital		
51	University Malaya Medical Centre	883

LIST OF SITE INVESTIGATORS AND SOURCE DATA COLLECTORS

January – December 2013

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 Norashikin Man SN Noorazimah Salleh
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
4	Kuala Lumpur	Dr Tai Li Ling	SN Salmi Zawati Serif SN Ismee Jusoh
5	Selayang	Dr Laila Kamariah Kamalul Baharin	SN Nor Zaila Saad@ Senafi SN Noor Azwati Daud
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	Sr Lim Yek Fong SN Farawahida Ahmad (till Sept 2013) SN Normah Abdul Taib (from Sept 2013)
8	Melaka	Dr Nahla Irtiza Ismail	SN Morni Omar (till Aug 2013) SN Noriza Rawi 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 Zakuan Mohd Nor AMO Hairizam Zulkhifli AMO Mohd Adib Jasni AMO Anand Sivasamy
10	Tengku Ampuan Afzan Kuantan	Dr Muhammad Zihni Abdullah	Sr Salina Sulaiman Sr Gan Soo Heng SN Amimah Abd Hamid SN Nur Azura Hamzah
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12	Raja Perempuan Zainab II Kota Bharu	Dr Wan Nasrudin Wan Ismail	Sr Azilah Ishak SN Azizum Ismail SN Suzana Yusof
13	Umum Sarawak Kuching	Dr.Jamaidah Jamorek	SN Noreafa Daim SN Sabia Lew SN Rosnica Jiton

14	Queen Elizabeth Kota Kinabalu	Dr Khoo Tien Meng	Sr Safiah Mokhtar SN Conny Chong Chiew Fah SN Aslinda Ahmad SN Saihin Maun
15	Sultan Abdul Halim Sungai Petani	Dr Rosman Noor Ali	Sr Rafizah Md Zuki Sr Puziah Yahya SN Hamiza Mohd Noor SN Zainun Awang
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20	Seberang Jaya	Dr Jeffry Wong Kep Kee (till Jun 2013) Dr Teoh Wei Tsung	Sr Nooraslina Othman (till Dec 2013) SN Nur Hasniza Abdul Aziz
21	Kajang	Dr Wan Hafizah Wan Tajul Ariffin	Sr Normaizana Ismail Sr Nurafidah Mohamad Rasip SN Saiza Mat Yusof
22	Tuanku Fauziah Kangar	Dr Azilah Desa	Sr Chua Pek Hong SN Zarina Mat Bistaman SN Norazlisyan Ramli
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25	Tuanku Ampuan Najihah Kuala Pilah	Dr Zalifah Nordin	Sr Lee New SN Norhafidah Ismail
26	Sri Manjung	Dr Khairudin Zainal Abidin	Sr Rohani Ali SN Hartini Abd Rahman SN Salbiah Abdul Rashid SN Norfaizal Abdul Majid
27	Batu Pahat	Dr Nasrudin Bunasir	SN Rosmawati Saimin SN Norhaezah Jani

28	Tawau	Dr Muzaffar Mohamad (till August 2013) Dr Sein Win	SN Lilybeth Feliciano Ferez SN Sarwah Isa SN Sharifah Maznah Habib Muhammad Sr Haliza Kasau
29	Miri	Dr Rozaini Ahmad Dr Lim Hong Jin	SN Noriah Ilai SN Zuriha Achim
30	Kulim	Dr Chua Kok Boon Dr Loh Hoong Heng	SN Mohana Omar SN Bahayah Mohamed Bakari SN Che Asmah Haji Md Isa
31	Serdang	Dr Nazarinna Muhamad	Sr Norain Saad SN Sarina Jamhari Sr Hamidah Mat Rasip (till May 2013)
32	Sibu	Dr Anita Alias	Sr Wong Chen Chen SN Yong Suk Moi
33	Duchess of Kent Sandakan	Dr Rusnah Abd Rahman	Sr Noorasmah Hassim SN Norahimah Dulraman SN Sofiah Yampi
34	Sultan Ismail Johor Bahru	Dr Mohd Zaini Laman	Sr Azleena Mohd Yusop SN Huzaimah Jahir SN Norwati Jamiran SN Norelessa Abd Aziz
35	Sungai Buloh	Dr Shanti Ratnam	Sr Sri Jayanthi Gobalan Sr Noorhaidah Baharuddin SN Norazlina Kasban
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40	Bukit Mertajam	Dr Nur Sabrina Mohd Sabry	Sr Teng Get Sim (till Aug 2013) Sr Thanaletchimi Packirisamy SN Faizah Abdul
41	Slim River	Dr Tin Tin Myint Dr Iqbalmumauwir bin Abd Rashid	Sr Khairol Nazimah Musa SN Suliati Baghdadi
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44	Segamat	Dr Wirza Feldi Bin Sawir	SN Hasneyza Bakar Sr Noryati Ab Majid
45	Tanah Merah	Dr Mohd Azmi Mamat	Sr Roslawani bt Ghazali SN Fadilah bt Mohd Nor
46	Kemaman	Dr Ahmad Nizam Ismail	Sr Sabariah Embong (till July 2013) Sr Rosmazariawati Zahari
47	Kuala Lipis	Dr Wan Satifah Wan Ngah	Sr W. Norlizer W.Muda SN Nik Arienti Nik Man
48	Labuan	Dr Betty Shee	Sr Roslin Akiu SR Loinsah Sibin
49	Keningau	DrSeinWin (tillAugust2013) Dr. Fazilawati Zakaria	Sr Beatrice Olas Sr Haineh Amin
50	Bintulu	Dr Norizawati bt Dzulkifli	Sr Jennifer Anak Sahim Sr Raimah Sebli SN Ann Lampung SN Yuhana Dalang
51	Lahad Datu	Dr Norazura Ahmad@Said	Sr Juraini Mohd Jaffar SN NoorlailaD urahman

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
CRRT	Continuous renal replacement therapy
CVC	Central venous catheter
CVC-BSI	Central venous catheter-related bloodstream infection
ED	Emergency department
ENT	Otorhinolaryngology
HD	Haemodialysis
HDU	High dependency unit
Hosp	Hospital
Hrs	Hours
ICU	Intensive care unit
MOH	Ministry of Health
MRIC	Malaysian Registry of Intensive Care
MV	Mechanical ventilation
NAICU	National Audit on Adult Intensive Care Units
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
Yrs	Years
%	Percentage

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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 ten yearly reports and introduced several quality measures such as ventilator care bundle and central venous catheter care bundle.

In 2009, the NAICU was renamed the Malaysian Registry of Intensive Care (MRIC). This report is the sixth for MRIC, but eleventh 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.

This report describes the intensive care practices and outcomes in 49 ICUs in MOH, 1 ICU in a private hospital 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 51 participating ICUs from 1st January to 31st December 2013. The total number of admissions in 2013 was 38,780 out of which 1344 (3.5%) were readmissions. For patients with multiple ICU admissions, only the first admission was included in the analysis.

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 37,436 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 and central venous catheter-related bloodstream infections in MOH participating centres.

SECTION A:

GENERAL INFORMATION

Table 1 : No. of ICU beds and occupancy rate, by MOH hospitals 2009–2013

Hospital	Number of functional ICU beds (as of 31-12-2013)	Median ICU bed occupancy rate %				
		2009	2010	2011	2012	2013
AS	24	88.6	83.2	87.0	96.7	93.3
PP	22	81.3	61.5	89.9	88.7	90.9
IPH	24	103.0	104.0	107.0	106.0	104.0
KL	30	108.6	109.3	107.5	111.7	110.6
SLG	22	72.6	97.7	111.4	99.8	101.8
KLG	29*	198.7	91.9	87.8	108.3	105.9
SBN	8	111.8	114.0	118.4	114.6	108.3
MLK	22*	84.2	88.1	106.0	107.9	97.5
JB	29	115.1	108.7	106.2	105.6	109.4
KTN	12*	102.2	103.0	105.2	106.4	106.5
KT	18	115.2	93.9	102.0	103.6	104.6
KB	21	86.6	88.5	80.8	80.0	96.2
KCH	16	101.5	104.9	116.6	125.9	101.0
KK	21	87.3	100.1	101.7	93.4	95.9
SP	16	79.3	80.9	84.6	84.9	92.5
PJY	11	88.4	89.5	78.2	75.2	71.2
MUR	8	72.6	89.6	82.4	97.5	97.5
TI	4	86.5	91.0	101.3	123.8	105.2
TPG	20	83.6	98.4	103.2	92.7	84.7
SJ	8	101.9	90.7	89.6	99.1	80.2
KJG	6*	75.8	75.6	78.9	77.2	77.1
KGR	5	71.8	70.2	63.3	77.3	78.1
TML	10*	119.0	110.5	104.0	113.0	127.0
KP	8*	51.0	56.2	68.5	61.8	72.4
SMJ	8	71.6	79.0	82.4	92.7	85.5
BP	7	77.0	71.4	69.0	87.0	79.6
TW	7	45.9	82.5	60.6	80.7	70.0
MRI	8	54.5	79.7	72.7	76.1	79.6
KLM	7*	121.2	99.2	98.9	100.5	95.4
SDG	16*	102.0	87.4	88.2	50.4	84.4
SB	14	-	102.6	99.2	60	120.5
DKS	18	-	116.2	87.9	87.9	99.1
SI	17	-	79.2	87.3	86.2	90.2
SBL	32*	-	118.2	108.1	94.6	94.0
AMP	12	-	89.0	85.5	45.7	82.9
LIK	6	-	62.0	76.7	76.9	106.0
LKW	4*	-	-	-	67.0	67.4
BM	6	-	-	-	65.6	106.8

SLR	**7***	**-**	**-**	**-**	76.0	71.0
PD	4	**-**	**-**	**-**	85.5	65.6
KKR	4	**-**	**-**	**-**	69.8	85.2
SGT	4	**-**	**-**	**-**	58.1	89.7
TM	2*	**-**	**-**	**-**	68.7	74.0
KEM	2	**-**	**-**	**-**	59.6	50.9
KLP	3*	**-**	**-**	**-**	21.8	53.0
LAB	5*	**-**	**-**	**-**	30.7	41.2
KEN	4	**-**	**-**	**-**	90.4	78.0
BIN	5	**-**	**-**	**-**	88.3	63.2
LD	4	**-**	**-**	**-**	104.2	101.2
Total	**600**	**-**	**-**	**-**		
Median	**-**	**87.0**	**90.2**	**88.6**	**86.2**	**90.2**

* *These hospitals did not report the number of ICU beds for 2013 to the Head of Anaesthesia service. These figures represent the number of ICU beds for 2012.*

The total number of ICU beds in the 49 MOH hospitals as of 31st December 2013 was 600 with a median bed occupancy rate (BOR) of 90.2%. There was a 2% increase (11) in the number of ICU beds from the previous year.

There was a wide variation in the BOR across the centers. LAB had the lowest BOR of 41.2. This may be partly due to some centers still using the "midnight count" method to calculate BOR. The preferred method would be to use the "throughput count" which would give a better reflection of the ICU workload. TML recorded the highest BOR at 127%.

Table 2 : ICU admissions, by individual hospital 2009 – 2013

Hospital	2009	2010	2011	2012	2013
	n (%)	n (%)	n (%)	n (%)	N (%)
AS	1121 (5.3)	1094 (4.1)	1212 (4.1)	1201 (3.5)	1347 (3.6)
PP	505 (2.4)	911 (3.4)	1198 (4.0)	1287 (3.8)	1121 (3.0)
IPH	924 (4.3)	1143 (4.2)	1140 (3.8)	926 (2.7)	1203 (3.2)
KL	1768 (8.3)	1947 (7.2)	1842 (6.2)	1971 (5.8)	1905 (5.1)
SLG	888 (4.2)	1053 (3.9)	1141 (3.8)	1289 (3.8)	1507 (4.0)
KLG	1080 (5.1)	1215 (4.5)	1608 (5.4)	2136 (6.3)	2065 (5.5)
SBN	510 (2.4)	542 (2.0)	554 (1.9)	537 (1.6)	471 (1.3)
MLK	1439 (6.8)	1636 (6.1)	1593 (5.3)	1694 (5.0)	1673 (4.5)
JB	1245 (5.9)	1443 (5.3)	1685 (5.7)	1752 (5.2)	1931 (5.2)
KTN	613 (2.9)	744 (2.8)	612 (2.1)	641 (1.9)	837 92.2)
KT	824 (3.9)	1087 (4.0)	1207 (4.1)	1363 (4.0)	1180 (3.2)
KB	803 (3.8)	826 (3.1)	1125 (3.8)	1286 (3.8)	1337 (3.6)
KCH	461 (2.2)	512 (1.9)	643 (2.2)	854 (2.5)	950 (2.5)
KK	319 (1.5)	808 (3.0)	843 (2.8)	954 (2.8)	1022 (2.7)
SP	261 (1.2)	207 (0.8)	270 (0.9)	159 (0.5)	583 (1.6)
PJY	397 (1.9)	523 (1.9)	537 (1.8)	574 (1.7)	606 (1.6)
MUR	774 (3.6)	759 (2.8)	473 (1.6)	636 (1.9)	675 (1.8)
TI	262 (1.2)	276 (1.0)	308 (1.0)	384 (1.1)	401 (1.1)
TPG	867 (4.1)	834 (3.1)	860 (2.9)	1203 (3.5)	1348 (3.6)
SJ	599 (2.8)	590 (2.2)	579 (1.9)	644 (1.9)	413 (1.1)
KJG	265 (1.2)	323 (1.2)	341 (1.1)	371 (1.1)	321 (0.9)
KGR	302 (1.4)	294 (1.1)	298 (1.0)	350 (1.1)	322 (0.9)
SJMC	2085 (9.8)	1578 (5.8)	2018 (6.8)	1467 (4.3)	1335 (3.6)
TML	607 (2.9)	624 (2.3)	543 (1.8)	436 (1.3)	599 (1.6)
KP	165 (0.8)	234 (0.9)	359 (1.2)	334 (1.0)	394 (1.1)
SMJ	336 (1.6)	314 (1.2)	380 (1.3)	403 (1.2)	376 (1.0)
BP	397 (1.9)	409 (1.5)	454 (1.5)	415 (1.2)	459 (1.2)
TW	215 (1.0)	238 (0.9)	274 (0.9)	433 (1.3)	449 (1.2)
MRI	212 (1.00	302 (1.1)	385 (1.3)	478 (1.4)	481 (1.3)
KLM	343 (1.6)	474 (1.8)	498 (1.7)	601 (1.8)	561 (1.5)
SDG	679 (3.2)	824 (3.1)	883 (3.0)	875 (2.6)	851 (2.3)
SB	-	471 (1.7)	569 (1.9)	490 (1.4)	506 (1.4)
DKS	-	246 (0.9)	526 (1.8)	526 (1.6)	964 (2.6)
SI	-	568 (2.1)	647 (2.2)	806 (2.4)	970 (2.6)
SBL	-	1234 (4.6)	1260 (4.2)	1583 (4.7)	1922 (5.1)
AMP	-	534 (2.0)	553 (1.9)	572 (1.7)	566 (1.5)
LIK	-	160 (0.6)	376 (1.3)	270 (0.8)	517 (1.4)
UMMC	-	-	-	474 (1.4)	883 (2.4)

LKW	-	-	-	157 (0.5)	180 (0.5)
BM	-	-	-	38 (0.1)	158 (0.4)
SLR	-	-	-	154 (0.5)	225 (0.6)
PD	-	-	-	204 (0.6)	245 (0.7)
KKR	-	-	-	149 (0.4)	240 (0.6)
SGT	-	-	-	127 (0.4)	159 (0.4)
TM	-	-	-	17 (0.1)	127 (0.3)
KEM	-	-	-	94 (0.3)	105 (0.3)
KLP	-	-	-	7 (0.0)	116 (0.3)
LAB	-	-	-	107 (0.3)	165 (0.4)
KEN	-	-	-	82 (0.2)	161 (0.4)
BIN	-	-	-	213 (0.6)	260 (0.7)
LD	-	-	-	168 (0.5)	244 (0.7)
Total	**21266 (100)**	**26977 (100)**	**29794 (100)**	**33892 (100)**	**37436 (100)**

Figure 1 : ICU admissions, 2003 – 2013

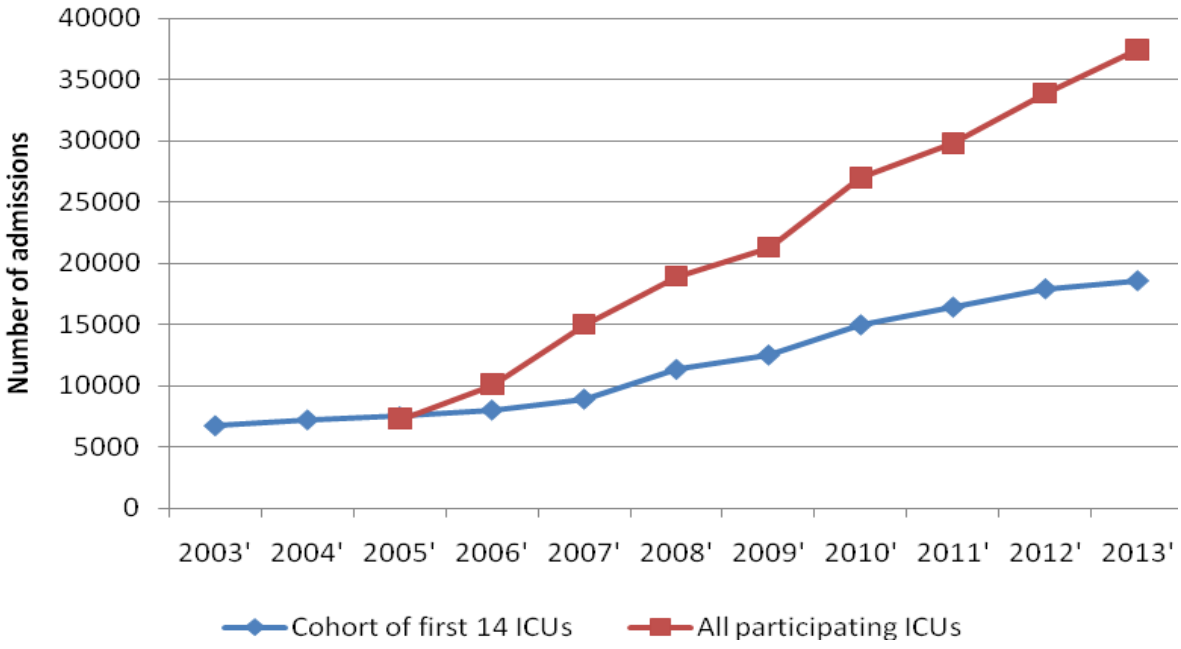
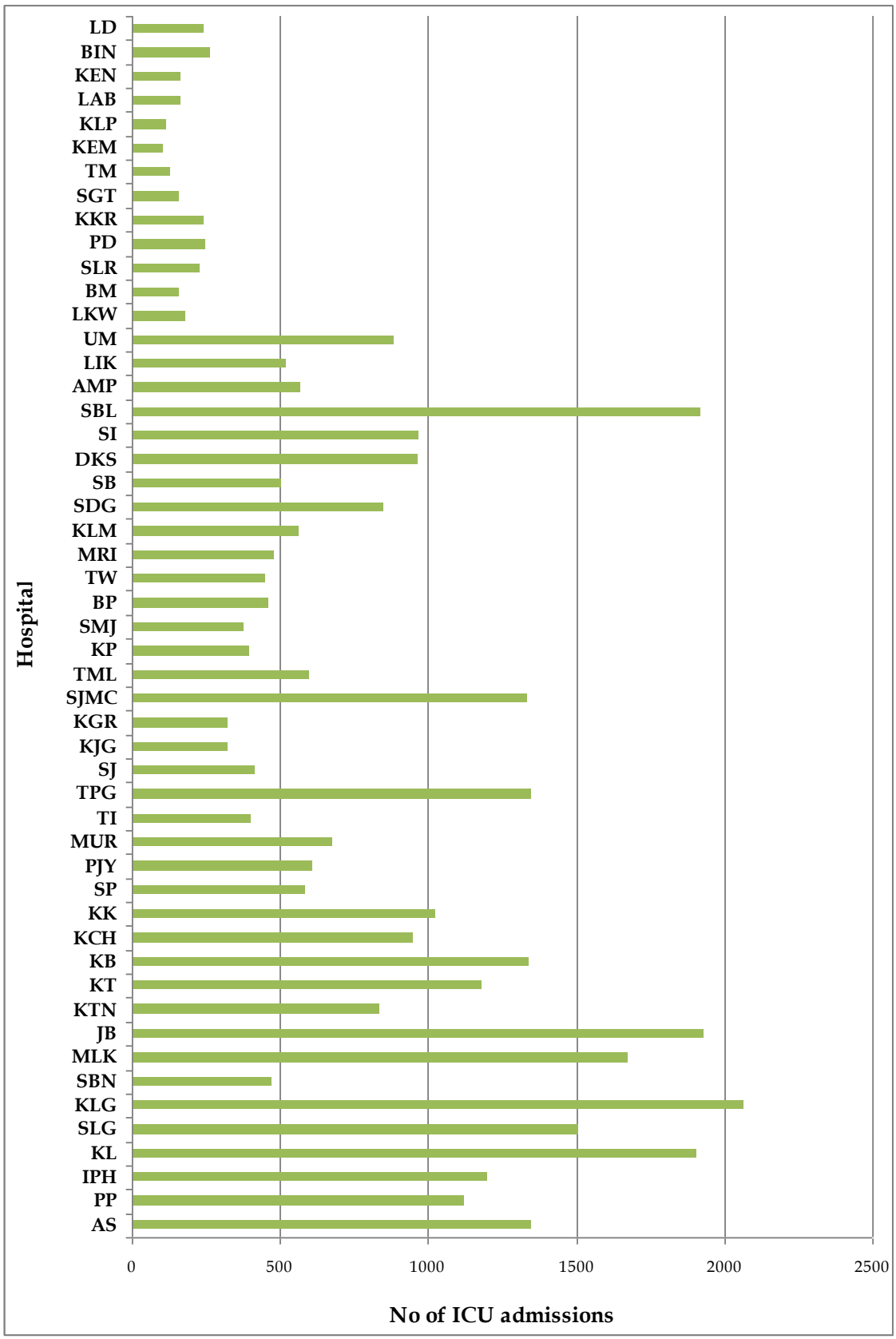


Figure 2 : ICU admissions, by participating centres 2013



The number of admissions had increased over the years in the MOH hospitals. There was an increase of 76% over the past five years from 2009 to 2013. 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 12,500 to 18,549 (an increase of 48%) over the last 5 years. There was an increase of 39% in the number of ICU beds from 214 to 298 in the centres of the same cohort.

Readmission within 48 to 72 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 admit patients due to unavailability of ICU beds.

The readmission rate within the first 48 hours of ICU discharge for the 49 MOH centres was 1.3% in 2013. This rate has varied from 1.2% to 2.1% over the past five years. 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 2009 – 2013

Hospital	2009 %	2010 %	2011 %	2012 %	2013 %
AS	93	92.2	98.2	93.1	99.6
PP	93	87.4	90.1	96.2	92.2
IPH	96	96.3	99.2	97.5	95.9
KL	95	94.8	98.7	98.5	95.0
SLG	84	94.8	95.0	97.6	95.3
KLG	92	91.1	86.0	97.3	97.7
SBN	97	96.4	99.5	99.3	97.3
MLK	92	94.8	99.5	98.8	95.2
JB	97	97.4	99.8	97.2	95.7
KTN	96	94.8	99.0	97.2	124.4*
KT	90	96.1	99.8	99.1	95.0
KB	94	95.7	94.4	98.7	83.0
KCH	89	87.5	94.3	95.3	89.6
KK	60	89.4	95.4	94.9	95.2
SP	50	38.5	53.1	30.8	106.0*
PJY	87	96.5	99.1	98.0	92.9
MUR	80	63.0	97.4	94.6	98.0
TI	97	92.0	98.4	91.2	90.3
TPG	95	95.5	94.0	99.3	95.5
SJ	96	95.2	98.5	98.3	85.7
KJG	87	81.4	95.5	99.7	75.2
KGR	94	97.0	98.1	98.6	94.2
TML	86	87.4	81.4	62.6	68.3
KP	98	98.3	100.0	66.4	51.0
SMJ	100	95.4	100.0	99.5	97.9
BP	90	95.1	98.5	97.9	106.3*
TW	93	78.3	91.7	98.6	95.5
MRI	65	94.1	88.5	99.2	97.6
KLM	97	95.2	98.9	98.5	94.1
SDG	94	66.7	94.9	90.5	108.4*
SB	-	74.8	73.1	70.0	46.7
DKS	-	54.8	99.6	95.5	92.7
SI	-	92.4	86.3	94.6	97.3
SBL	-	92.5	100.0	90.7	82.0
AMP	-	95.5	85.2	100.0	97.1
LIK	-	27.2	60.9	57.4	80.7
LKW	-	-	-	69.8	87.4
BM	-	-	-	11.3	39.4
SLR	-	-	-	42.5	67.6

PD	-	-	-	84.0	93.2
KKR	-	-	-	87.1	94.9
SGT	-	-	-	41.2	50.5
TM	-	-	-	22.4	104.1*
KEM	-	-	-	75.2	82.0
KLP	-	-	-	36.8	87.9
LAB	-	-	-	96.4	91.2
KEN	-	-	-	16.4	59.2
BIN	-	-	-	75.5	80.5
LD	-	-	-	67.2	92.4

* *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 2013 were excluded in the analysis.

Hospitals with reporting rates of 75% and less included KJG (75%), TML (68%), SLR (67%), KEN (59%), KP (51%), SGT (50%), SB (46%) and BM (39%).

Table 4 : Intensive care referrals and refusal of admission, by individual hospital 2009 – 2013

Hosp	2009		2010		2011		2012		2013	
	No. refer.	% denied adm.	No. refer.	% denied adm.	No. refer.	% denied adm.	No. refer.	% denied adm.	No. refer.	% denied adm.
AS	358	19.0	*	*	*	*	*	*	*	*
PP	1407	82.3	1292	83.3	942	70.2	1329	67.8	1365	73.6
IPH	612	82.5	1275	69.3	1525	66.7	1834	63.4	1639	70.2
KL	2230	31.0	2218	34.6	1971	32.8	2364	30.4	2515	30.1
SLG	345	33.6	151	40.4	448	27.2	1173	24.2	1537	35.3
KLG	2072	64.2	2155	56.7	2264	33.1	2458	21.2	2576	23.1
SBN	1863	63.3	1862	59.3	2125	60.8	1929	56.0	1640	51.6
MLK	981	56.0	1035	70.3	919	55.2	993	61.2	1285	73.9
JB	1111	50.1	2065	50.4	2069	39.8	2205	28.8	2634	33.7
KTN	755	20.4	1092	29.1	791	42.4	455	39.6	608	40.0
KT	105	30.5	264	20.1	150	18.0	544	26.3	183	27.9
KB	1219	66.1	1399	63.3	1431	50.1	1417	41.5	1884	46.9
KCH	486	58.4	326	61.4	477	51.4	1132	57.8	1271	53.1
KK	378	7.9	992	13.2	1340	16.0	1282	13.0	1619	21.7
SP	48	18.8	*	*	*	*	254	44.1	562	46.1
PJY	*	*	*	*	*	*	36	5.6	486	0.6
MUR	*	*	619	15.8	685	31.4	903	34.3	1223	31.5
TI	*	*	186	21.0	54	40.7	170	42.9	156	49.1
TPG	1186	11.6	902	2.0	958	0.5	1498	10.4	2004	12.4
SJ	660	15.0	758	23.5	625	31.2	592	34.1	813	41.7
KJG	*	*	170	5.3	67	19.4	*	*	488	22.1
KGR	165	22.4	230	21.7	201	20.4	405	12.8	390	16.7
TML	68	35.3	800	35.3	921	35.6	875	38.5	836	37.6
KP	346	48.6	372	33.3	412	7.3	412	9.7	587	21.8
SMJ	174	17.8	203	16.3	191	13.1	145	13.8	122	12.3
BP	442	7.0	382	8.6	454	2.6	372	2.2	458	3.7
TW	*	*	250	0.0	297	*	505	3.2	591	5.4
MRI	126	29.4	141	16.3	81	18.5	132	4.6	335	22.4
KLM	302	10.6	411	2.9	509	2.9	710	5.2	699	10.7
SDG	698	30.8	581	21.5	712	14.2	506	22.9	1221	10.2
SB	-	-	*	*	*	*	*	*	565	22.5
DKS	-	-	130	38.5	10	50.0	214	33.6	81	26.0
SI	-	-	478	35.6	635	34.8	547	21.4	734	31.7
SBL	-	-	119	40.3	*	*	689	17.4	636	14.8
AMP	-	-	*	*	149	39.6	716	26.7	1333	29.5
LIK	-	-	*	*	*	*	*	*	*	*
UMMC	-	-	-	-	-	-	657	57.5	955	41.8
LKW	-	-	-	-	-	-	*	*	171	0.6
BM	-	-	-	-	-	-	*	*	*	*

SLR	-	-	-	-	-	-	55	10.9	166	7.2
PD	-	-	-	-	-	-	216	7.4	249	1.6
KKR	-	-	-	-	-	-	49	24.5	105	27.6
SGT	-	-	-	-	-	-	*	*	*	*
TM	-	-	-	-	-	-	*	*	95	3.2
KEM	-	-	-	-	-	-	60	1.7	119	12.6
KLP	-	-	-	-	-	-	*	*	100	3.0
LAB	-	-	-	-	-	-	*	*	*	*
KEN	-	-	-	-	-	-	46	4.4	*	*
BIN	-	-	-	-	-	-	*	*	*	*
LD	-	-	-	-	-	-	*	*	*	*
Total	**18365**	**40.0**	**22861**	**36.5**	**25321**	**34.2**	**31341**	**32.0**	**37962**	**29.4**

* *Missing data*

The reason for ICU refusal for the purpose of this registry was limited to the unavailability of ICU beds. Over the past five years, the percentage of patients denied ICU admission has reduced steadily due to 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

Table 5 : Gender 2009-2013

Gender	2009 n (%)	2010 n (%)	2011 n (%)	2012 n (%)	2013 n (%)
Male	12489 (58.7)	16040 (59.6)	17788 (59.7)	20295 (60.0)	22331 (59.7)
Female	8768 (41.3)	10875 (40.4)	11968 (40.2)	13554 (40.0)	15048 (40.3)

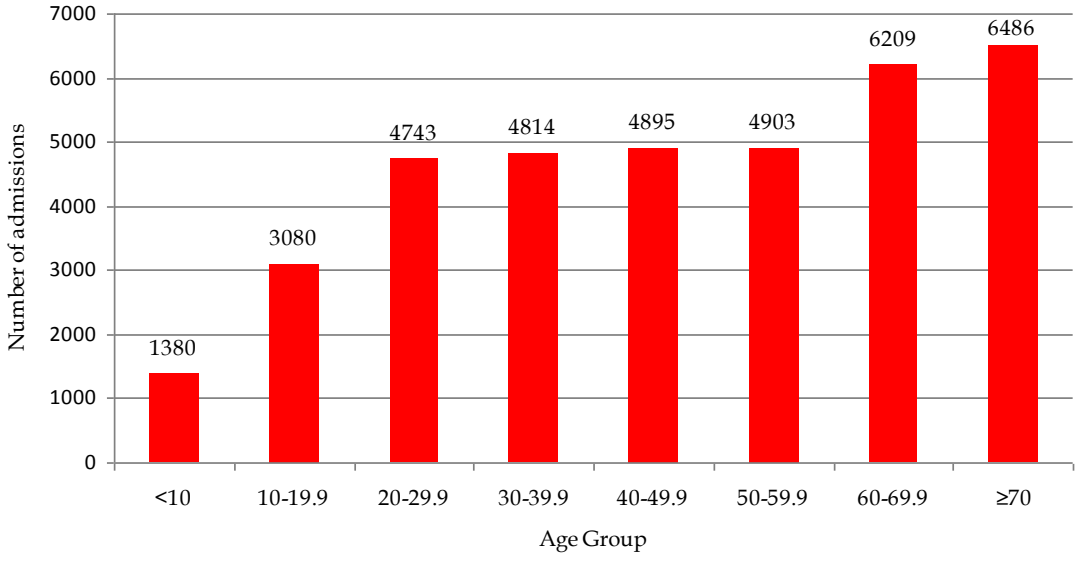
The ratio of male to female patients (3:2) has remained fairly constant over the years.

Table 6 : Mean age (years) 2009 – 2013

Age	2009	2010	2011	2012	2013
All ages, Mean ± SD yrs	46.5 ± 20.9	45.6 ± 20.6	46.5± 20.7	46.6 ± 20.7	46.46 ± 20.6
Age ≥ 18 years Mean ± SD yrs	50.3 ± 18.1	49.4 ± 18.1	50.2± 18.0	50.3 ± 17.8	50.27 ± 17.7

The average age for all age groups was 46.5 ± 20.6 years (median 48.8 years). For adult patients, with age exceeding 18 years, the average age was 50.3 ± 17.7 years (median 51.9 years). The average age of patients admitted to ICUs has remained almost the same over the last 5 years.

Figure 3 : Age groups, 2013

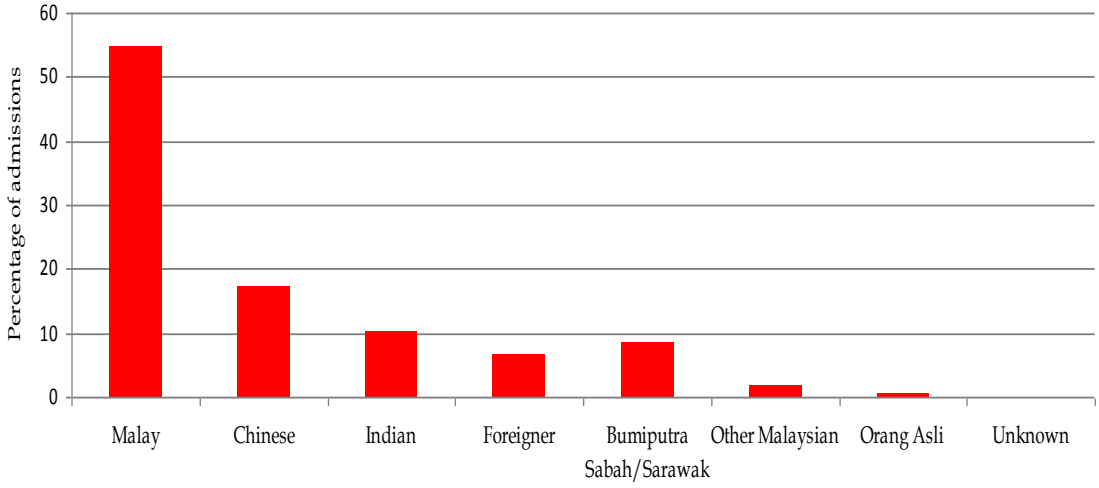


Geriatric patients (age more than 65 years) and paediatric patients (age less than 12 years) accounted for 21.3% and 4.2% of total admissions respectively in 2012.

Table 7 : Ethnic groups 2013

Ethnic group	n	%
Malay	37363	54.7
Chinese	6386	17.1
Indian	3862	10.3
Foreigner	2497	6.7
Bumiputra Sabah/Sarawak	3209	8.6
Other Malaysian	684	1.8
Orang Asli	222	0.6
Unknown	29	0.1
Total	**37436**	**100**

Figure 4 : Ethnic groups 2013



The distribution of patients admitted to ICU reflected the distribution of the ethnic groups in the general population in Malaysia.

Table 8 : Length of ICU stay, by individual hospital 2009 – 2013

Hospital	Mean (Median), days				
	2009	2010	2011	2012	2013
AS	3.9 (2.2)	4.1 (2.2)	4.6 (2.8)	5.6 (3.1)	4.9 (2.9)
PP	5.4 (2.5)	5.6 (2.8)	5.1 (2.5)	5.4 (2.6)	5.9 (2.7)
IPH	5.1 (2.8)	5.0 (2.6)	5.3 (2.6)	5.5 (2.9)	5.9 (3.0)
KL	4.9 (2.8)	4.7 (2.5)	4.7 (2.8)	5.1 (2.8)	5.0 (2.7)
SLG	4.4 (2.7)	4.4 (2.1)	4.4 (2.4)	4.5 (2.6)	4.2 (2.0)
KLG	4.9 (2.7)	4.9 (2.7)	3.6 (2.0)	4.1 (2.1)	4.3 (1.9)
SBN	5.3 (2.9)	5.1 (2.8)	4.8 (2.7)	4.9 (2.7)	5.9 (2.9)
MLK	4.3 (2.1)	4.1 (2.1)	4.0 (2.7)	4.1 (2.1)	4.1 (2.1)
JB	4.5 (2.4)	5.0 (2.8)	5.2 (3.0)	5.2 (3.0)	4.7 (2.8)
KTN	4.7 (2.9)	4.4 (2.5)	6.3 (3.4)	6.3 (3.6)	5.6 (3.3)
KT	4.3 (2.7)	4.5 (2.5)	4.0 (2.3)	4.1 (2.2)	4.6 (2.7)
KB	4.4 (2.3)	4.8 (2.0)	4.7 (1.9)	4.7 (2.3)	4.9 (2.3)
KCH	5.4 (2.7)	5.0 (2.7)	5.6 (3.0)	5.2 (2.9)	4.7 (2.6)
KK	5.4 (2.9)	6.2 (3.2)	6.3 (3.7)	6.3 (3.8)	6.2 (3.6)
SP	3.9 (2.4)	4.6 (3.2)	4.0 (2.4)	7.6 (2.2)	4.7 (2.6)
PJY	4.4 (1.9)	3.6 (1.7)	3.2 (1.5)	3.2 (1.5)	3.5 (1.8)
MUR	4.4 (2.0)	3.5 (1.8)	4.8 (2.4)	3.5 (1.8)	3.0 (1.8)
TI	3.5 (2.1)	4.2 (1.8)	4.0 (2.0)	3.5 (2.1)	3.0 (1.8)
TPG	5.4 (2.7)	7.4 (3.5)	7.0 (3.7)	5.1 (2.7)	4.1 (2.7)
SJ	4.3 (2.6)	4.3 (2.3)	4.3 (2.1)	4.2 (2.1)	6.2 (3.1)
KJG	4.9 (2.6)	3.8 (2.1)	4.0 (2.7)	4.6 (2.9)	4.7 (3.2)
KGR	4.0 (2.7)	4.2 (2.2)	3.4 (1.7)	4.3 (2.1)	4.2 (2.6)
SJMC	2.3 (1.2)	2.5 (1.3)	2.4 (1.3)	2.7 (1.6)	2.6 (1.6)
TML	5.0 (2.8)	4.9 (2.8)	5.1 (3.0)	6.4 (3.5)	4.8 (2.6)
KP	4.9 (2.4)	3.5 (2.0)	5.8 (3.1)	5.7 (3.0)	5.5 (2.9)
SMJ	5.3 (3.0)	4.4 (2.2)	3.7 (2.3)	3.9 (2.5)	3.6 (2.2)
BP	4.3 (2.5)	4.8 (2.7)	4.3 (2.2)	5.7 (3.3)	4.5 (2.8)
TW	4.2 (2.2)	4.1 (2.3)	3.5 (2.2)	3.5 (2.4)	3.8 (2.5)
MRI	6.2 (3.0)	5.4 (2.8)	4.4 (2.3)	5.2 (2.5)	4.5 (2.6)
KLM	4.2 (2.6)	3.9 (2.3)	3.6 (2.0)	3.3 (1.9)	3.2 (1.7)
SDG	4.3 (2.1)	4.3 (2.1)	4.8 (2.7)	4.8 (2.8)	4.4 (2.2)
SB	-	5.3 (2.9)	4.7 (2.4)	5.1 (2.5)	5.4 (3.3)
DKS	-	6.8 (3.2)	6.0 (3.1)	5.1 (3.1)	4.5 (2.5)
SI	-	5.2 (2.3)	7.0 (3.7)	6.2 (3.3)	5.4 (2.7)
SBL	-	5.7 (2.8)	6.0 (3.2)	5.7 (3.1)	5.5 (3.1)
AMP	-	5.3 (2.9)	5.4 (3.2)	5.0 (2.9)	5.4 (2.9)
LIK	-	2.4 (1.5)	2.5 (1.6)	3.5 (1.8)	3.5 (1.9)
UMMC	-	-	-	7.2 (3.8)	5.6 (3.3)
LKW	-	-	-	5.3 (2.0)	4.1 (2.0)
BM	-	-	-	-	9.0 (4.3)
SLR	-	-	-	6.3 (3.2)	6.3 (3.0)
PD	-	-	-	4.0 (2.5)	4.4 (2.8)
KKR	-	-	-	5.6 (2.9)	5.7 (3.4)

SGT	-	-	-	4.5 (2.8)	3.3 (2.3)
TM	-	-	-	3.5 (1.9)	3.8 (2.5)
KEM	-	-	-	3.3 (2.6)	4.2 (2.8)
KLP	-	-	-	1.3 (0.8)	2.9 (1.5)
LAB	-	-	-	4.6 (2.2)	4.4 (1.9)
KEN	-	-	-	6.5 (2.9)	5.1 (2.9)
BIN	-	-	-	5.4 (2.8)	3.9 (2.1)
LD	-	-	-	5.7 (2.7)	4.8 (2.7)
Total	**4.4 (2.3)**	**4.7 (2.4)**	**4.7 (2.4)**	**4.8 (2.6)**	**4.7 (2.5)**

The average length of ICU stay was 4.7 days while the median length of stay was 2.5 days. SJMC recorded the shortest length of stay (2.6 days). Among the MOH ICUs, KLP had the shortest average length of stay (2.9 days). BM recorded the longest length of ICU stay (9.0 days).

Table 9 : Length of hospital stay, by individual hospital 2009 – 2013

Hospital	Mean (Median), days				
	2009	2010	2011	2012	2013
AS	12.6 (7.9)	13.4 (8.3)	14.5 (9.5)	15.1 (9.2)	14.6 (8.8)
PP	20.4 (11.5)	21.1 (12.0)	19.0 (11.5)	19.5 (12.0)	19.2 (12.0)
IPH	14.5 (10.0)	14.6 (9.4)	15.4 (9.3)	16.0 (10.6)	15.2 (9.8)
KL	18.5 (10.8)	17.8 (10.3)	19.1 (11.0)	17.7 (10.7)	16.5 (10.2)
SLG	17.1 (10.2)	15.3 (9.8)	16.7 (11.0)	17.3 (12.1)	15.2 (10.5)
KLG	15.5 (10.8)	14.1 (9.6)	13.6 (8.4)	12.2 (7.6)	12.5 (7.80
SBN	16.0 (10.8)	16.7 (10.1)	19.9 (11.0)	17.0 (10.6)	18.5 (10.7)
MLK	13.6 (8.9)	13.6 (8.3)	14.2 (9.3)	16.0 (10.0)	14.4 (8.6)
JB	14.9 (10.0)	14.2 (9.8)	14.6 (10.1)	14.7 (9.9)	13.6 (9.3)
KTN	15.3 (10.9)	14.9 (10.0)	17.1 (12.1)	18.0 (12.3)	15.8 (10.8)
KT	13.2 (8.7)	12.7 (8.9)	12.6 (8.3)	14.5 (9.7)	14.6 (9.80
KB	17.2 (10.7)	16.6 (10.1)	14.5 (10.0)	16.5 (10.0)	14.4 (9.6)
KCH	19.8 (12.8)	19.6 (12.8)	20.5 (12.6)	21.4 (13.7)	19.2 (12.1)
KK	23.2 (14.9)	21.0 (13.2)	21.4 (14.1)	19.9 (11.7)	17.7 (11.1)
SP	10.5 (7.9)	12.8 (8.3)	10.8 (7.4)	14.0 (8.2)	12.9 (8.9)
PJY	13.5 (8.3)	11.7 (8.1)	11.6 (8.0)	11.7 (8.6)	13.2 (8.2)
MUR	15.8(10.2)	13.3 (8.3)	16.3 (10.3)	22.0 (10.5)	13.6 (8.4)
TI	11.6 (7.6)	12.4 (8.0)	12.5 (8.4)	14.2 (9.6)	11.4 (8.2)
TPG	12.5 (8.3)	14.3 (8.7)	15.1 (10.3)	12.6 (8.3)	10.7 (7.8)
SJ	11.0 (8.7)	11.4 (8.4)	12.9 (9.1)	13.0 (8.2)	14.3 (9.7)
KJG	13.8 (9.2)	12.2 (7.6)	11.2 (7.9)	13.5 (8.3)	12.5 (8.6)
KGR	16.3 (10.7)	12.7 (8.1)	12.6 (8.2)	18.3 (10.9)	14.2 (9.7)
SJMC	8.4 (5.1)	7.3 (5.1)	7.7 (5.3)	8.4 (5.1)	7.7 (4.6)
TML	14.0 (10.4)	13.8 (9.0)	14.6 (9.9)	14.5 (10.7)	13.1 (9.3)
KP	12.9 (8.6)	12.1 (6.0)	12.8 (8.7)	15.5 (9.3)	13.6 (8.5)
SMJ	11.4 (7.9)	12.5 (8.0)	12.1 (7.1)	12.0 (7.2)	10.5 (7.1)
BP	12.0 (8.4)	13.1 (8.3)	11.4 (8.0)	13.6 (9.5)	14.0 (9.0)
TW	13.3 (7.9)	14.1 (9.0)	15.3 (9.1)	13.0 (8.4)	14.1 (9.1)
MRI	15.1 (9.9)	16.6 (10.6)	15.0 (9.6)	14.0 (10.8)	12.4 (9.9)
KLM	10.8 (7.8)	10.6 (7.4)	11.4 (7.3)	12.6 (7.8)	11.7 (7.9)
SDG	15.8 (9.3)	14.6 (8.8)	14.7 (9.0)	14.6 (9.4)	14.3 (8.1)
SB	-	15.4 (9.0)	13.1 (8.1)	13.1 (8.3)	15.7 (10.5)
DKS	-	15.8 (9.0)	13.7 (10.1)	12.4 (8.2)	11.4 (7.6)
SI	-	16.6 (10.9)	19.7 (12.2)	16.0 (9.7)	14.6 (9.2)
SBL	-	17.1 (9.8)	19.5 (11.2)	19.2 (10.8)	17.0 (9.8)
AMP	-	15.6 (9.0)	15.1 (10.2)	15.4 (10.5)	15.1 (10.7)
LIK	-	11.8 (8.1)	11.6 (7.6)	18.4 (9.7)	15.3 (10.9)
UMMC	-	-	-	25.2 (16.2)	22.0 (12.4)
LKW	-	-	-	12.7 (6.4)	12.5 (6.6)
BM	-	-	-	20.9 (10.1)	16.3 (10.3)
SLR	-	-	-	12.1 (7.9)	12.2 (6.6)
PD	-	-	-	10.2 (5.9)	10.9 (7.4)
KKR	-	-	-	12.5 (9.6)	13.6 (8.6)

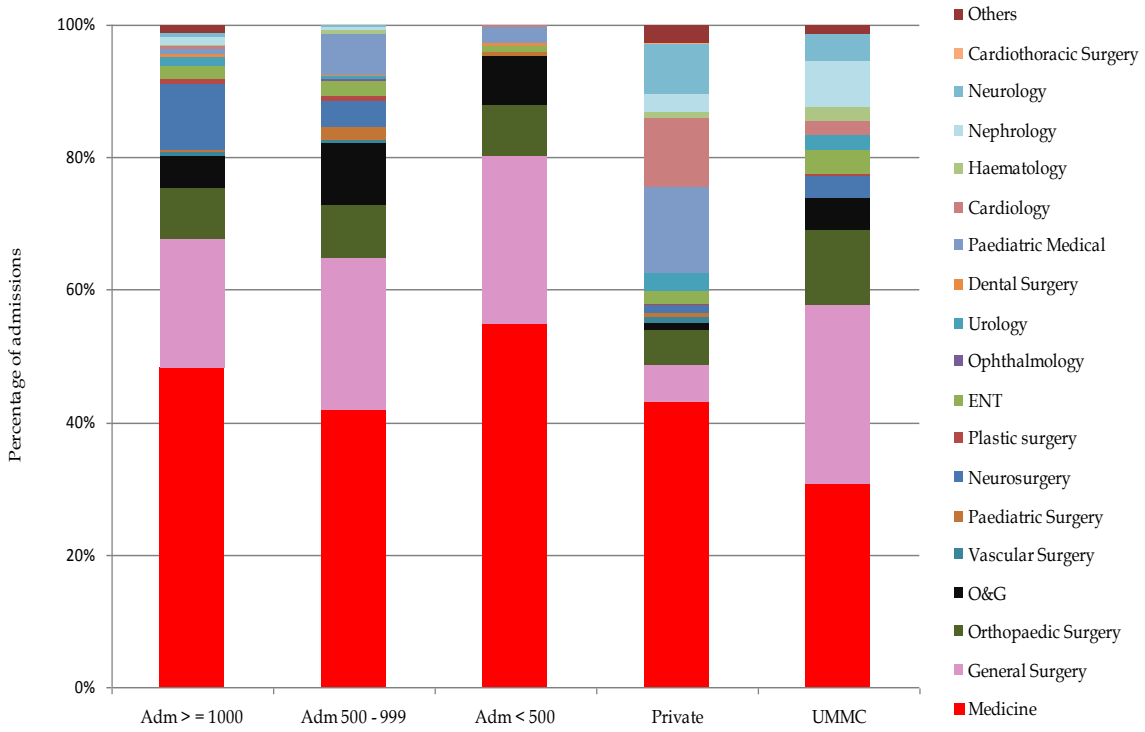
SGT	-	-	-	14.8 (8.3)	10.4 (7.1)
TM	-	-	-	12.0 (8.2)	9.1 (6.3)
KEM	-	-	-	9.6 (7.8)	12.3 (8.0)
KLP	-	-	-	6.3 (6.9)	11.4 (6.9)
LAB	-	-	-	14.4 (6.4)	10.0 (4.3)
KEN	-	-	-	19.2 (10.4)	15.0 (9.6)
BIN	-	-	-	21.5 (12.6)	14.2 (10.3)
LD	-	-	-	12.8 (7.7)	13.2 (8.3)
Total	**14.4 (9.0)**	**14.6 (9.0)**	**14.9 (9.3)**	**15.5 (9.5)**	**14.4 (9.0)**

The average length of hospital stay was 14.4 days with a median of 9.0 days. UMMC recorded the longest length of hospital stay of 22 days. Among MOH hospitals, KCH and TPG had length of hospital stays of 19.2 days. TM recorded the shortest length of hospital stay of 9.1 days.

Table 10 : Referring units, by category of ICU 2013

Referring units	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Medicine	9445 48.3%	3589 41.8	3856 54.8%	572 43.0%	267 30.7%	**17729** **47.4%**
General Surgery	3776 19.3%	1984 23.1%	1786 25.4%	76 5.7%	236 27.1%	**7858** **21.0%**
Orthopaedic Surgery	1495 7.7%	682 7.9%	549 7.8%	72 5.4%	99 11.4%	**2897** **7.8%**
O&G	945 4.8%	810 9.4%	517 7.3%	12 0.9%	41 4.7%	**2325** **6.2%**
Vascular Surgery	136 0.7%	47 0.5%	4 0.1%	12 0.9%	0 0.0%	**199** **0.5%**
Paediatric Surgery	51 0.3%	152 1.8%	45 0.6%	9 0.7%	0 0.0%	**257** **0.7%**
Neurosurgery	1972 10.1%	356 4.1%	8 0.1%	14 1.1%	30 3.4%	**2380** **6.4%**
Plastic Surgery	120 0.6%	54 0.6%	1 0.0%	4 0.3%	3 0.3%	**182** **0.5**
ENT	378 1.9%	209 2.4%	65 0.9%	27 2.0%	32 3.7%	**711** **1.9%**
Ophthalmology	23 0.1%	8 0.1%	0 0.0%	0 0.0%	0 0.0%	**31** **0.1%**
Urology	257 1.3%	41 0.5%	0 0.0%	33 2.5%	20 2.3%	**351** **0.9%**
Dental Surgery	93 0.5%	25 0.3%	18 0.3%	0 0.0%	0 0.0%	**136** **0.4%**
Paediatric Medical	168 0.9%	512 6.0%	179 2.5%	176 13.2%	0 0.0%	**1035** **2.8%**
Cardiology	77 0.4%	4 0.0%	11 0.2%	137 10.3%	18 2.1%	**247** **0.7%**
Haematology	29 0.1%	56 0.7%	0 0.0%	12 0.9%	19 2.2%	**116** **0.3%**
Nephrology	239 1.2%	41 0.5%	0 0.0%	39 2.9%	61 7.0%	**380** **1.0%**
Neurology	117 0.6%	12 0.1%	0 0.0%	98 7.4%	33 3.8%	**260** **0.7%**
Cardiothoracic Surgery	13 0.1%	2 0.0%	0 0.0%	2 0.2%	1 0.1%	**18** **0.0%**
Others	205 1.0%	10 0.1%	1 0.0%	36 2.7%	11 1.3%	**263** **0.7%**
Total	**19539** **100.0%**	**8594** **100.0%**	**7040** **100.0%**	**1331** **100.0%**	**871** **100.0%**	**37375** **100.0%**

Figure 5 : Referring units, by category of ICU 2013



The percentage of patients admitted from the medical-based disciplines increased from 29.5% in 2003 to 49.4% in 2013.

Table 11 : Category of patients, by category of ICU 2013

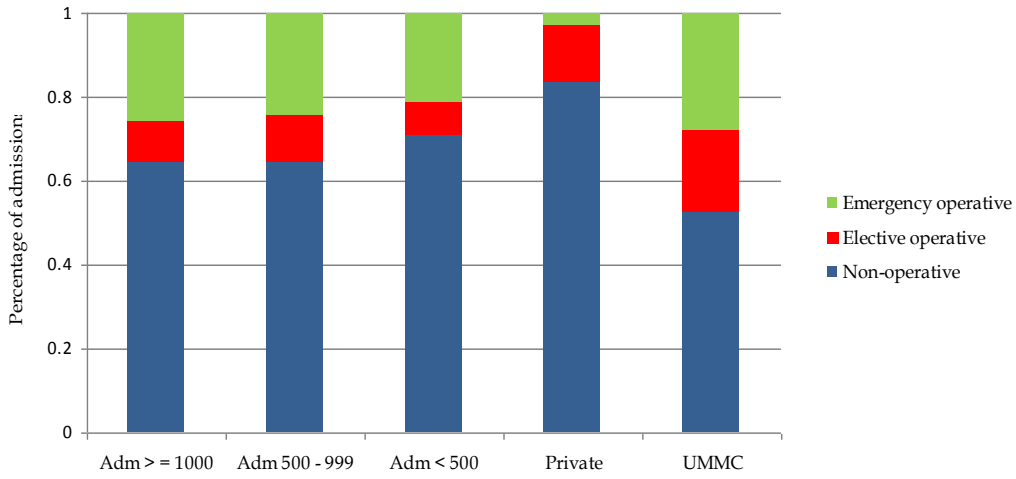
	ICUs					
	Adm ≥ 1000	**Adm 500 - 999**	**Adm < 500**	**Private**	**UMMC**	**Total**
	n (%)	**n (%)**	**n (%)**	**n (%)**		**n (%)**
Non-operative	12597 64.4%	5540 64.5%	4986 70.8%	1116 83.6%	461 52.8%	**24700** **66.1%**
Elective operative	1971 10.1%	973 11.3%	581 8.2%	183 13.7%	169 19.4%	**3877** **10.4%**
Emergency operative	4979 25.5%	2078 24.2%	1478 21.0%	36 2.7%	243 27.8%	**8814** **23.6%**
Total	**19547** **100.0%**	**8591** **100.0%**	**7045** **10.0%**	**1335** **100.0%**	**873** **100.0%**	**37391** **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 6 : Category of patients, by category of ICU 2013

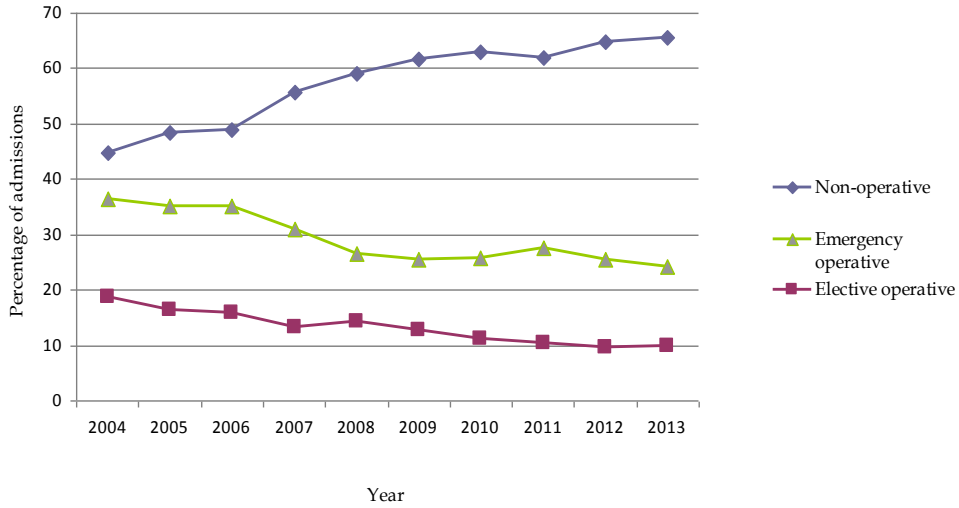


The categories of patients did not differ much among ICUs in MOH hospitals. Non-operative admissions accounted for 66%, 53% and 84% of all admissions to MOH ICUs, UMMC and private hospital respectively. The proportion of patients admitted into ICU after elective operations was relatively higher in UMMC (19%) compared with that of MOH hospitals (10%). Emergency operative patients admitted into the private hospital ICU were relatively low compared with MOH hospitals and UMMC.

Table 12 : Category of patients in MOH hospitals 2009 - 2013

Category of patients	2009 (%)	2010 (%)	2011 (%)	2012 (%)	2013 (%)
Non-operative	61.6	62.9	62.0	65.1	66.1%
Elective operative	12.8	11.3	10.5	10.3	10.4%
Emergency operative	25.4	25.8	27.5	24.6	23.6%

Figure 7 : Category of patients in MOH hospitals 2004 – 2013



There was a steady increase in non-operative patients over the past 10 years with a 21% increase from 2004 to 2013, while the percentage of elective operative and emergency operative patients decreased by 9% and 12% respectively.

Table 13 : Location before ICU admission, by category of ICU 2013

Location	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Ward	6365 32.6%	3197 37.2%	3004 42.7%	337 25.3%	294 33.7%	**13197** **35.3%**
OT	5552 28.4%	2248 26.2%	1494 21.2%	161 12.1%	327 37.5%	**9782** **26.2%**
A&E	5839 29.9%	2551 29.7%	2072 29.4%	747 56.0%	237 27.1%	**11446** **30.6%**
Other critical area	740 3.8%	130 1.5%	165 2.3%	10 0.7%	0 0.0%	**1045** **2.8%**
Other location	146 0.7%	55 0.6%	9 0.1%	58 4.3%	1 0.1%	**269** **0.7%**
Other hospital	909 4.6%	411 4.8%	295 4.2%	21 1.6%	14 1.6%	**1650** **4.4%**
Total	**19551** **100.0%**	**8592** **100.0%**	**7039** **100.0%**	**1334** **100.0%**	**873** **100.0%**	**37389** **100.0%**

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

Figure 8 : Location before ICU admission, by category of ICU 2013

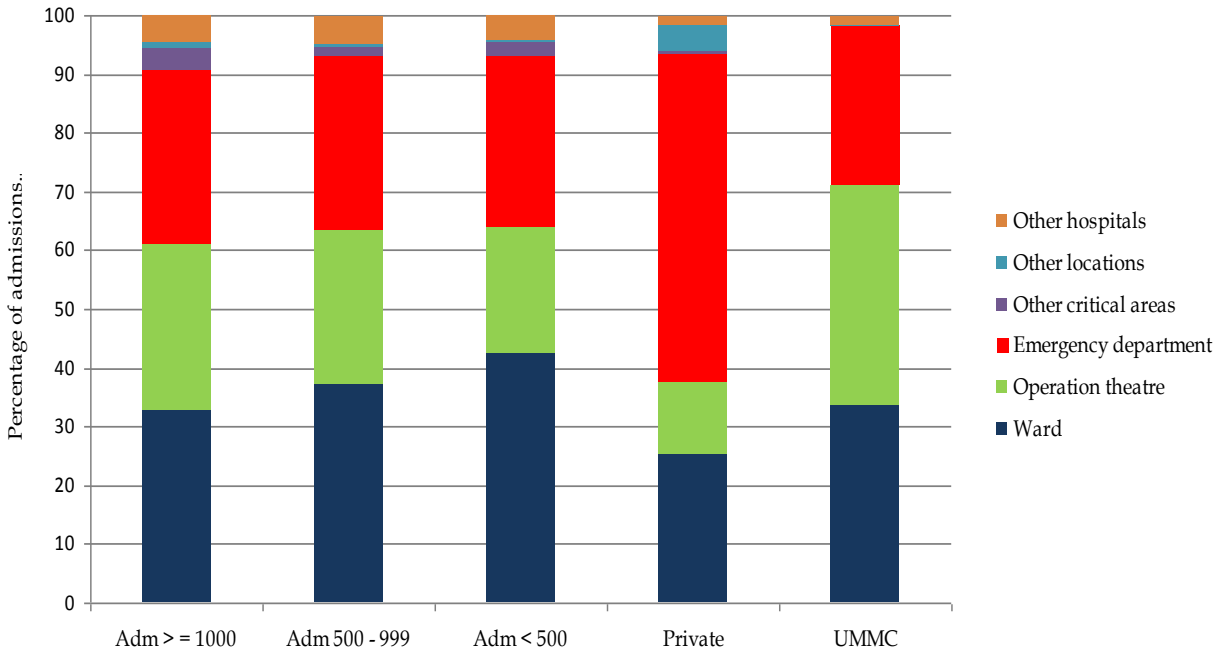
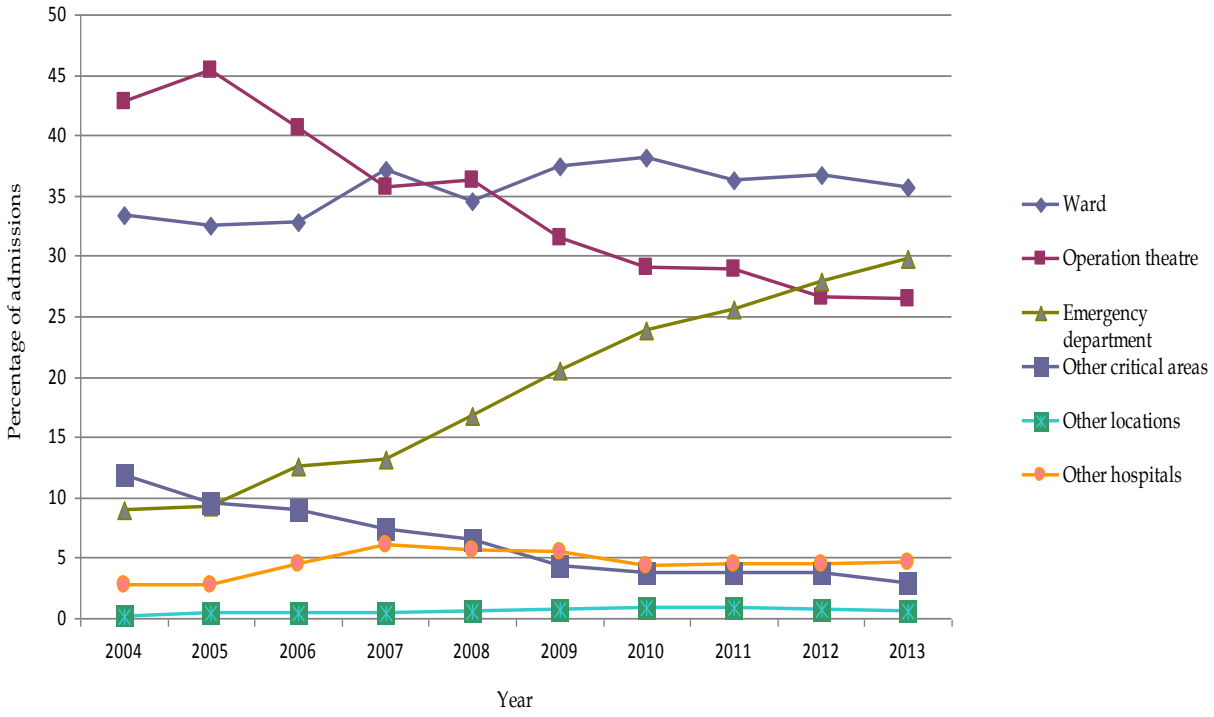


Table 14 : Location before ICU admission in MOH hospitals 2009 – 2013

Location	2009 (%)	2010 (%)	2011 (%)	2012 (%)	2013 (%)
Ward	37.5	38.2	37.4	36.7	35.7
Operation theatre	31.5	29.0	29.3	26.6	26.4
Emergency department	20.5	23.9	24.0	27.9	29.7
Other critical areas	4.4	3.7	4.1	3.7	2.9
Other locations	0.7	0.9	0.5	0.7	0.6
Other hospitals	5.5	4.3	4.7	4.5	4.6

Figure 9 : Location before ICU admission in MOH hospitals 2004 – 2013



The percentage of admissions from the emergency department has increased significantly more than three-fold over the last 10 years. Admissions from the operating theatre had decreased by almost half over the last 10 years.

Table 15 : Main organ failure on ICU admission, by category of ICU 2013

Main organ failure	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Without organ failure	5439 (31.4)	2575 (37.6)	1939 (33.0)	904 (85.2)	300 (35.3)	**11157 (34.9)**
Respiratory	3035 (17.5)	1154 (16.8)	1338 (22.8)	9 (0.8)	109 (12.8)	**5645 (17.6)**
Cardiovascular	4724 (27.2)	1524 (22.2)	1231 (20.9)	0 (0.0)	257 (30.3)	**7736 (24.2)**
Neurological	2112 (12.2)	833 (12.1)	795 (13.5)	19 (1.8)	70 (8.2)	**3829 (12.0)**
Renal	1222 (7.0)	462 (6.7)	378 (6.4)	52 (4.9)	57 (6.7)	**2171 (6.8)**
Haematological	645 (3.7)	241 (3.5)	153 (2.6)	69 (6.5)	38 (4.5)	**1146 (3.6)**
Hepatic	165 (1.0)	67 (1.0)	46 (0.8)	8 (0.8)	18 (2.1)	**304 (1.0)**
Total	**17342 (100.0)**	**6856 (100.0)**	**5880 (100.0)**	**1061 (100.0)**	**849 (100.0)**	**31988 (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.*

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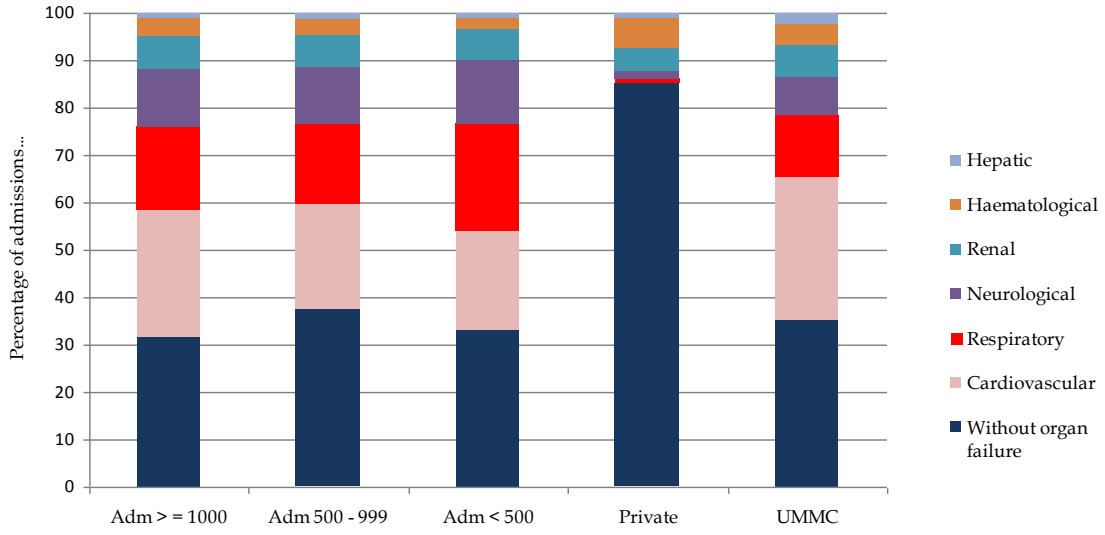
Fig 10 : Main organ failure on ICU admission, by category of ICU 2013



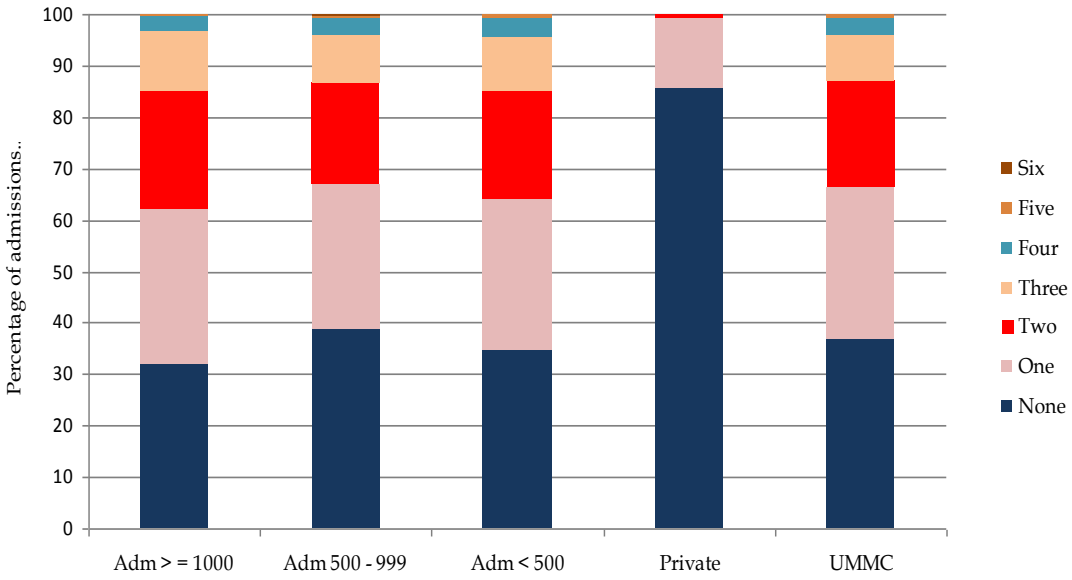
In 2013, about a third of admissions to ICUs in MOH hospitals (33.1%) and UMMC (35.0%) did not have any organ failure in comparison to private hospital ICU where more than four-fifth (85.2%) were without any organ failure.

In MOH ICUs, cardiovascular failure (37%) was the most common organ failure during the first 24 hours of ICU admission followed by respiratory (28%), neurological (19%), renal (10%), haematological (5%) and hepatic (1%).

Table 16 : Number of organ failure(s) on ICU admission, by category of ICU 2013

Main organ failure	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Without	5576 (32.2)	2670 (38.9)	2038 (34.7)	908 (85.6)	313 (37.0)	**11505 (36.0)**
Single	5191 (29.9)	1934 (28.2)	1721 (29.3)	144 (13.6)	250 (29.5)	**9240 (28.9)**
Two	3998 (23.1)	1345 (19.6)	1243 (21.1)	7 (0.7)	175 (20.7)	**6768 (21.2)**
Three	2018 (11.6)	650 (9.5)	628 (10.7)	0 (0.0)	75 (8.9)	**3371 (10.5)**
Four	479 (2.8)	220 (3.2)	211 (3.6)	1 (0.1)	27 (3.2)	**938 (2.9)**
Five	80 (0.5)	30 (0.4)	34 (0.6)	0 (0.0)	7 (0.8)	**151 (0.5)**
Six	0 (0.0)	7 (0.1)	5 (0.1)	1 (0.1)	0 (0.0)	**13 (0.0)**
Total	**17342 (100.0)**	**6856 (100.0)**	**5880 (100.0)**	**1061 (100.0)**	**847 (100.0)**	**31986 (100.0)**

Figure 11: Number of organ failure(s) on ICU admission by hospitals 2013



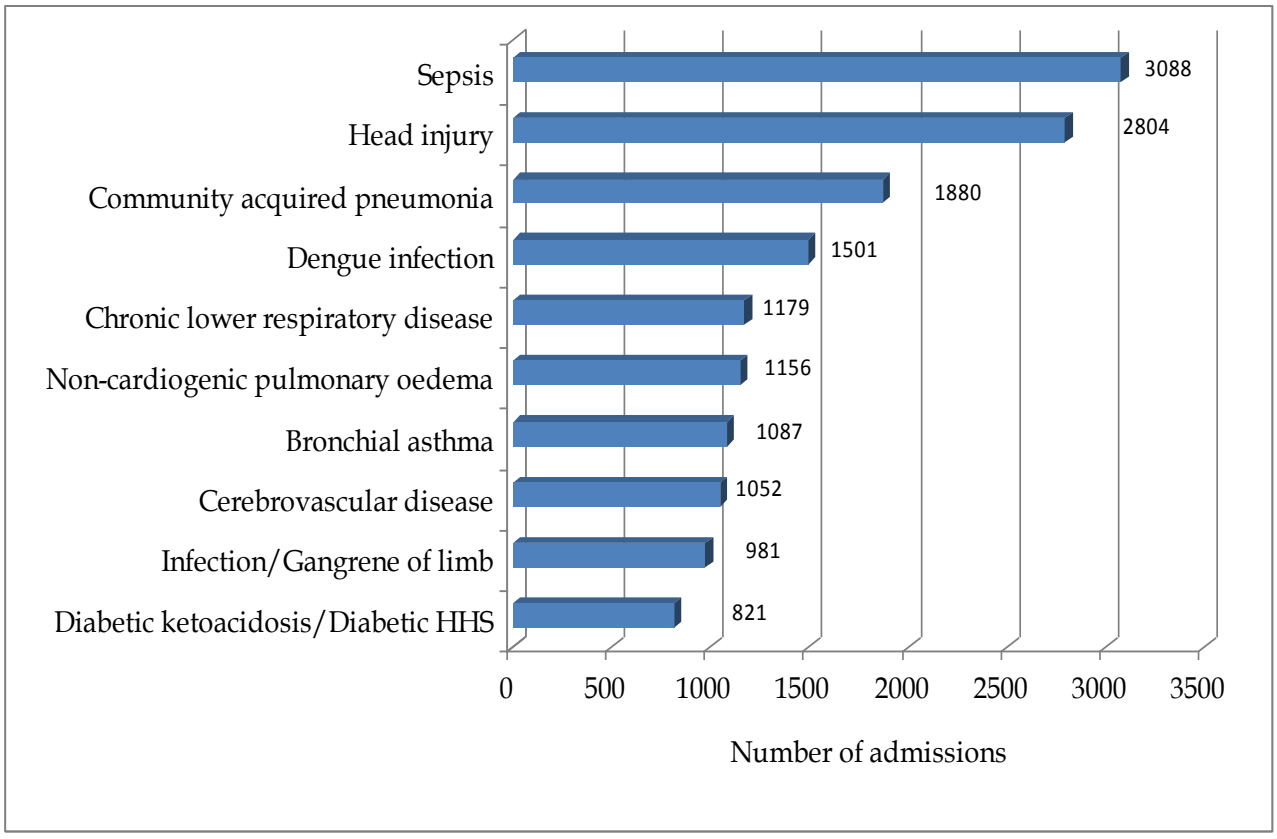
In 2013, about two-thirds (63.6%) of the patients were admitted with one or no organ failure in MOH ICUs. This high percentage could be partly attributed to more ICUs functioning as combined intensive care/high dependency care units.

Table 17 : Ten most common diagnoses leading to ICU admission 2013

Diagnosis	Number	Percentage
Hospitals with admission ≥ 1000		
Sepsis	2000	10.2
Head Injury	1825	9.3
Dengue	967	4.9
Community acquired pneumonia	881	4.5
Non-cardiogenic pulmonary oedema	712	3.6
Cerebrovascular disease (infarct, thrombosis, haemorrhage)	639	3.3
Bronchial asthma	589	3.0
Chronic lower respiratory disease	586	3.0
Diabetic ketoacidosis / diabetic hyperosmolar hyperglycaemic state (HHS)	528	2.7
Infection/gangrene of limb (including osteomyelitis, necrotizing fasciitis)	476	2.4
Hospitals with admission 500 – 999		
Head injury	550	6.4
Sepsis	541	6.3
Community acquired pneumonia	531	6.2
Dengue	302	3.5
Infection / gangrene of limb (including osteomyelitis, necrotizing fasciitis)	290	3.4
Cerebrovascular disease (infarct, thrombosis, haemorrhage)	265	3.1
Bronchial asthma	263	3.1
Chronic lower respiratory disease	256	3.0
Pregnancy-induced hypertension / Eclampsia	212	2.5
Meningitis / Encephalitis / Myelitis / Intracranial abscess / Spinal cord abscess	201	2.3
Hospitals with admission < 500		
Sepsis	547	7.8
Community acquired pneumonia	468	6.6
Head injury	429	6.1
Chronic lower respiratory disease	337	4.8
Non-cardiogenic pulmonary oedema	253	3.6
Bronchial asthma Other adverse perioperative events	235	3.3
Dengue	232	3.3
Ischaemic heart disease / acute coronary syndrome	229	3.2
Infection / gangrene of limb (including osteomyelitis, necrotizing fasciitis)	215	3.0
Gastrointestinal perforation (including anastomotic leak)	167	2.4
Private Hospital		
Dengue	138	10.3
Cerebrovascular disease (infarct, thrombosis, haemorrhage)	80	6.0
Gastrointestinal bleeding	79	5.9
Seizures (primary, no structural brain disease)	70	5.2
Other respiratory conditions	70	5.2

Ischaemic heart disease / acute coronary syndrome	62	4.6
Other abdominal / pelvic conditions	53	4.0
Bronchial asthma	50	3.7
Other cardiovascular conditions	37	2.8
Other CNS conditions	36	2.7
UMMC		
Sepsis	84	9.5
Diabetic ketoacidosis / diabetic hyperosmolar hyperglycaemic state (HHS)	32	3.6
Gastrointestinal malignancy	29	3.3
Gastrointestinal perforation (including anastomotic leak)	24	2.7
Dengue	23	2.6
Head injury	23	2.6
Bronchial asthma	22	2.5
Community acquired pneumonia	21	2.4
Congestive heart failure	21	2.4
ENT / oral conditions	20	2.3

Figure 12 : Ten most common diagnoses leading to ICU admission in MOH Hospitals, 2013



Sepsis, head injury and community-acquired pneumonia were the three most common diagnoses leading to ICU admission in MOH hospitals in 2013. Over the past 9 years, these 3 conditions have remained the three most common diagnoses leading to ICU admission.

Table 18 : Ten most common diagnoses leading to ICU admission using APACHE II diagnostic category 2013

Diagnosis	Number	Percentage
Hospitals with admission ≥ 1000		
Non-operative: Cardiovascular failure from Sepsis	2614	13.4
Non-operative: Respiratory system as principal reason for admission	1481	7.6
Operative: Respiratory system as principal reason for admission	1454	7.4
Non-operative: Respiratory failure from Infection	1355	6.9
Operative: Cardiovascular system as principal reason for admission	792	4.0
Non-operative: Neurologic system as principal reason for admission	732	3.7
Operative: Multiple trauma	717	3.7
Non-operative: Haemorrhagic shock / hypovolemia	710	3.6
Non-operative: Multiple trauma	704	3.8
Non-operative: Metabolic / renal system as principal reason for admission	633	3.2
Hospitals with admission 500 – 999		
Non-operative: Cardiovascular failure from Sepsis	1046	12.2
Non-operative: Respiratory failure from infection	989	11.5
Non-operative: Respiratory system as principal reason for admission	718	8.3
Operative: Respiratory system as principal reason for admission	438	5.1
Non-operative: Metabolic/ renal system as principal reason for admission	373	4.3
Operative: Respiratory insufficiency after surgery	353	4.1
Operative: Cardiovascular system as principal reason for admission	320	3.7
Non-operative: Head trauma	297	3.5
Operative: Gastrointestinal perforation / obstruction	264	3.1
Non-operative: Cardiovascular system as principal reason for admission	250	2.9
Hospitals with admission < 500		
Non-operative: Cardiovascular failure from Sepsis	768	10.9
Non-operative: Respiratory failure from infection	761	10.8
Non-operative: Respiratory system as principal reason for admission	560	7.9
Non-operative: Metabolic/ renal system as principal reason for admission	313	4.4
Operative: Respiratory system as principal reason for admission	278	3.9
Non-operative: Pulmonary oedema (non-cardiogenic)	278	3.9
Operative: Respiratory insufficiency after surgery	259	3.7
Non-operative: Head trauma	243	3.4
Non-operative: COPD	229	3.2
Non-operative: Cardiovascular system as principal reason for admission	225	3.2
Private Hospital		
Non-operative: Metabolic/ renal system as principal reason for admission	170	12.7
Non-operative: Respiratory system as principal reason for admission	166	12.4
Non-operative: Respiratory failure from infection	155	11.6
Non-operative: Neurologic system as principal reason for admission	146	10.9
Non-operative: Coronary artery disease	91	6.8

Non-operative: Gastrointestinal system as principal reason for admission	71	5.3
Non-operative: Gastrointestinal bleeding	67	5.0
Operative: Cardiovascular system as principal reason for admission	54	4.0
Non-operative: Seizure disorder	49	3.7
Operative: Metabolic / renal system as principal reason for admission	47	3.5
UMMC		
Non-operative: Cardiovascular failure from Sepsis	86	9.8
Operative: Respiratory system as principal reason for admission	82	9.3
Operative: Cardiovascular system as principal reason for admission	67	7.6
Non-operative: Respiratory system as principal reason for admission	53	6.0
Non-operative: Respiratory failure from infection	53	6.0
Operative: Gastrointestinal perforation / obstruction	48	5.4
Non-Operative: Cardiovascular system as principal reason for admission	43	4.9
Operative: Multiple trauma	35	4.0
Non-operative: Metabolic/ renal system as principal reason for admission	32	3.6
Operative: Metabolic/ renal system as principal reason for admission	30	3.4

Table 19 : Severe sepsis, ARDS and AKI within 24hrs of ICU admission 2013

	ICUs					
	Adm ≥ 1000	**Adm 500 - 999**	**Adm < 500**	**Private**	**UMMC**	**Total**
	n (%)	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Severe sepsis*	4473 (22.9)	1342 (15.6)	1119 (15.9)	12 (0.9)	225 (25.9)	**7171 (19.2)**
ARDS#	1668 (8.5)	759 (8.8)	504 (7.2)	9 (0.7)	99 (11.4)	**3039 (8.1)**
AKI^	2913 (14.9)	1101 (12.8)	898 (12.8)	7 (0.5)	210 (24.1)	**5129 (13.7)**

** 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 injuryI 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 2011 – 2013

Hospital	2011			2012			2013		
	Severe sepsis n (%)	ARDS n (%)	AKI n (%)	Severe sepsis n (%)	ARDS n (%)	AKI n (%)	Severe sepsis n (%)	ARDS n (%)	AKI n (%)
AS	359 (29.6)	287 (23.7)	198 (16.4)	410 (34.3)	278 (23.2)	213 (17.8)	380 (28.3)	198 (14.7)	227 (16.9)
PP	358 (29.9)	113 (9.4)	326 (27.2)	449 (34.9)	115 (8.9)	397 (30.9)	413 (36.8)	58 (5.2)	377 (33.6)
IPH	74 (6.5)	131 (11.5)	50 (4.4)	60 (6.6)	61 (6.6)	46 (5.0)	149 (12.4)	87 (7.2)	129 (10.8)
KL	578 (31.5)	473 (25.8)	707 (38.5)	1073 (54.5)	192 (9.8)	589 (29.9)	727 (38.2)	46 (2.4)	245 (12.9)
SLG	222 (19.5)	146 (12.8)	148 (13.0)	352 (27.3)	106 (8.2)	228 (17.7)	409 (27.1)	190 (12.6)	259 (17.2)
KLG	268 (16.7)	62 (3.9)	176 (11.0)	208 (9.7)	22 (1.0)	122 (5.7)	491 (23.8)	346 (16.8)	229 (11.1)
SBN	185 (33.5)	88 (15.9)	100 (18.1)	153 (28.5)	141 (26.3)	90 (16.8)	134 (28.5)	133 (28.2)	95 (20.2)
MLK	346 (21.7)	36 (2.3)	296 (18.6)	93 (5.5)	13 (0.8)	125 (7.4)	10 (0.6)	1 (0.1)	30 (1.8)
JB	457 (27.1)	105 (6.2)	350 (20.8)	478 (27.3)	71 (4.1)	364 (20.8)	557 (28.9)	95 (4.9)	465 (24.1)
KTN	63 (10.3)	39 (6.4)	54 (8.8)	117 (18..3)	66 (10.3)	127 (19.8)	201 (24.0)	109 (13.0)	180 (21.5)
KT	49 (4.1)	3 (0.2)	5 (0.4)	7 (0.5)	1 (0.1)	2 (0.1)	11 (0.9)	3 (0.3)	55 (4.7)
KB	143 (12.7)	33 (2.9)	74 (6.6)	155 (12.1)	185 (14.4)	174 (13.5)	168 (12.6)	241 (18.0)	234 (17.5)
KCH	82 (12.8)	25 (3.9)	59 (19.2)	111 (13.0)	14 (1.6)	59 (6.9)	122 (12.8)	9 (0.9)	48 (5.1)
KK	146 (17.3)	274 (32.6)	86 (10.2)	248 (26.0)	390 (40.9)	164 (17.2)	348 (34.1)	293 (28.7)	243 (23.8)
SP	34 (12.6)	26 (9.6)	13 (4.8)	19 (11.9)	1 (0.6)	10 (6.3)	92 (15.8)	20 (3.4)	72 (12.3)
PJY	71 (13.2)	49 (9.1)	33 (6.2)	63 (11.0)	54 (9.4)	57 (8.0)	115 (19.0)	91 (15.0)	91 (15.0)
MUR	62 (13.1)	13 (2.7)	23 (4.9)	7 (1.1)	22 (3.5)	51 (8.0)	16 (2.4)	44 (6.5)	45 (6.7)
TI	81 (26.3)	199 (64.6)	60 (19.5)	65 (17.0)	88 (22.9)	48 (12.5)	24 (6.0)	5 (1.2)	38 (9.5)
TPG	590 (68.6)	3 (0.3)	40 (4.7)	788 (65.5)	18 (1.5)	57 (4.7)	650 (48.2)	18 (1.3)	99 (7.3)
SJ	163 (28.2)	15 (2.6)	91 (15.7)	138 (21.4)	29 (4.5)	113 (17.5)	97 (23.5)	29 (7.0)	72 (17.5)
KJG	38 (11.1)	9 (2.6)	35 (10.3)	14 (3.8)	9 (2.4)	16 (4.3)	8 (2.5)	1 (0.3)	23 (7.2)
KGR	12 (4.0)	2 (0.7)	0 (0.0)	6 (1.7)	-	-	11 (3.4)	0 (0.0)	3 (0.9)
SJMC	13 (0.6)	9 (0.4)	15 (0.7)	7 (0.5)	12 (0.8)	15 (1.0)	12 (0.9)	9 (0.7)	7 (0.5)
TML	60 (11.1)	15 (2.8)	22 (4.1)	48 (11.0)	21 (4.8)	57 (13.1)	56 (9.3)	11 (1.8)	112 (18.8)
KP	111 (30.9)	15 (4.2)	61 (17.0)	110 (32.9)	14 (4.2)	83 (24.9)	142 (36.0)	22 (5.6)	77 (19.6)

SMJ	4 (1.1)	1 (0.3)	0 (0.0)	0 (0.0)	1 (0.2)	2 (0.5)	2 (0.5)	1 (0.3)	2 (0.5)
BP	145 (32.0)	114 (25.2)	150 (33.1)	86 (20.7)	57 (13.7)	85 (20.5)	75 (16.4)	8 (1.7)	42 (9.2)
TW	33 (12.0)	30 (10.9)	29 (10.6)	84 (19.4)	55 (12.7)	66 (15.3)	30 (6.7)	45 (10.0)	54 (12.1)
MRI	0 (0.0)	1 (0.3)	0 (0.0)	30 (6.3)	7 (1.5)	5 (1.1)	78 (16.2)	6 (1.2)	35 (7.3)
KLM	106 (21.3)	24 (4.8)	35 (7.0)	94 (15.6)	32 (5.3)	28 (4.7)	70 (12.5)	36 (6.4)	47 (8.4)
SDG	42 (4.8)	156 (17.7)	74 (8.4)	51 (5.8)	260 (29.7)	158 (18.1)	75 (8.8)	117 (13.8)	141 (16.6)
SB	97 (17.1)	43 (7.6)	117 (20.6)	78 (15.9)	38 (7.8)	95 (19.5)	72 (14.3)	47 (9.3)	82 (16.2)
DKS	64 (12.2)	22 (4.2)	36 (6.9)	67 (12.7)	26 (4.9)	53 (10.1)	100 (10.4)	48 (5.0)	65 (6.8)
SI	194 (30.1)	67 (10.4)	129 (20.0)	277 (34.6)	76 (9.5)	156 (19.5)	275 (28.6)	116 (12.1)	156 (16.2)
SBL	69 (5.5)	108 (8.6)	102 (8.1)	199 (12.6)	111 (7.0)	230 (14.6)	160 (8.3)	92 (4.8)	321 (16.8)
AMP	237 (42.9)	206 (37.3)	81 (14.6)	295 (51.6)	187 (32.7)	102 (17.8)	235 (41.5)	120 (21.2)	126 (22.3)
LIK	10 (2.7)	15 (4.0)	4 (1.1)	18 (6.7)	7 (2.6)	10 (3.7)	5 (1.0)	11 (2.1)	8 (1.6)
UMMC	-	-	-	136 (28.8)	75 (15.8)	135 (28.5)	225 (25.9)	99 (11.4)	210 (24.1)
LKW	-	-	-	45 (28.7)	30 (19.1)	40 (25.5)	21 (11.7)	10 (5.6)	17 (9.4)
BM	-	-	-	3 (7.9)	0 (0)	7 (18.4)	17 (11.1)	3 (2.0)	6 (4.0)
SLR	-	-	-	43 (27.9)	27 (17.5)	37 (24.0)	40 (17.9)	15 (6.7)	45 (20.2)
PD	-	-	-	40 (19.6)	2 (1.0)	27 (13.2)	16 (6.5)	1 (0.4)	38 (15.5)
KKR	-	-	-	6 (4.0)	7 (4.7)	16 (10.7)	64 (26.9)	59 (24.9)	39 (16.3)
SGT	-	-	-	34 (27.0)	10 (7.9)	33 (26.2)	24 (15.1)	16 (10.1)	37 (23.4)
TM	-	-	-	0 (0)	1 (5.9)	1 (5.9)	21 (16.5)	15 (11.8)	16 (12.7)
KEM	-	-	-	7 (7.4)	5 (5.3)	10 (10.6)	12 (11.4)	4 (3.8)	6 (5.8)
KLP	-	-	-	0 (0)	0 (0)	0 (0)	10 (8.6)	3 (2.6)	21 (18.1)
LAB	-	-	-	17 (15.9)	15 (14.0)	11 (10.3)	28 (17.0)	23 (14.0)	25 (15.2)
KEN	-	-	-	8 (9.9)	7 (8.6)	5 (6.2)	31 (19.3)	6 (3.7)	36 (22.4)
BIN	-	-	-	51 (23.9)	67 (31.6)	29 (13.6)	96 (36.9)	42 (16.2)	43 (16.5)
LD	-	-	-	30 (18.0)	24 (14.3)	45 (26.8)	46 (19.2)	37 (15.4)	56 (23.2)
Total	**5566 (18.7)**	**2957 (9.9)**	**3779 (12.7)**	**6878 (20.3)**	**3050 (9.0)**	**4593 (13.6)**	**7171 (19.2)**	**3039 (8.1)**	**5129 (13.7)**

During the first 24 hours of ICU admission, 19.2%, 8.1% and 13.7% 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 2009 – 2013

Hospital	SAPS II score (mean)				
	2009	2010	2011	2012	2013
AS	47.2	42.4	39.4	40.1	39.4
PP	37.8	34.9	38.0	36.5	35.8
IPH	32.9	33.7	33.0	32.0	34.0
KL	38.3	34.5	38.3	38.9	40.4
SLG	38.2	33.2	34.5	36.0	35.7
KLG	34.3	34.5	38.2	36.9	35.3
SBN	39.1	38.0	39.2	39.2	37.3
MLK	36.6	31.9	33.4	36.8	31.8
JB	39.0	38.2	39.1	40.7	31.8
KTN	35.9	33.4	34.5	39.8	38.6
KT	36.0	36.2	39.0	41.5	42.0
KB	25.4	30.0	33.4	34.4	34.3
KCH	33.9	32.4	35.0	33.0	33.7
KK	34.0	37.4	36.4	33.2	35.1
SP	38.1	41.0	40.1	43.3	39.7
PJY	30.8	29.6	28.7	28.0	29.5
MUR	31.2	32.1	37.9	37.6	38.4
TI	43.3	42.6	41.7	41.1	43.7
TPG	42.0	43.5	42.2	40.4	39.7
SJ	42.6	40.6	40.3	38.9	41.9
KJG	35.5	34.9	36.0	31.7	32.9
KGR	34.5	36.3	33.9	35.3	36.6
SJMC	19.7	18.3	18.0	18.8	18.6
TML	40.6	38.3	37.3	34.5	31.5
KP	43.3	43.0	40.0	41.2	39.9
SMJ	39.9	39.6	38.8	40.0	40.5
BP	45.4	41.0	43.3	43.4	40.1
TW	52.9	51.4	40.0	41.4	38.8
MRI	37.5	33.5	34.9	35.5	35.6
KLM	40.6	41.0	42.8	42.7	44.6
SDG	33.7	35.5	37.6	41.9	40.8
SB	-	39.6	39.2	40.4	43.9
DKS	-	51.0	41.3	38.0	39.3
SI	-	40.1	38.3	38.1	38.4
SBL	-	33.2	37.6	39.1	31.5
AMP	-	45.9	46.5	48.6	45.9
LIK	-	17.0	21.6	21.1	15.2
UMMC	-	-	-	36.5	36.5
LKW	-	-	-	41.2	29.3
BM	-	-	-	42.8	47.5
SLR	-	-	-	47.9	38.8

PD	-	-	-	31.3	33.8
KKR	-	-	-	36.0	44.0
SGT	-	-	-	39.9	43.8
TM	-	-	-	25.3	35.9
KEM	-	-	-	39.2	38.7
KLP	-	-	-	8.4	26.9
LAB	-	-	-	40.0	45.7
KEN	-	-	-	44.9	34.3
BIN	-	-	-	33.5	32.4
LD	-	-	-	48.8	43.3
Total	**35.8**	**35.1**	**36.1**	**37.3**	**36.5**

The average SAPS II score has remained the same over the years. The average SAPS II score in MOH hospitals for 2013 was 36.5; which carries predicted in-hospital mortality of 30.4% [8].

Table 22 : Sequential Organ Failure Assessment (SOFA) [4] by individual hospital 2009 – 2013

Hospital	SOFA score Mean (Median)				
	2009	2010	2011	2012	2013
AS	7.9 (7)	8.0 (8)	7.3 (7)	7.3 (7)	7.1 (7)
PP	7.1 (7)	6.3 (6)	6.2 (5)	6.7 (6)	6.9 (6)
IPH	5.9 (5)	5.9 (5)	5.4 (5)	5.4 (5)	5.9 (5)
KL	6.7 (6)	6.4 (6)	6.5 (6)	7.0 (7)	7.2 (7)
SLG	7.1 (6)	6.3 (5)	6.5 (6)	6.7 (6)	6.8 (6)
KLG	6.5 (6)	6.6 (6)	7.5 (7)	7.4 (7)	7.0 (7)
SBN	7.1 (7)	6.9 (6)	7.1 (7)	7.0 (7)	7.3 (7)
MLK	6.1 (6)	5.6 (5)	5.6 (5)	6.1 (6)	5.1 (4)
JB	7.3 (7)	7.4 (7)	7.2 (7)	7.4 (7)	7.6 (7)
KTN	6.3 (6)	5.7 (5)	5.9 (5)	7.0 (7)	7.0 (6)
KT	5.9 (5)	6.0 (6)	6.1 (6)	6.6 (6)	6.8 (7)
KB	3.6 (2)	4.7 (3)	5.1 (4)	5.3 (4)	5.5 (5)
KCH	5.9 (5)	5.6 (4)	6.0 (5)	5.4 (4)	5.7 (5)
KK	5.5 (5)	6.0 (5)	6.0 (6)	5.7 (5)	6.2 (6)
SP	5.3 (4)	6.8 (6)	6.9 (6)	6.8 (6)	7.0 (6)
PJY	4.4 (3)	4.2 (3)	4.1 (3)	4.2 (3)	5.0 (4)
MUR	5.3 (5)	5.1 (4)	5.9 (6)	5.5 (5)	5.5 (5)
TI	7.4 (7)	8.0 (8)	7.3 (7)	7.4 (7)	7.8 (7)
TPG	7.7 (8)	8.2 (8)	7.6 (8)	7.1 (7)	6.8 (6)
SJ	7.3 (7)	6.3 (6)	6.6 (6)	6.2 (6)	7.3 (7)
KJG	5.7 (5)	6.0 (5)	7.3 (7)	5.6 (5)	6.1 (5)
KGR	6.0 (6)	5.9 (5)	5.5 (4)	5.5 (5)	5.6 (5)
SJMC	1.6 (0)	1.3 (0)	1.4 (0)	1.4 (0)	1.1 (0)
TML	6.8 (6)	6.4 (6)	6.2 (5)	6.1 (5)	5.1 (4)
KP	7.7 (7)	7.6 (7)	7.3 (7)	7.3 (7)	6.6 (6)
SMJ	8.3 (8)	7.3 (7)	6.9 (7)	7.3 (7)	7.1 (7)
BP	6.7 (6)	6.7 (6)	6.9 (6)	7.1 (7)	6.4 (6)
TW	9.0 (9)	8.8 (9)	7.2 (6)	7.2 (6)	7.4 (7)
MRI	6.2 (6)	5.2 (4)	5.5 (5)	5.9 (6)	5.8 (5)
KLM	7.3 (7)	8.4 (8)	8.5 (8)	7.8 (7)	7.3 (7)
SDG	5.7 (5)	6.3 (5)	6.5 (6)	7.2 (7)	7.2 (7)
SB	-	7.8 (7)	7.8(7)	7.6 (7)	7.3 (7)
DKS	-	9.2 (9)	6.5 (6)	5.8 (5)	5.5 (4)
SI	-	6.6 (6)	6.5 (6)	6.8 (6)	6.1 (5)
SBL	-	6.6 (7)	7.0 (8)	7.3 (8)	7.0 (7)
AMP	-	8.6 (9)	8.8 (9)	8.9 (9)	8.5 (8)
LIK	-	1.3 (0)	2.2 (1)	2.6 (1)	1.6 (0)
UMMC	-	-	-	7.6 (7)	7.4 (6)
LKW	-	-	-	5.7 (5)	3.4 (0)
BM	-	-	-	9.5 (10)	6.8 (6)

SLR	-	-	-	7.9 (8)	6.5 (6)
PD	-	-	-	4.7 (4)	4.9 (4)
KKR	-	-	-	6.8 (6)	7.5 (7)
SGT	-	-	-	6.4 (6)	6.6 (6)
TM	-	-	-	3.1 (3)	6.2 (5)
KEM	-	-	-	6.0 (5)	6.5 (6)
KLP	-	-	-	0.8 (1)	3.7 (3)
LAB	-	-	-	4.2 (2)	5.9 (6)
KEN	-	-	-	5.9 (5)	6.1 (6)
BIN	-	-	-	5.7 (5)	4.9 (4)
LD	-	-	-	8.7 (9)	7.5 (7)
Overall	**6.0 (5)**	**6.2 (5)**	**6.2 (6)**	**6.4 (6)**	**6.4 (6)**

The average SOFA score in 2013 was 6.4. AMP had the highest score of 8.5 while SJMC had the lowest score of 1.1.

SECTION C:

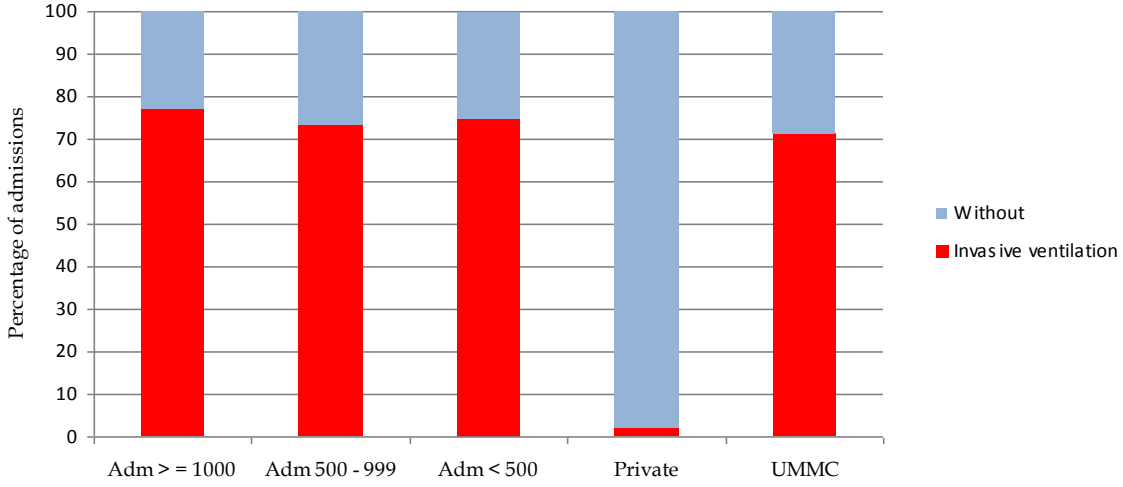
INTERVENTIONS

Table 23 : Invasive ventilation, non-invasive ventilation and reintubation, by category of ICU 2013

	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Invasive ventilation	15034 76.9%	6313 73.4%	5272 74.4%	26 1.9%	626 71.1%	**27271** **72.9%**
Non-invasive ventilation	3578 19.2%	1553 18.1%	1130 16.0%	6 0.5%	241 27.4%	**6508** **17.8%**
Reintubation	1130 7.9%	329 5.2%	337 6.4%	1 4.0%	39 6.2%	**1836** **6.9%**

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

Fig 13 : Invasive ventilation, by category of ICU 2013



77% and 71% of ICU admission to MOH hospitals and UMMC received invasive mechanical ventilation respectively. In contrast, majority of patients (98%) in private hospital were not mechanically ventilated

Fig 14 : Non-invasive ventilation, by category of ICU 2013

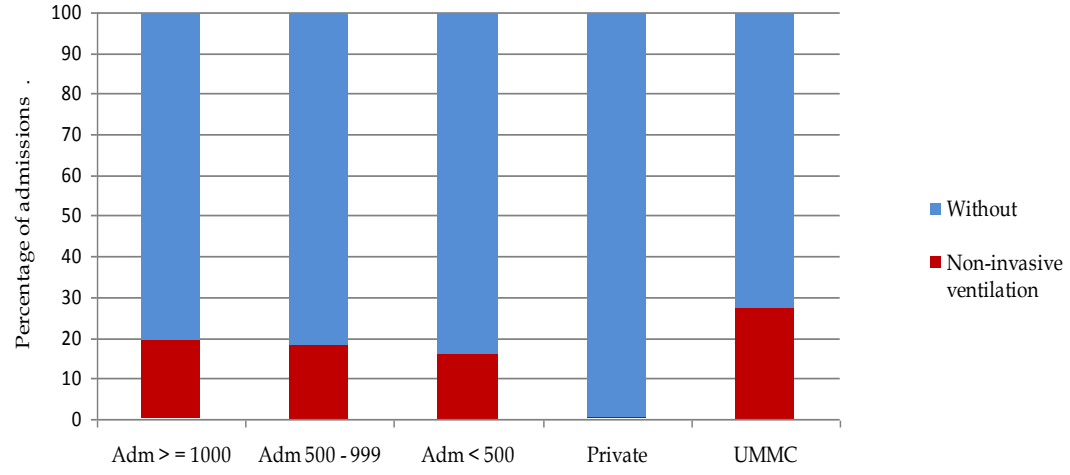
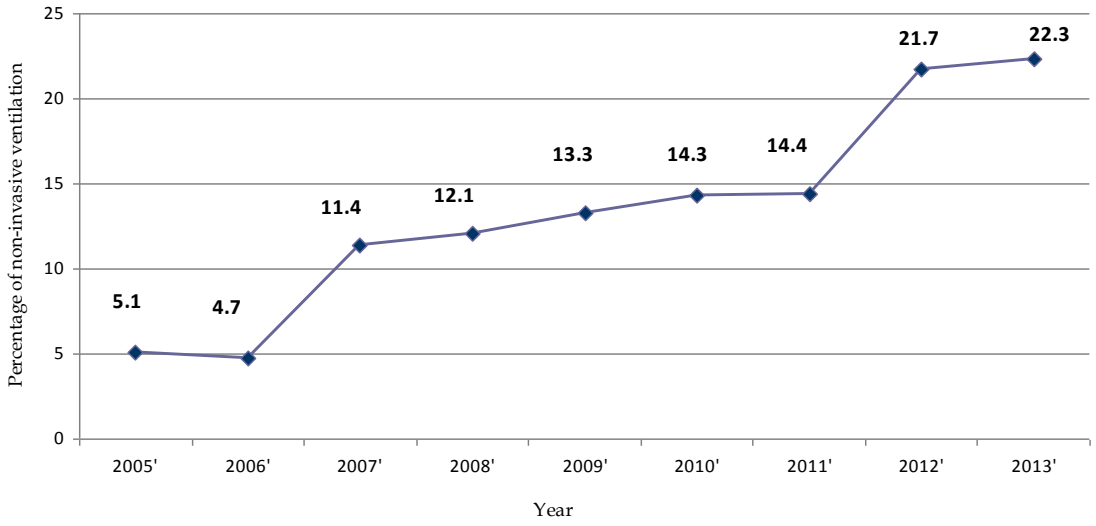
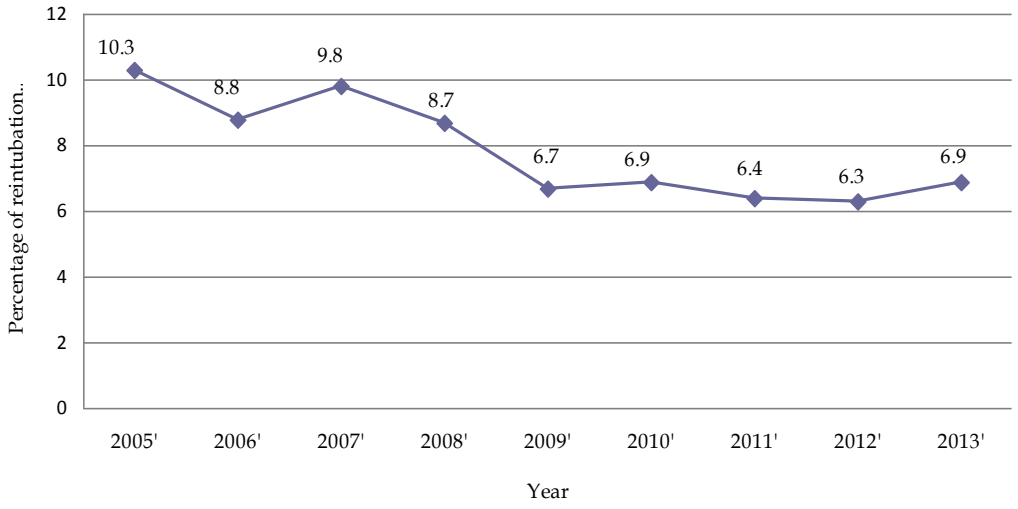


Figure 15 : Non-invasive ventilation, MOH hospitals 2005 – 2013



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. 27% of ICU admissions in UMMC received non-invasive ventilation while 0.5% of ICU patients in SJMC received non-invasive ventilation.

Fig 16 : Reintubation, MOH hospitals 2005 – 2013



The reintubation rate in MOH participating centres and UMMC was 6.9% and 6.2% respectively.

Table 24 : Duration of invasive mechanical ventilation, by individual hospital 2009 – 2013

Hospital	Mean ± SD days				
	2009	2010	2011	2012	2013
AS	3.4. ± 6.1	3.2 ± 4.5	3.6 ± 4.8	4.8 ± 6.0	4.1 ± 5.5
PP	5.0 ± 8.6	4.8 ± 7.6	5.1 ± 7.1	5.2 ± 7.8	5.4 ± 7.0
IPH	4.6 ± 6.2	4.3 ± 5.9	5.3 ± 7.2	5.1 ± 6.7	5.2 ± 8.2
KL	3.8 ± 6.4	3.7 ± 6.4	3.9 ± 5.8	4.5 ± 7.1	4.4 ± 7.4
SLG	4.3 ± 5.4	4.1 ± 6.4	4.5 ± 6.3	4.9 ± 5.9	4.3 ± 5.4
KLG	4.7 ± 7.3	4.1 ± 5.3	2.9 ± 4.3	2.7 ± 4.5	2.5 ± 5.7
SBN	4.7 ± 6.8	4.4 ± 6.9	5.1 ± 7.4	4.9 ± 6.8	6.1 ± 8.9
MLK	4.6 ± 6.7	4.2 ± 5.2	4.0 ± 1.7	4.3 ± 5.7	4.6 ± 6.7
JB	4.2 ± 6.5	4.2 ± 5.7	4.8 ± 6.3	4.9 ± 6.2	4.3 ± 5.5
KTN	3.3 ± 4.5	2.9 ± 3.8	4.9 ± 7.1	5.6 ± 6.9	5.0 ± 6.5
KT	4.2 ± 6.7	3.6 ± 4.3	3.5 ± 4.6	3.4 ± 4.6	3.9 ± 4.9
KB	3.5 ± 5.5	3.6 ± 6.0	3.9 ± 7.3	3.6 ± 6.3	4.0 ± 6.6
KCH	4.6 ± 6.7	4.1 ± 6.2	5.4 ± 7.4	5.0 ± 7.2	4.4 ± 6.6
KK	4.9 ± 6.1	4.7 ± 7.1	5.2 ± 7.0	5.5 ± 7.2	5.9 ± 8.8
SP	3.5 ± 3.3	3.6 ± 4.0	3.9 ± 5.3	3.9 ± 4.0	4.3 ± 5.9
PJY	4.1 ± 6.3	3.0 ± 5.7	3.3 ± 5.5	3.1 ± 4.9	3.5 ± 5.4
MUR	4.5 ± 6.4	2.9 ± 4.0	5.1 ± 8.1	3.8 ± 6.8	2.9 ± 4.4
TI	3.5 ± 5.7	3.0 ± 8.0	3.7 ± 5.8	4.0 ± 8.0	2.5 ± 3.0
TPG	5.3 ± 7.6	7.0 ± 10.1	7.3 ± 9.6	5.2 ± 8.0	4.1 ± 5.3
SJ	4.1 ± 5.6	3.7 ± 4.8	4.0 ± 6.3	4.3 ± 7.2	6.4 ± 9.7
KJG	5.3 ± 7.3	3.6 ± 4.4	4.8 ± 15.3	4.9 ± 7.3	4.1 ± 5.0
KGR	3.4 ± 4.3	3.1 ± 4.7	3.5 ± 6.3	3.8 ± 6.5	3.6 ± 7.0
SJMC	3.8 ± 4.5	4.2 ± 5.4	2.9 ± 4.7	2.5 ± 4.1	4.8 ± 5.1
TML	4.4 ± 6.0	4.5 ± 6.3	5.5 ± 8.9	4.9 ± 6.7	4.6 ± 8.2
KP	4.1 ± 5.9	2.6 ± 3.5	5.6 ± 8.2	5.0 ± 7.5	4.9 ± 7.0
SMJ	4.9 ± 7.5	3.9 ± 6.0	3.0 ± 4.9	3.2 ± 4.1	2.9 ± 4.3
BP	4.7 ± 6.4	4.5 ± 7.0	4.4 ± 6.1	5.2 ± 6.4	4.4 ± 6.0
TW	4.5 ± 9.5	3.1 ± 3.7	2.9 ± 3.9	3.2 ± 6.3	4.1 ± 6.3
MRI	6.1 ± 7.7	4.7 ± 5.7	4.6 ± 5.3	4.7 ± 5.4	4.4 ± 5.3
KLM	3.4 ± 5.5	3.2 ± 3.8	3.6 ± 5.6	3.3 ± 4.3	3.2 ± 4.8
SDG	4.1 ± 6.1	3.2 ± 4.8	4.6 ± 6.0	4.5 ± 5.4	4.3 ± 6.1
SB	-	4.6 ± 7.3	5.1 ± 7.0	5.3 ± 9.1	5.5 ± 7.7
DKS	-	5.8 ± 8.5	6.3 ± 11.2	5.2 ± 8.1	4.3 ± 6.2
SI	-	4.3 ± 6.5	7.1 ± 13.6	5.9 ± 10.3	5.5 ± 8.7
SBL	-	5.8 ± 6.6	6.2 ± 7.0	5.7 ± 6.3	5.8 ±7.6
AMP	-	3.8 ± 5.5	5.1 ± 7.7	4.4 ± 5.9	4.8 ± 6.3
LIK	-	1.4 ± 1.7	1.8 ± 2.2	3.6 ± 5.2	2.7 ± 3.8
UMMC	-	-	-	8.1 ± 11.4	6.0 ± 8.2
LKW	-	-	-	4.2 ± 7.6	4.2 ± 5.9

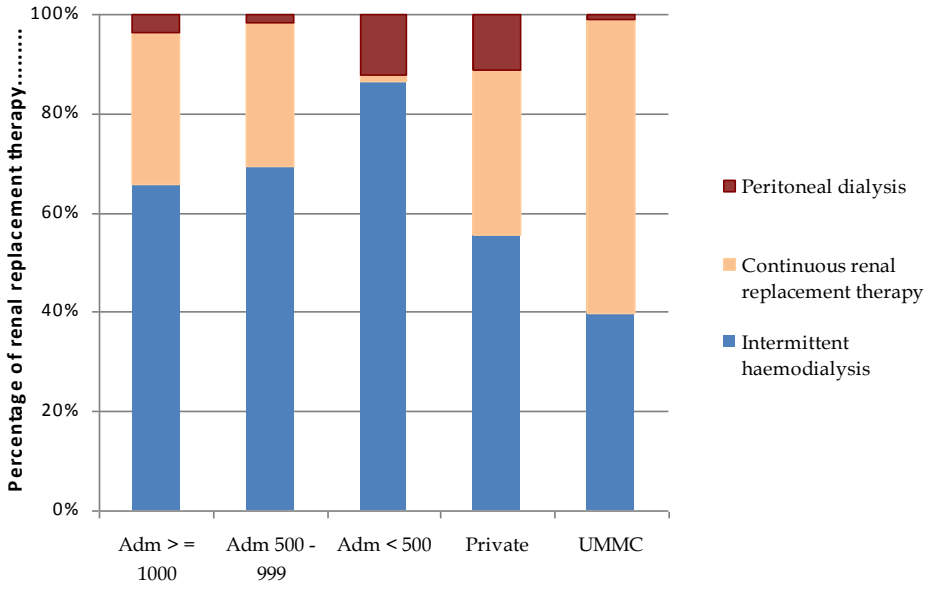
BM	-	-	-	-	6.2 ± 9.1
SLR	-	-	-	5.3 ± 6.3	5.7 ± 8.1
PD	-	-	-	2.8 ± 3.4	2.7 ± 3.0
KKR	-	-	-	4.8 ± 6.3	5.3 ± 7.6
SGT	-	-	-	4.3 ± 7.1	3.0 ± 4.0
TM	-	-	-	-	3.7 ± 4.6
KEM	-	-	-	-	3.1 ± 2.2
KLP	-	-	-	-	2.1 ± 4.0
LAB	-	-	-	4.6 ± 6.6	3.8 ± 5.2
KEN	-	-	-	-	6.7 ± 9.8
BIN	-	-	-	6.2 ± 8.3	4.3 ± 5.0
LD	-	-	-	5.2 ± 14.0	5.4 ± 6.7
Total	**4.3 ± 6.5**	**4.1 ± 6.1**	**4.6 ± 7.1**	**4.5 ± 6.8**	**4.5 ± 6.6**

The average duration of mechanical ventilation was 4.5 days in 2013. KLP had the shortest duration of invasive mechanical ventilation at 2.1 days while KEN had the longest at 6.7 days.

Table 25 : Renal replacement therapy and modalities of therapy, by category of ICU 2013

	ICUs					
	Adm ≥ 1000 n (%)	**Adm 500 - 999 n (%)**	**Adm < 500 n (%)**	**Private n (%)**	**UMMC n (%)**	**Total n (%)**
Renal replacement therapy	2917 (15.6)	1082 (12.6)	855 (12.2)	13 (1.0)	118 (13.4)	**4985 (13.7)**
Modalities of therapy						
Intermittent haemodialysis	2179 (67.8)	796 (69.6)	746 (85.5)	11 (84.6)	26 (22.0)	**3758 (70.1)**
CRRT	946 (29.4)	323 (28.3)	45 (5.2)	0 (0.0)	92 (77.9)	**1406 (26.3)**
Peritoneal dialysis	85 (2.6)	24 (2.0)	81 (9.3)	2 (15.4)	0 (0.0)	**192 (3.6)**
Total	**3210 (100)**	**1143 (100)**	**872 (100)**	**13 (100)**	**118 (100)**	**5356 (100)**

Figure 17 : Modalities of renal replacement therapy, by category of ICU 2013



In MOH ICUs, 13% of admissions received renal replacement therapy in 2013. 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.

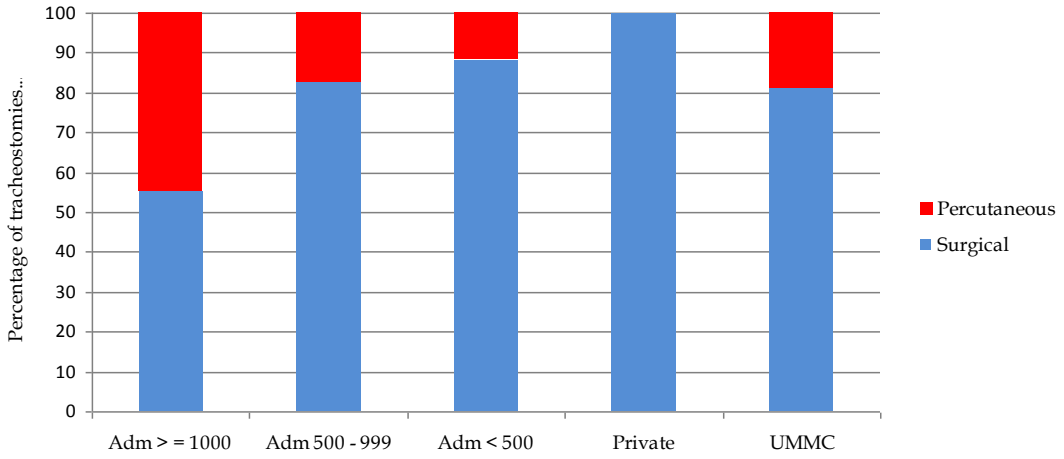
Intermittent haemodialysis and continuous renal replacement therapy were the most common modalities of renal replacement therapy performed in MOH ICUs and UMMC respectively.

Table 26 : Tracheostomy 2013

	ICUs					
	Adm ≥ 1000 n (%)	**Adm 500 - 999 n (%)**	**Adm < 500 n (%)**	**Private n (%)**	**UMMC n (%)**	**Total n (%)**
Tracheostomy	1719 11.9%	595 9.4%	418 7.9%	3 12.0%	64 10.2%	**2799** **10.5%**
Tracheostomy technique						
Surgical	949 55.2%	490 82.4%	367 87.8%	3 100%	52 81.2%	**1861** **66.8%**
Percutaneous	770 44.8%	105 17.6%	51 12.2%	0 0.0%	12 18.8%	**940** **33.2%**

Tracheostomy: Refers to the procedure done during ICU stay

Figure 18 : Techniques of tracheostomy, by category of ICU 2013



Percutaneous tracheostomy (44.8%) was more commonly performed in ICUs with more than 1000 admissions. ICUs with admissions 500 to 999 had 82.4% of tracheostomies performed via surgical technique. UMMC had 18.8%of tracheostomies performed percutaneously.

Table 27 : Tracheostomy, by individual hospital 2013

Hospital	Tracheostomy performed n (%)	Tracheostomy in relation to days of ventilation mean (median)	Type of tracheostomy	
			Surgical n (%)	Percutaneous n (%)
AS	160 (12.9)	6.8 (7.0)	123 (76.9)	37 (23.1)
PP	196 (20.8)	6.3 (6.3)	67 (34.2)	129 (65.8)
IPH	141 (14.7)	8.1 (6.2)	70 (19.6)	71 (50.4)
KL	119 (8.4)	9.2 (8.4)	30 (22.5)	89 (74.8)
SLG	121 (10.5)	9.7 (9.2)	87 (71.9)	34 (28.1)
KLG	133 (9.5)	4.0 (3.7)	32 (24.1)	101 (75.9)
SBN	50 (13.3)	12.6 (5.4)	50 (100.0)	0 (0.0)
MLK	57 (5.4)	13.2 (11.5)	57 (100.0)	0 (0.0)
JB	238 (14.6)	6.7 (5.7)	76 (31.9)	162 (68.1)
KTN	115 (15.9)	7.9 (6.7)	106 (92.2)	9 (7.8)
KT	95 (9.5)	7.3 (5.8)	58 (61.1)	37 (38.9)
KB	40 (3.9)	13.4 (11.5)	31 (77.5)	9 (22.5)
KCH	76 (9.5)	7.2 (6.2)	71 (94.0)	5 (6.0)
KK	123 (15.6)	9.2 (7.1)	105 (85.4)	18 (14.6)
SP	30 (6.6)	8.8 (9.3)	30 (100.0)	0 (0.0)
PJY	19 (4.5)	9.3 (10.3)	18 (94.7)	1 (5.3)
MUR	29 (5.7)	6.4 (5.7)	29 (100.0)	0 (0.0)
TI	13 (4.2)	8.5 (8.9)	13 (100.0)	0 (0.0)
TPG	108 (10.1)	7.4 (6.7)	108 (100.0)	0 (0.0)
SJ	42 (11.7)	11.8 (10.9)	13 (31.0)	29 (69.0)
KJG	24 (9.3)	5.2 (4.7)	24 (100.0)	0 (0.0)
KGR	38 (12.4)	6.2 (5.4)	37 (97.4)	1 (2.6)
SJMC	3 (12.0)	8.5 (10.8)	3 (100.0)	0 (0.0)
TML	39 (8.4)	10.2 (8.3)	39 (100.0)	0 (0.0)
KP	14 (4.3)	12.9 (13.9)	14 (100.0)	0 (0.0)
SMJ	10 (3.7)	7.0 (5.3)	0 (0.0)	10 (100.0)
BP	35 (9.6)	8.7 (9.1)	35 (100.0)	0 (0.0)
TW	34 (10.0)	6.0 (5.1)	33 (97.1)	1 (2.9)
MRI	22 (6.0)	10.0 (8.4)	21 (95.5)	1 (4.5)
KLM	46 (9.9)	6.7 (6.3)	46 (100.0)	0 (0.0)
SDG	64 (10.0)	9.0 (9.5)	59 (92.2)	5 (7.8)
SB	52 (12.1)	8.7 (8.7)	52 (100.0)	0 (0.0)
DKS	36 (5.0)	8.1 (7.7)	4 (11.1)	32 (88.9)
SI	72 (9.9)	11.8 (12.1)	65 (90.3)	7 (9.7)
SBL	197 (24.7)	8.9 (8.3)	113 (57.4)	84 (42.6)
AMP	55 (11.4)	9.2 (9.0)	8 (14.5)	47 (85.5)
LIK	6 (5.1)	9.1 (9.7)	6 (100.0)	0 (0.0)
UMMC	64 (10.2)	11.4 (12.7)	52 (81.2)	12 (18.8)
LKW	11 (8.7)	9.1 (6.5)	11 (100.0)	0 (0.0)
BM	17 (12.9)	13.9 (18.4)	14 (82.3)	3 (17.6)

SLR	7 (3.8)	15.8 (16.9)	6 (85.7)	1 (14.3)
PD	5 (4.9)	11.6 (11.5)	5 (100.0)	0 (0.0)
KKR	7 (4.1)	11.2 (11.5)	7 (100.0)	0 (0.0)
SGT	10 (7.5)	7.5 (5.8)	10 (100.0)	0 (0.0)
TM	-	-	-	-
KEM	1 (1.6)	1.8 (1.8)	1 (100.0)	0 (0.0)
KLP	1 (2.1)	22.6 (22.6)	1 (100.0)	0 (0.0)
LAB	14 (12.4)	11.3 (7.9)	14 (100.0)	0 (0.0)
KEN	9 (9.2)	10.8 (11.7)	9 (100.0)	0 (0.0)
BIN	12 (6.0)	8.6 (7.2)	12 (100.0)	0 (0.0)
LD	21 (11.5)	8.8 (7.3)	16 (76.2)	5 (23.8)
Total	**2799 (10.5)**	**8.3 (7.2)**	**1891 (66.8)**	**940 (33.2)**

Among all invasively ventilated patients, 10.5% had tracheostomies performed. 10.3% of invasively ventilated MOH patients underwent tracheostomy. The mean time from initiation of invasive ventilation to tracheostomy was 8.3 days. KEM had the shortest interval of 1.8 days while KLP had the longest interval of 22.6 days.

Table 28 : Tracheostomy, by individual hospital 2009 – 2013

	Total tracheostomy (% percutaneous tracheostomy) n (%)				
	2009	**2010**	**2011**	**2012**	**2013**
AS	125 (41.6)	105 (42.9)	126 (23.0)	150 (23.3)	160 (23.1)
PP	86 (29.1)	135 (63.0)	199 (64.8)	210 (65.7)	196 (65.8)
IPH	124 (12.9)	153 (3.9)	140 (2.9)	109 (16.5)	141 (50.4)
KL	104 (79.8)	142 (78.2)	128 (75.0)	149 (75.8)	119 (74.8)
SLG	58 (6.9)	66 (8.0)	77 (18.2)	102 (28.4)	121 (28.1)
KLG	117 (1.7)	110 (21.8)	190 (73.7)	155 (76.1)	133 (75.9)
SBN	58 (0.0)	59 (0.0)	68 (1.5)	55 (0.0)	50 (0.0)
MLK	134 (0.0)	105 (0.0)	100 (1.0)	88 (0.0)	57 (0.0)
JB	225 (83.6)	325 (77.8)	465 (79.4)	332 (73.2)	238 (68.1)
KTN	50 (8.0)	40 (5.0)	80 (7.5)	112 (4.5)	115 (7.8)
KT	53 (67.9)	60 (78.3)	67 (50.7)	88 (37.5)	95 (38.9)
KB	12 (8.3)	14 (14.3)	29 (24.1)	27 (37.0)	40 (22.5)
KCH	23 (13.0)	47 (17.0)	63 (36.5)	71 (23.9)	76 (6.6)
KK	28 (0.0)	58 (24.1)	46 (8.7)	104 (25.0)	123 (14.6)
SP	26 (3.8)	8 (0.0)	23 (0)	11 (0.0)	30 (0.0)
PJY	10 (0.0)	11 (0.0)	21 (0)	26 (0.0)	19 (5.3)
MUR	26 (0.0)	26 (3.8)	36 (0)	40 (2.5)	29 (0.0)
TI	12 (83.3)	8 (0.0)	18 (0)	24 (0.0)	13 (0.0)
TPG	140 (0.0)	145 (0.7)	149 (0)	127 (0.8)	108 (0.0)
SJ	56 (0.0)	60 (8.3)	61 (37.7)	57 (22.8)	42 (69.0)
KJG	25 (0.0)	26 (0.0)	19 (5.3)	14 (0.0)	24 (0.0)

KGR	33 (15.2)	11 (0.0)	7 (0)	19 (0.0)	38 (2.6)
SJMC	9 (44.4)	2 (0.0)	6 (16.7)	3 (33.3)	3 (0.0)
TML	40 (0.0)	45 (0.0)	38 (0)	29 (3.4)	39 (0.0)
KP	18 (0.0)	7 (0.0)	27 (0)	24 (0.0)	14 (0.0)
SMJ	19 (57.9)	9 (66.7)	9 (88.9)	16 (75.0)	10 (100.0)
BP	39 (0.0)	46 (0.0)	54 (0)	36 (0.0)	35 (0.0)
TW	13 (15.4)	10 (0.0)	21 (0)	25 (0.0)	34 (2.9)
MRI	29 (0.0)	10 (20.0)	8 (0)	33 (18.2)	22 (4.5)
KLM	34 (0.0)	47 (0.0)	55 (0)	78 (0.0)	46 (0.0)
SDG	51 (64.7)	44 (43.2)	52 (42.3)	56 (32.1)	64 (7.8)
SB	-	22 (18.2)	36 (0)	56 (3.6)	52 (0.0)
DKS	-	13 (53.8)	21 (76.2)	25 (80.0)	36 (88.9)
SI	-	30 (26.7)	64 (26.6)	66 (24.2)	72 (9.7)
SBL	-	212 (87.3)	262 (68.3)	206 (42.7)	197 (42.6)
AMP	-	33 (97.0)	55 (92.7)	59 (93.2)	55 (85.5)
LIK	-	0 (0.0)	1 (0)	5 (0.0)	6 (0.0)
UMMC				76 (21.1)	64 (18.8)
LKW				10 (0.0)	11 (0.0)
BM				11 (0.0)	17 (17.6)
SLR				5 (0.0)	7 (14.3)
PD				5 (0.0)	5 (0.0)
KKR				6 (0.0)	7 (0.0)
SGT				7 (0.0)	10 (0.0)
TM				-	
KEM				1 (0.0)	1 (0.0)
KLP				-	1 (0.0)
LAB				6 (0.0)	14 (0.0)
KEN				-	9 (0.0)
BIN				12 (58.3)	12 (0.0)
LD				10 (80.0)	21 (23.8)
Total	**1821 (28.4)**	**2244 (39.0)**	**2821 (41.7)**	**2936 (35.8)**	**2831 (33.2)**

In 2013, 33.2% of all tracheostomies were performed percutaneously. The percentage of percutaneous tracheostomies had increased from 2002 until 2011. This however, decreased slightly in 2012 and 2013. SMJ had all their tracheostomies performed percutaneously.

Table 29 : Withdrawal / withholding therapy, by individual hospital 2009 – 2013

Hospital	Withdrawal / Withholding of therapy n (%)				
	2009	2010	2011	2012	2013
AS	188 (42.5)	181 (54.4)	192 (66.2)	203 (64.2)	253 (71.5)
PP	36 (50.0)	44 (41.9)	105 (60.7)	191 (91.4)	133 (78.2)
IPH	0 (0.0)	0 (0.0)	0 (0.0)	7 (4.6)	48 (23.1)
KL	190 (57.2)	183 (60.6)	230 (73.5)	299 (83.8)	267 (80.4)
SLG	5 (2.3)	3 (1.6)	6 (2.9)	42 (20.9)	110 (54.7)
KLG	0 (0.0)	25 (11.2)	162 (58.9)	206 (63.2)	137 (49.5)
SBN	49 (40.2)	47 (44.8)	58 (49.2)	61 (52.6)	36 (38.7)
MLK	22 (6.0)	41 (11.5)	38 (10.4)	22 (5.7)	58 (15.4)
JB	157 (57.7)	196 (71.5)	270 (72.8)	278 (75.7)	332 (79.8)
KTN	16 (12.9)	16 (11.5)	4 (3.8)	9 (5.8)	11 (6.0)
KT	31 (15.0)	102 (46.2)	82 (32.5)	54 (21.5)	48 (19.2)
KB	9 (6.1)	24 (15.1)	3 (1.5)	48 (23.8)	33 (17.5)
KCH	2 (2.3)	19 (23.5)	1 (0.7)	8 (5.4)	7 (4.2)
KK	3 (4.2)	27 (14.6)	29 (17.9)	43 (22.8)	60 (30.9)
SP	61 (78.2)	14 (21.9)	1 (1.1)	0 (0.0)	5 (3.9)
PJY	1 (1.3)	1 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)
MUR	0 (0.0)	4 (3.1)	4 (3.1)	33 (22.4)	38 (29.0)
TI	13 (17.3)	6 (10.3)	0 (0.0)	1 (1.5)	3 (3.7)
TPG	75 (23.7)	79 (25.8)	56 (24.1)	108 (43.2)	100 (43.1)
SJ	13 (7.8)	68 (58.1)	53 (36.3)	67 (48.9)	40 (37.0)
KJG	11 (20.8)	2 (4.7)	5 (8.6)	4 (7.7)	1 (2.0)
KGR	25 (61.0)	60 (95.2)	*	1 (1.8)	0 (0.0)
SJMC	2 (2.4)	0 (0.0)	2 (2.3)	4 (6.5)	0 (0.0)
TML	8 (6.2)	8 (5.3)	2 (1.9)	4 (6.3)	9 (9.6)
KP	2 (3.8)	19 (19.4)	21 (17.2)	19 (20.2)	43 (39.8)
SMJ	1 (0.7)	42 (50.0)	31 (33.3)	27 (28.7)	17 (17.2)
BP	17 (16.0)	10 (13.0)	13 (13.4)	11 (9.2)	28 (26.9)
TW	5 (10.9)	2 (4.2)	7 (16.3)	8 (14.8)	4 (6.0)
MRI	2 (4.1)	0 (0.0)	2 (2.3)	9 (10.6)	7 (7.8)
KLM	23 (22.3)	69 (53.1)	59 (44.4)	66 (54.5)	70 (52.6)
SDG	40 (33.3)	127 (89.4)	53 (34.0)	0 (0.0)	3 (1.9)
SB	-	57 (51.8)	63 (46.3)	58 (54.2)	51 (42.1)
DKS	-	3 (2.7)	10 (7.1)	5 (3.9)	4 (1.7)
SI	-	1 (0.7)	21 (15.2)	11 (5.6)	11 (5.5)
SBL	-	82 (42.9)	185 (83.3)	198 (74.2)	212 (63.9)
AMP	-	29 (14.7)	8 (4.2)	146 (69.2)	46 (26.7)
LIK	-	0 (0.0)	1 (9.1)	0 (0.0)	3 (14.3)
UMMC	-	-	-	63 (66.3)	89 (62.7)

LKW	-	-	-	11 (25.0)	8 (25.8)
BM	-	-	-	0 (0.0)	0 (0.0)
SLR	-	-	-	2 (3.4)	0 (0.0)
PD	-	-	-	7 (26.9)	19 (50.0)
KKR	-	-	-	8 (38.1)	24 (42.9)
SGT	-	-	-	1 (3.8)	3 (10.0)
TM	-	-	-	0 (0.0)	1 (3.7)
KEM	-	-	-	3 (33.3)	6 (40.0)
KLP	-	-	-	-	1 (10.0)
LAB	-	-	-	5 (16.7)	0 (0.0)
KEN	-	-	-	0 (0.0)	1 (9.1)
BIN	-	-	-	6 (16.7)	6 (18.2)
LD	-	-	-	2 (4.2)	2 (4.3)
Total	**1007 (21.8)**	**1591 (29.6)**	**1778 (30.8)**	**2359 (36.9)**	**2388 (35.1)**

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 35% of deaths in ICU. There was a wide variability of this practice ranging from 0% (SLR, BM, SJMC, KGR, PJY) to 80.4% (KL).

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

Table 30 : Incidence of ventilator-associated pneumonia, by individual hospital 2008 – 2013

Hospital	VAP per 1000 ventilator days					
	2008	2009	2010	2011	2012	2013
AS	0.68	4.4	9.6	7.5	3.0	1.3
PP	18.6	10.8	12.9	10.1	6.9	4.2
IPH	2.9	22.1	12.3	3.7	7.2	8.8
KL	18.9	12.3	15.2	13.6	13.5	7.5
SLG	32.9	21.4	13.5	8.4	4.6	5.6
KLG	9.5	4.4	3.5	3.8	3.6	9.2
SBN	6.1	7.3	8.7	4.4	2.4	3.4
MLK	11.9	2.8	8.5	9.1	7.0	1.6
JB	13.2	5.5	9.0	5.4	4.3	0.9
KTN	5.4	3.4	3.3	1.6	2.7	1.2
KT	8.2	1.6	8.7	4.1	7.2	2.9
KB	3.5	3.4	4.1	5.6	9.2	7.5
KCH	15.2	10.7	5.0	2.4	6.3	0.0
KK	2.1	-	0.4	-	0.8	2.4
SP	33.1	39.5	23.4	23.6	8.3	4.3
PJY	16.8	18.3	14.4	9.3	3.8	8.6
MUR	4.0	7.1	4.9	1.7	0.6	0.7
TI	4.7	5.4	8.8	1.4	2.0	0.0
TPG	21.7	28.8	3.0	0.6	1.1	0.0
SJ	58.3	28.4	14.7	5.4	3.5	3.3
KJG	22.8	15.7	10.9	6.0	10.3	14.3
KGR	20.4	6.0	10.8	8.7	21.0	11.8
TML	2.9	2.6	4.0	0.5	0	1.6
KP	21.2	4.1	2.2	0.7	0.8	1.9
SMJ	25.5	28.7	37.3	3.2	2.9	0.0
BP	3.6	1.6	2.3	0.7	1.7	0.6
TW	0.0	3.2	8.7	4.3	8.3	8.9
MRI	8.8	10.5	2.8	1.8	3.2	3.5
KLM	21.8	18.8	36.7	24.7	28.3	8.6
SDG	11.4	21.7	13.5	13.4	9.3	7.7
SB	-	-	7.7	10.4	11.3	6.2
DKS	-	-	7.0	0.4	1.6	0.0
SI	-	-	11.1	12.5	16.6	8.3
SBL	-	-	22.7	9.9	7.1	7.6
AMP	-	-	18.4	33.0	35.0	14.5
LIK	-	-	0.0	0.0	4.1	0.0
LKW	-	-	-	-	16.2	0.0
BM	-	-	-	-	-	0.7
SLR	-	-	-	-	24.9	13.3
PD	-	-	-	-	17.5	3.0
KKR	-	-	-	-	9.5	22.2
SGT	-	-	-	-	16.8	5.1
TM	-	-	-	-	-	0.0

KEM	-	-	-	-	-	0.0
KLP	-	-	-	-	-	0.0
LAB	-	-	-	-	3.6	2.0
KEN	-	-	-	-	-	2.3
BIN	-	-	-	-	22.4	11.2
LD	-	-	-	-	3.2	
MOH hospitals	**13.5**	**11.6**	**10.1**	**6.8**	**7.2**	**5.4**
SJMC	**4.4**	**0.0**	**3.4**	**8.0**	**0**	**8.4**
UMMC					**8.5**	**6.0**

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 2009 – 2013

Hospital	Interval from initiation of ventilation to VAP Mean (Median) days				
	2009	2010	2011	2012	2013
AS	9.1	7.6	7.9	11.0 (9.0)	19.6 (15.0)
PP	13.1	10.0	11.0	11.2 (7.8)	14.0 (13.2)
IPH	5.9	4.3	7.7	9.1 (7.7)	7.1 (5.7)
KL	9.7	11.2	11.8	10.3 (8.9)	13.3 (11.0)
SLG	8.0	11.9	11.2	11.4 (8.0)	12.0 (11.5)
KLG	10.5	14.0	11.0	12.9 (12.0)	7.3 (5.8)
SBN	9.7	10.1	15.4	7.7 (8.3)	15.2 (7.3)
MLK	10.7	7.8	7.2	7.8 (5.5)	20.0 (8.6)
JB	9.4	8.8	8.4	10.5 (5.7)	9.3 (6.5)
KTN	11.6	7.0	9.5	11.5 (10.9)	11.8 (6.6)
KT	10.7	7.2	8.6	10.9 (10.0)	11.7 (11.2)
KB	12.3	9.1	11.9	13.6 (11.3)	12.0 (10.7)
KCH	6.5	11.5	11.4	9.3 (6.6)	12.6 (12.1)
KK	-	11.2	*	7.7 (7.1)	10.0 (7.3)
SP	7.3	7.2	7.0	6.5 (6.5)	9.6 (7.9)
PJY	10.7	9.9	13.9	12.3 (10.9)	8.1 (7.7)
MUR	13.0	10.3	12.2	-	-
TI	10.1	25.0	19.5	16.8 (16.8)	12.2 (12.2)
TPG	8.1	7.9	9.6	16.3 (13.1)	-
SJ	6.5	6.5	9.3	12.0 (10.3)	14.6 (7.9)
KJG	12.7	6.4	6.2	7.6 (6.7)	7.9 (6.6)
KGR	8.5	7.2	3.9	9.6 (7.2)	9.1 (7.4)
SJMC	-	2.0	5.4	-	3.9 (3.9)
TML	6.9	10.3	9.0	-	6.8 (6.8)
KP	9.7	6.5	20.3	21.3 (21.3)	5.1 (5.1)
SMJ	6.0	5.7	13.2	12.6 (12.6)	3.7 (3.7)

BP	9.7	21.5	7.1	32.0 (32.0)	10.1 (10.1)
TW	4.8	6.1	10.1	5.6 (4.1)	5.7 (4.2)
MRI	15.2	8.9	4.0	6.8 (6.8)	12.9 (7.5)
KLM	7.3	5.9	7.6	6.4 (4.6)	7.6 (8.0)
SDG	8.5	6.6	7.9	12.4 (12.1)	9.6 (8.2)
SB	-	7.8	6.0	10.6 (7.2)	9.1 (8.6)
DKS	-	7.7	7.1	7.0 (5.5)	6.6 (5.6)
SI	-	12.8	12.1	11.5 (10.0)	9.7 (7.5)
SBL	-	9.1	10.7	9.6 (7.8)	7.9 (6.3)
AMP	-	7.1	8.5	6.5 (5.3)	8.6 (7.9)
LIK	-	-	-	3.0 (3.0)	-
UMMC	-	-	-	15.2 (10.8)	8.2 (7.8)
LKW	-	-	-	6.0 (4.4)	9.4 (3.9)
BM	-	-	-	2.2 (2.2)	-
SLR	-	-	-	8.5 (5.9)	10.0 (7.8)
PD	-	-	-	9.5 (9.5)	11.5 (11.5)
KKR	-	-	-	8.8 (9.5)	13.3 (9.4)
SGT	-	-	-	10.0 (7.3)	6.3 (6.3)
TM	-	-	-	-	6.4 (6.5)
KEM	-	-	-	-	-
KLP	-	-	-	-	-
LAB	-	-	-	10.1 (10.1)	15.9 (15.9)
KEN	-	-	-	-	-
BIN	-	-	-	12.2 (11.2)	8.5 (9.2)
LD	-	-	-	10.5 (10.5)	7.6 (5.6)
Total	**8.7**	**8.8**	**9.7**	**10.1 (7.8)**	**10.0 (7.9)**

Figure 19 : VAP per 1000 ventilator days 2004 – 2013

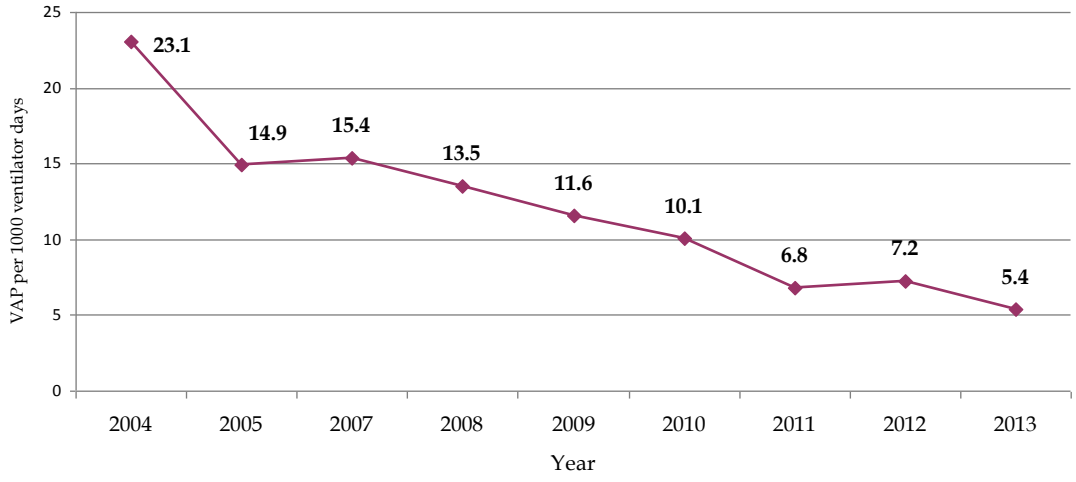


Figure 20 : VAP per 1000 ventilator days, by individual hospital 2013

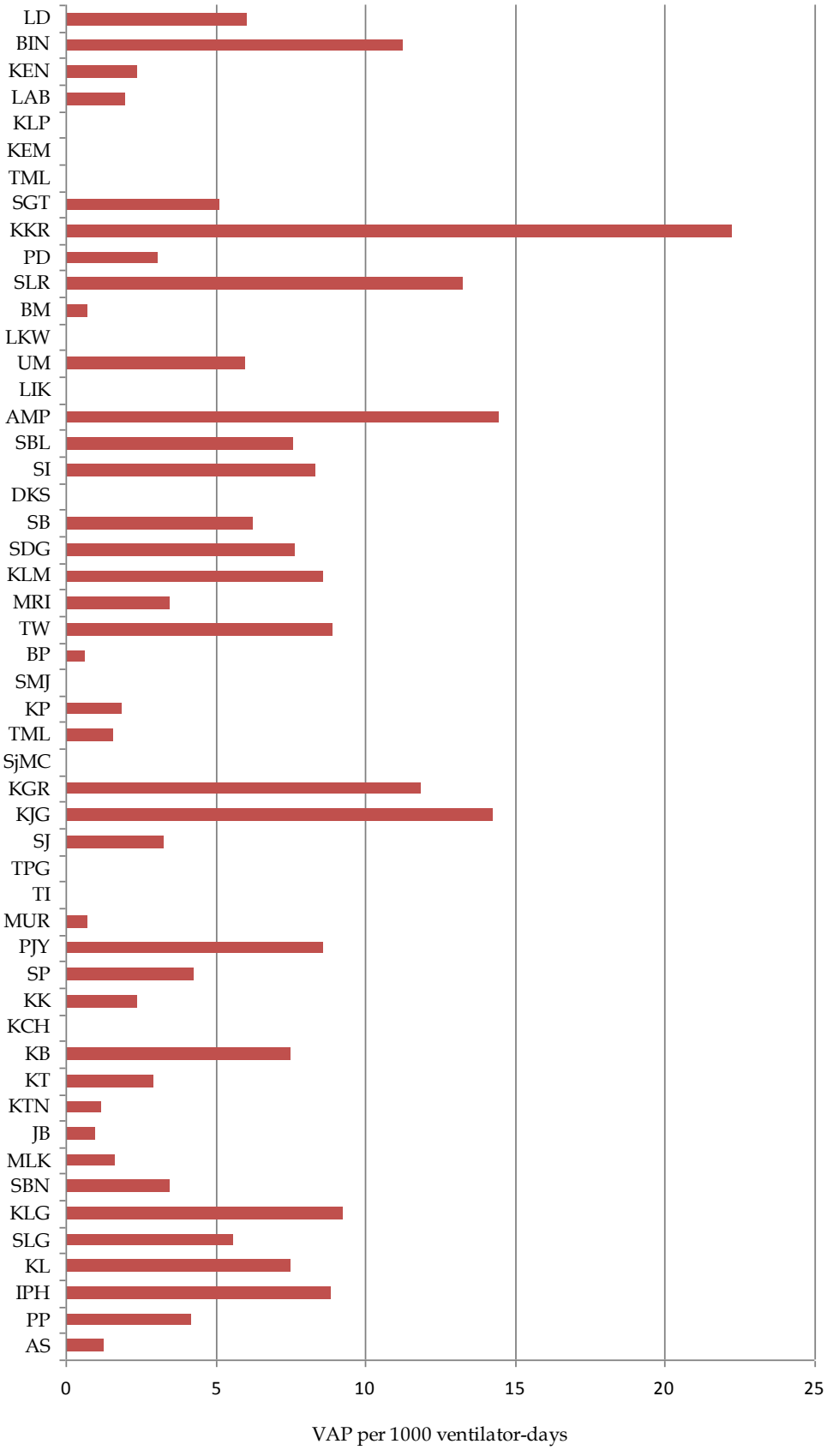


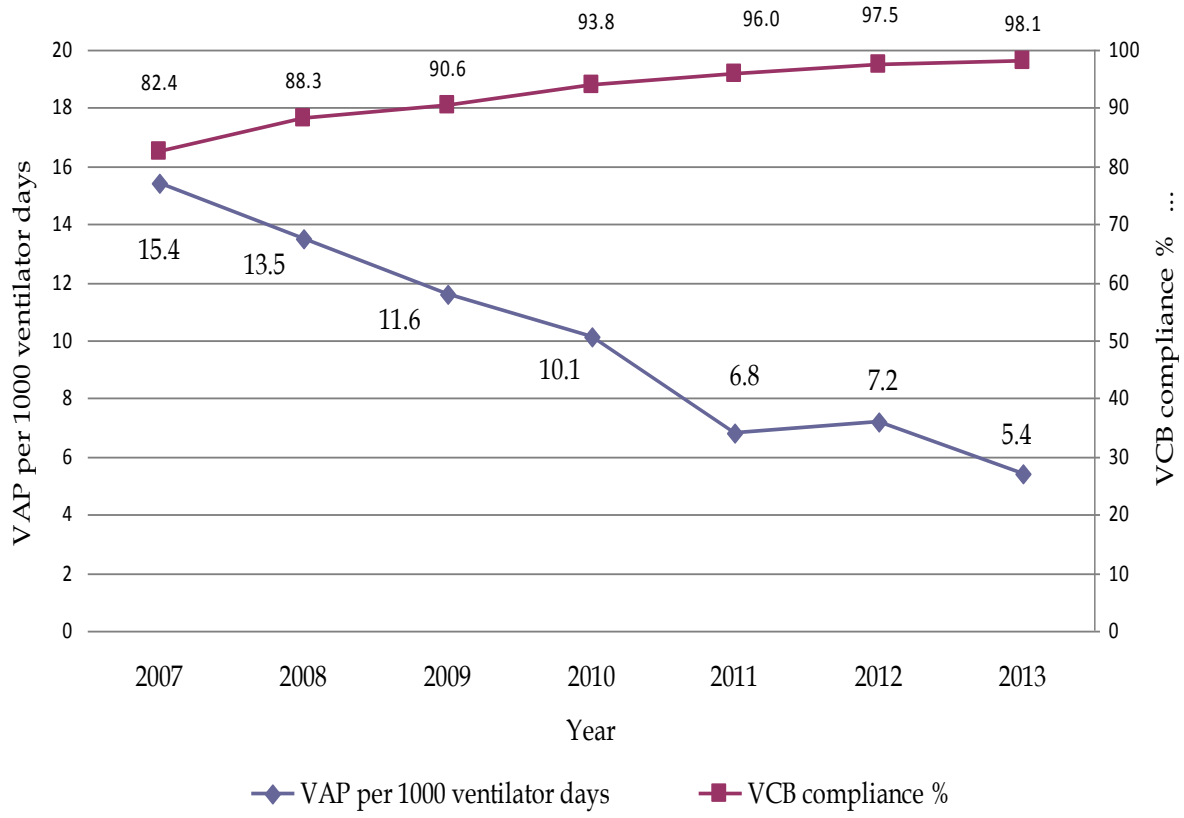
Table 32 : Ventilator Care Bundle Compliance 2010 - 2013

Hospital	% Compliance Year			
	2010	2011	2012	2013
AS	91.75	95.85	97.6	100.0
PP	99.05	94.79	92.8	93.5
IPH	97.67	98.65	98.5	97.8
KL	90.93	94.70	96.6	96.2
SLG	88.18	96.38	96.8	96.1
KLG	89.14	94.46	95.3	97.4
SBN	100.00	100.00	99.4	100.0
MLK	-	98.36	100	99.3
JB	99.30	98.97	99.2	99.5
KTN	96.57	98.13	98.4	100.0
KT	100.00	98.71	97.9	100.0
KB	99.13	100.00	100	100.0
KCH	85.14	92.08	97.2	96.1
KK	76.79	72.41	100	98.5
SP	98.13	100.00	100	100.0
PJY	100.00	100.00	100	100.0
MUR	98.29	100.00	100	99.1
TI	92.15	91.04	100	100.0
TPG	94.57	98.11	98.4	97.9
SJ	97.05	98.70	100	100.0
KJG	96.96	100.00	100	100.0
KGR	96.49	100.00	100	100.0
TML	90.95	97.60	97.2	99.0
KP	90.24	95.31	98.1	100.0
SMJ	-	96.15	98.5	100.0
BP	96.52	95.31	96.7	99.5
TW	100.00	94.44	100	100.0
MRI	96.90	87.61	100	100.0
KLM	90.00	86.77	93.9	94.7
SDG	86.25	96.04	100	100.0
SB	-	-	95.9	97.2
DKS	-	-	100	100.0
SI	-	-	91.3	92.9
SBL	-	-	99.8	100.0
AMP	-	-	95.0	94.4
LIK	-	-	100	100.0
UMMC				100.0
LKW	-	-	74.2	90.4
BM	-	-	100	100.0
SLR	-	-	92.0	89.4

PD	-	-	100	100.0
KKR	-	-	100	100.0
SGT	-	-	100	91.7
TM				100.0
KEM	-	-	100	100.0
LAB	-	-	100	100.0
KEN	-	-	100	100.0
BIN	-	-	97.6	95.7
LD	-	-	100	98.8
Total	**94.13**	**96.00**	**97.5**	**98.2**

The overall VCB compliance rate for 2013 was 98.2%. 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 21 : VCB compliance and VAP 2007 – 2013



National Healthcare Safety Network (NHSN) report, data summary for 2012							
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

The incidence of VAP had decreased by more than half, from 15.4 per 1000 ventilator days in 2007 to 5.4 per 1000 ventilator days in 2013.

The mean rate of VAP (5.4 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 was 0.70, which is more than two times higher than the ICUs in US.

The onset of VAP was 10.0 days from the initiation of invasive ventilation. Onset of VAP in all centres (except SJMC, SMJ) exceeded 5 days of ventilation, indicating that VAPs in MOH and UMMC ICUs were mostly of late onset.

Table 33 : Bacteriological cultures in VAP, by category of ICU 2013

Organisms	ICUs				
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	UMMC n (%)	Total n (%)
Acinetobacter spp.	151 (45.9)	91 (43.8)	67 (46.2)	6 (42.9)	**315 (45.3)**
MRO	128 (84.8)	81 (89.0)	46 (68.7)	6 (100.0)	**261 (82.9)**
Non-MRO	23 (15.2)	10 (11.0)	21 (31.3)	0 (0)	**54 (17.1)**
Pseudomonas aeruoginosa	57 (17.3)	38 (18.3)	23 (15.9)	2 (14.3)	**120 (17.2)**
MRO	19 (33.3)	4 (10.5)	2 (8.7)	0 (0.0)	**25 (20.8)**
Non-MRO	38 (66.7)	34 (89.5)	21 (91.3)	2 (100.0)	**95 (79.2)**
Klebsiella spp.	65 (19.8)	46 (22.1)	35 (24.1)	3 (21.4)	**149 (21.4)**
ESBL	38 (58.5)	28 (60.9)	19 (54.3)	0 (0.0)	**85 (57.0)**
Non-ESBL	27 (41.5)	18 (39.1)	16 (45.7)	3 (100.0)	**64 (43.0)**
MRSA	19 (5.8)	5 (2.4)	6 (4.1)	1 (7.1)	**31 (4.5)**
MSSA	7 (2.1)	2 (1.0)	1 (0.7)	1 (7.1)	**11 (1.6)**
Stenotrophomonas maltophilia	9 (2.7)	7 (3.4)	1 (0.7)	0 (0.0)	**17 (2.4)**
Coagulase negative *Staphylococcus*	2 (0.6)	0 (0)	2 (1.4)	0 (0.0)	**4 (0.6)**
Other gram negative bacteria	3 (0.9)	0 (0)	2 (1.4)	1 (7.1)	**6 (0.9)**
Fungal	1 (0.3)	5 (2.4)	3 (2.1)	0 (0.0)	**9 (1.3)**
Others	15 (4.6)	14 (6.7)	5 (3.4)	0 (0.0)	**34 (4.9)**
Total	**329 (100.0)**	**208 (100.0)**	**145 (100.0)**	**14 (100.0)**	**696 (100.0)**

MRSA : Methicillin-resistant *Staphylococcus aureus*
MSSA : Methicillin-sensitive *Staphylococcus aureus*

Figure 22 : Bacteriological cultures in VAP 2013

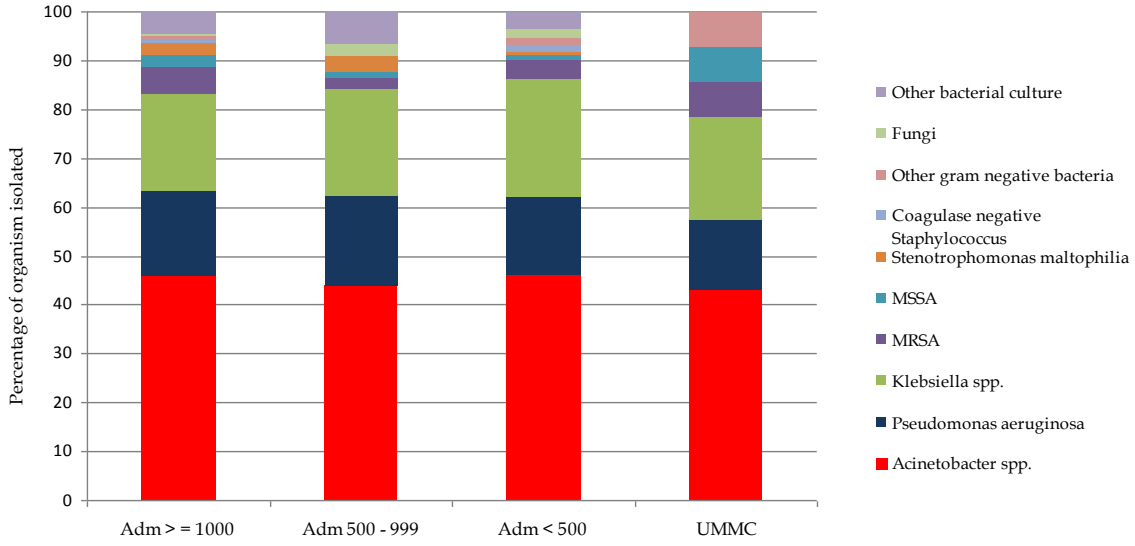
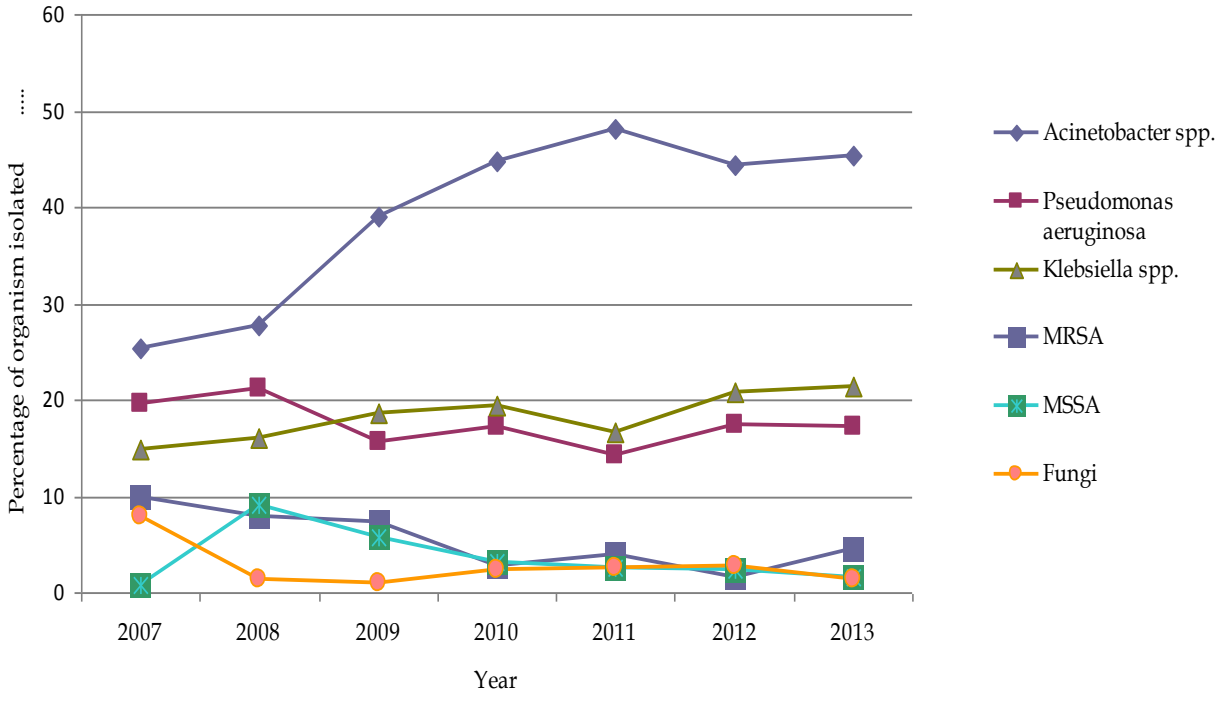


Table 34 : Bacteriological cultures in VAP 2008 – 2013

Organisms	2008 n (%)	2009 n (%)	2010 n (%)	2011 n (%)	2012 n (%)	2013 n (%)
Acinetobacter spp.	219 (27.7)	267 (39.0)	350 (44.8)	377 (48.2)	351 (44.4)	315 (45.3)
Klebsiella spp.	127 (16.0)	128 (18.7)	152 (19.5)	131 (16.7)	165 (20.8)	149 (21.4)
Pseudomonas aeruginosa	168 (21.2)	107 (15.6)	135 (17.3)	112 (14.3)	139 (17.5)	120 (17.2)
MRSA	63 (8.0)	50 (7.3)	22 (2.8)	31 (3.9)	12 (1.5)	31 (4.5)
MSSA	73 (9.2)	39 (5.7)	24 (3.1)	21 (2.6)	19 (2.4)	11 (1.6)
Stenotrophomonas maltophilia	25 (3.2)	20 (2.9)	20 (2.6)	19 (2.4)	20 (2.5)	17 (2.4)
Other gram negative bacteria	16 (2.0)	7 (1.0)	10 (1.3)	17 (2.1)	16 (2.0)	6 (0.9)
Fungi	11 (1.4)	6 (0.9)	19 (2.4)	21 (2.6)	22 (2.7)	9 (1.3)
Coagulase negative *Staphylococcus*	16 (2.0)	-	11 (1.4)	13 (1.6)	10 (1.2)	4 (0.6)
Others	73 (9.2)	60 (8.8)	38 (4.9)	40 (5.1)	36 (4.5)	34 (4.9)

Figure 23 : Common bacteriological cultures in VAP 2007 – 2013



For MOH ICUs in 2013, gram-negative organisms accounted for more than three quarter (87.2%) of the causative organisms in VAP. Over the last 7 years, the most common organisms were *Acinetobacter spp.*, *Klebsiella spp.* and *Pseudomonas aeruginosa* *Acinetobacter spp*. was the leading causative organism in VAP, accounting for 45.3% of all organisms in 2013.

Fifty eight percent of the causative organisms in VAP in MOH ICUs were of multi-drug resistant strains. *Acinetobacter spp*, *Klebsiella spp* and *Pseudomonas aeuroginosa* constituted

82.5%, 58.2% and 21.2% of multi-drug resistant strains respectively. Methicillin-resistant *Staphyloccus aureus* accounted for 75.0% of all *Staphyloccus aureus* isolated.

In UMMC, gram-negative organisms accounted for 85.7% of all causative organisms in VAP. Fifty 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 were methicillin-resistant.

Table 35: Extra length of mechanical ventilation, ICU stay and Crude in-hospital mortality in patients with VAP 2013

Extra length of mechanical ventilation	15.1 days, RR 1.12 (95% CI 1.11-1.13)
Extra length of ICU stay	18.3 days, RR 1.11 (95% CI 1.10-1.12)
Extra crude mortality	26%, RR 1.54 (95% CI 1.43-1.68)

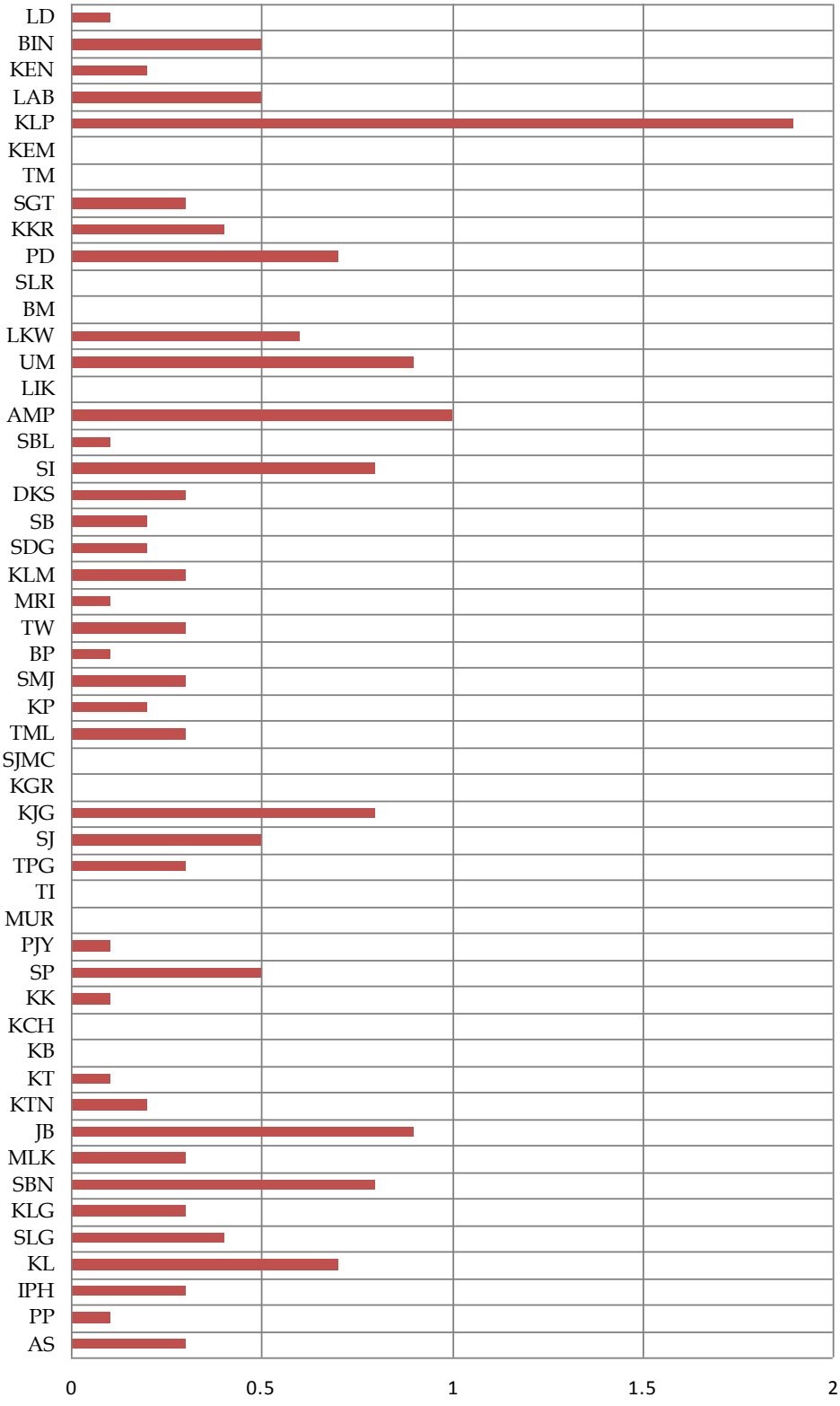
Patients with VAP stay longer on the ventilator for an additional 15 days. Their ICU stay was prolonged by an average of 18 days. They also had an excess mortality of 26%.

Table 36 : Unplanned extubation per 100 intubated days, by individual hospital 2009 – 2013

Hospital	Unplanned extubation per 100 intubated days				
	2009	2010	2011	2012	2013
AS	0.5	0.4	0.3	0.3	0.3
PP	0.2	0.3	0.2	0.3	0.1
IPH	0.9	0.4	0.4	0.3	0.3
KL	1.4	1.4	1.0	0.6	0.7
SLG	1.3	0.8	0.6	0.3	0.4
KLG	0.2	0.3	0.2	0.1	0.3
SBN	0.7	0.6	0.8	0.5	0.8
MLK	0.8	0.5	0.8	0.5	0.3
JB	1.8	0.9	1.2	0.7	0.9
KTN	0.1	0.6	0.1	0.0	0.2
KT	0.1	0.6	0.6	0.3	0.1
KB	0.0	0.2	0.1	0.1	0.0
KCH	0.1	0.2	0.1	0.1	0.0
KK	0.1	0.2	0.2	0.1	0.1
SP	0.3	0.4	0.5	0.0	0.5
PJY	0.0	0.5	0.1	0.2	0.1
MUR	0.1	0.2	0.0	0.0	0.1
TI	1.3	0.9	0.2	0.0	0.0
TPG	0.4	0.4	0.5	0.3	0.3
SJ	0.5	0.5	0.4	0.2	0.5
KJG	0.2	0.7	0.0	0.0	0.8
KGR	0.0	0.3	0.0	0.1	0.0
TML	0.0	0.4	0.2	0.5	0.3
KP	0.0	0.6	0.3	0.3	0.2
SMJ	0.0	0.2	0.0	0.0	0.3
BP	0.2	0.2	0.1	0.2	0.1
TW	0.0	0.2	0.0	0.5	0.3
MRI	0.0	0.3	0.1	0.0	0.1
KLM	0.5	1.0	0.6	0.6	0.3
SDG	0.4	0.3	0.4	0.4	0.2
SB	-	0.3	0.1	0.0	0.2
DKS	-	0.2	0.0	0.0	0.3
SI	-	0.5	0.4	0.7	0.8
SBL	-	0.2	0.0	0.0	0.1
AMP	-	0.7	1.0	0.9	1.0
LIK	-	0.0	0.0	0.3	0.0
LKW				0.8	0.6
BM				0.0	0.0

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

Figure 24 : Unplanned extubation, by individual hospital 2013



The rate of unplanned extubation has decreased over the past 5 years with a rate of 0.3 per 100 intubated days in 2013.

Table 37 : Pressure ulcer, by individual hospital 2009 – 2013

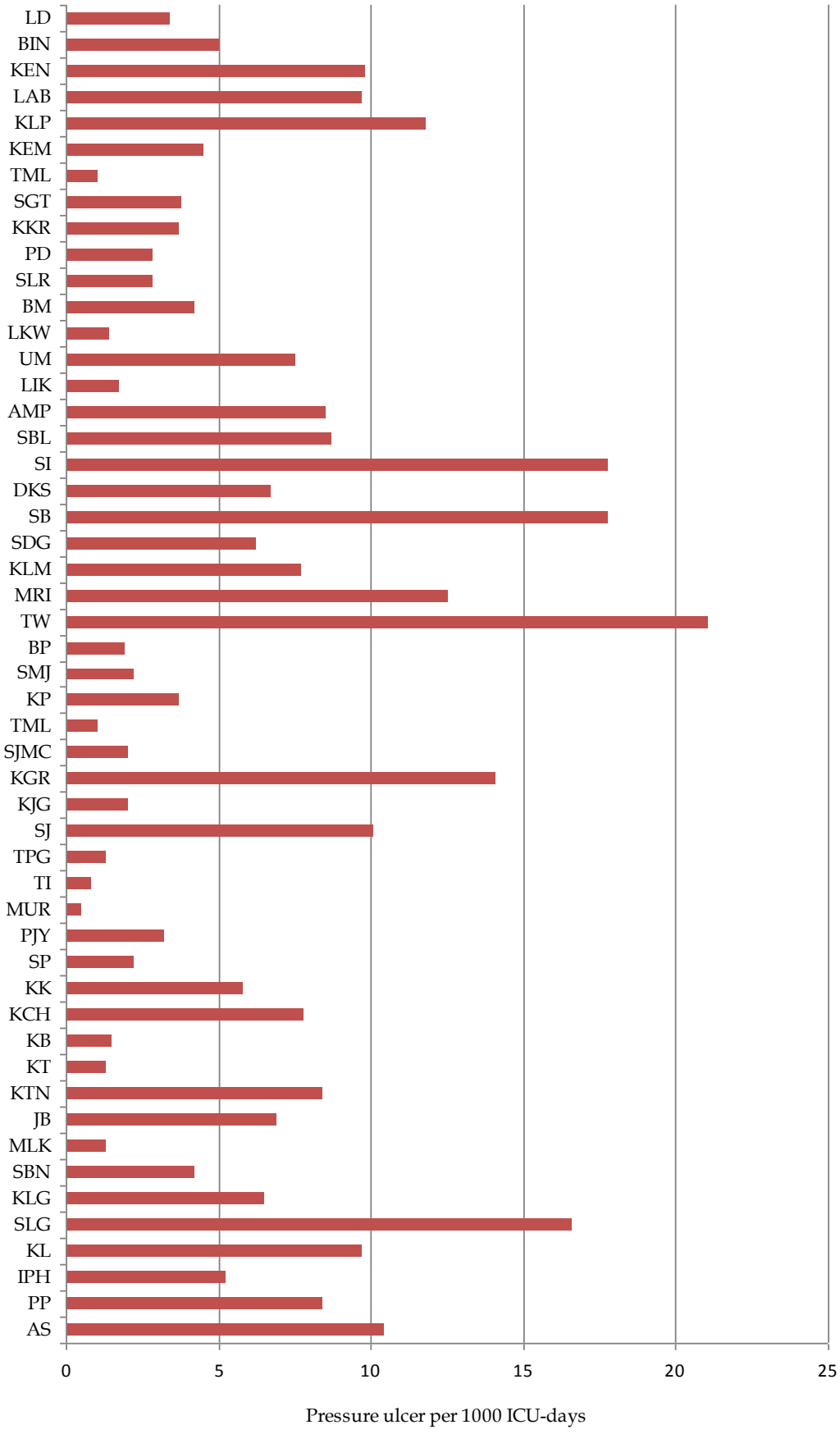
Hospital	Pressure ulcer per 1000 ICU days				
	2009	2010	2011	2012	2013
AS	4.6	14.9	15.2	8.6	10.4
PP	14.0	6.6	3.4	6.0	8.4
IPH	0.4	9.0	6.4	8.0	5.2
KL	31.6	8.3	7.9	7.1	9.7
SLG	15.3	13.5	14.4	11.3	16.6
KLG	1.3	2.4	5.6	6.1	6.5
SBN	3.7	2.6	1.1	2.8	4.2
MLK	7.6	4.5	3.8	2.5	1.3
JB	13.0	8.2	6.9	6.7	6.9
KTN	1.4	1.8	0.8	4.2	8.4
KT	0.3	4.3	2.5	1.8	1.3
KB	5.1	3.0	3.2	3.4	1.5
KCH	1.6	10.9	5.0	5.1	7.8
KK	0.0	5.2	5.1	9.8	5.8
SP	2.0	3.2	2.7	3.2	2.2
PJY	0.6	2.2	1.7	4.2	3.2
MUR	2.9	0.4	1.3	0.9	0.5
TI	0.0	3.5	1.6	1.3	0.8
TPG	10.5	9.7	5.4	1.6	1.3
SJ	6.6	9.1	3.2	2.8	10.1
KJG	5.4	10.6	14.5	5.9	2.0
KGR	1.6	4.1	2.9	13.4	14.1
TML	0.0	1.0	0.7	2.4	1.0
KP	6.2	6.1	5.7	11.2	3.7
SMJ	1.1	0.0	0.0	0.0	2.2
BP	3.5	14.7	10.1	3.9	1.9
TW	9.0	4.1	11.2	15.9	21.1
MRI	18.3	2.5	12.2	5.7	12.5
KLM	3.5	8.1	11.0	13.0	7.7
SDG	7.1	8.7	4.5	3.0	6.2
SB	-	9.2	9.3	10.0	17.8
DKS	-	7.2	0.0	2.1	6.7
SI	-	8.1	9.7	13.5	10.7
SBL	-	5.6	2.2	8.4	8.7
AMP	-	6.0	7.2	7.4	8.5
LIK	-	0.0	1.0	5.8	1.7
LKW	-	-	-	15.0	1.4
BM	-	-	-	3.7	4.2
SLR	-	-	-	2.7	2.8
PD	-	-	-	9.8	2.8
KKR	-	-	-	6.5	3.7

SGT	-	-	-	8.5	3.8
TM	-	-	-	0.0	4.1
KEM	-	-	-	2.5	2.0
KLP	-	-	-	0.0	11.8
LAB	-	-	-	10.4	9.7
KEN	-	-	-	0.0	4.5
BIN	-	-	-	1.9	5.0
LD	-	-	-	4.5	3.4
Total MOH					**6.5**
UMMC	-	-	-	27.0	7.5
SJMC	1.0	4.3	6.8	6.9	2.0
Total	**7.7**	**6.6**	**5.8**	**6.8**	**6.6**

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 0.5 to 21.1 per 1000 ICU days with a mean of 6.6.

Fig 25 : Pressure ulcers, by individual hospital 2013



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 37: 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

Hospitals	Central Venous Catheter utilisation ratio	CVC care bundle compliance	Incidence of CVC-BSI per 1000 catheter days
AS	0.46	100.0	0.0
PP	0.80	100.0	2.6
IPH	0.48	95.7	0.3
KL	0.49	100.0	1.5
SLG	0.91	90.8	0.0
KLG	0.27	100.0	0.0
SBN	0.42	99.5	0.9
MLK	0.62	99.1	0.0
JB	0.32	96.3	16.4
KTN	1.23	100.0	0.0
KT	0.54	100.0	0.3

KB	0.73	100.0	0.4
KCH	0.78	100.0	0.0
KK	0.71	95.1	0.2
SP	1.54	100.0	0.0
PJY	0.71	100.0	0.7
MUR	0.36	100.0	0.0
TI	0.75	100.0	0.0
TPG	0.53	100.0	0.0
SJ	0.77	100.0	0.0
KJG	0.34	100.0	0.0
KGR	0.80	100.0	0.0
TML	0.95	100.0	0.4
KP	0.61	100.0	0.0
SMJ	0.54	100.0	2.7
BP	0.46	91.1	2.1
TW	0.53	86.8	0.0
MRI	0.33	100.0	0.0
KLM	0.93	95.5	0.0
SDG	0.41	100.0	0.0
SB	0.89	92.9	0.0
DKS	0.58	100.0	0.0
SI	0.80	97.1	0.0
SBL	0.87	100.0	0.4
AMP	0.92	82.4	0.0
LIK	0.36	100.0	0.0
LKW	0.73	100.0	0.0
BM	0.80	93.1	0.0
SLR	1.00	100.0	0.0
PD	0.31	100.0	0.0
KKR	0.59	99.1	1.2
SGT	0.85	85.0	2.2
TM	0.64	77.6	0.0
KEM	0.16	100.0	0.0
KLP	0.72	100.0	0.0
LAB	0.50	100.0	0.0
KEN	0.08	100.0	0.0
BIN	0.60	100.0	0.0
LD	0.70	100.0	0.0
MOH Hospitals	**0.64**	**97.5**	**0.8**
SJMC	NA	NA	NA
UMMC	0.39	100.0	0.0

National Healthcare Safety Network (NHSN) report, data summary for 2012							
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	0.48	0.9	0.0	0.0	0.7	1.4	2.2
Mixed medical/ surgical ≤ 15 beds	0.35	0.9	0.0	0.0	0.0	1.2	2.6
Neurosurgical	0.44	1.1	0.0	0.0	0.9	1.9	2.8
Surgical	0.54	0.9	0.0	0.0	0.7	1.5	2.5
Trauma	0.54	1.6	0.0	0.5	1.3	2.4	3.9

Table 39 : Bacteriological cultures in CVC-BSI, 2013

Organisms	Total n (%)
Acinetobacter spp.	**12**
MRO	**5**
Non-MRO	
Not known	**7**
Pseudomonas aeruginosa	**15**
MRO	
Non-MRO	**6**
Not known	**9**
Klebsiella spp.	**25**
MRO	**8**
Non- MRO	
Not known	**17**
Stenotrophomonas maltophilia	**3**
Other gram negative bacteria	**5**
MRO	**2**
Non-MRO	
Not Known	**3**
Staphylococcus aureus	
Methicillin resistant (MRSA)	**7**
Coagulase negative *Staphylococcus*	**3**
Methicillin resistant	**2**
Not known	**1**
Fungal	**3**
Total	**73 (100.0)**

The mean compliance rate to CVC care bundle was 97.5%. The incidence of CVC-BSI was 0.8 per 1000 catheter days and it was lower when benchmarked with that of US National Healthcare Safety Network (NHSN) [12]; as shown in the table above. However, there was a high possibility of under diagnosis and under reporting in many units.

The pooled catheter utilization ratio was 0.64, which was higher than the benchmark. The incidence of CRBSI varies considerably by type of catheter, frequency of catheter manipulation, and patient-related factors, such as underlying disease and severity of illness. 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 predominant microorganisms isolated from these infections in 2013 for MOH ICUs were gram negative (82.2%). The predominant organisms isolated were *Klebsiella pneumonia* followed by *Pseudomonas aeruginosa* and *Acinetobacter sp*.

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. 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].

SECTION E:

MORTALITY OUTCOMES

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 40 : ICU outcome, by category of ICU 2013

ICU outcome	ICUs					
	Adm ≥ 1000 n (%)	**Adm 500 - 999 n (%)**	**Adm < 500 n (%)**	**Private n (%)**	**UMMC n (%)**	**Total n (%)**
Alive	15665 80.1%	6685 77.7%	5341 75.7%	1293 96.9%	728 82.6%	**29712** **79.4%**
Died	3470 17.7%	1732 20.1%	1429 20.3%	31 2.3%	142 16.1%	**6804** **18.2%**
Discharged with grave prognosis	210 1.1%	71 0.8%	95 1.3%	1 0.1%	7 0.8%	**384** **1.0%**
Transfer to another hospital	216 1.1%	114 1.3%	190 2.7%	10 0.7%	4 0.5%	**534** **1.4%**
Total	**19561** **100%**	**8602** **100%**	**7055** **100%**	**1335** **100%**	**881** **100%**	**37434** **100%**

Table 41 : Hospital outcome, by category of ICU 2013

Hospital outcome	ICUs					
	Adm ≥ 1000 n (%)	**Adm 500 - 999 n (%)**	**Adm < 500 n (%)**	**Private n (%)**	**UMMC n (%)**	**Total n (%)**
Alive	13315 68.1%	6007 69.8%	4666 66.1%	1285 96.3%	660 74.9%	**25933** **69.3%**
Died	4944 25.3%	2290 26.6%	1889 26.8%	39 2.9%	205 23.3%	**9367** **25.0%**
Discharged with grave prognosis	350 1.8%	119 1.4%	171 2.4%	1 0.1%	13 1.5%	**654** **1.7%**
Transfer to another hospital	952 4.9%	186 2.2%	329 4.7%	10 0.7%	3 0.3%	**1480** **4.0%**
Total	**19561** **100.0%**	**8602** **100.0%**	**7055** **100.0%**	**1335** **100.0%**	**881** **100.0%**	**37434** **100.0%**

Table 42 : Crude in-ICU and in-hospital mortality rate, by individual hospital 2009 – 2013

Hospital	Crude in-ICU mortality (in-hospital mortality) %				
	2009	2010	2011	2012	2013
AS	39.0 (52.7)	32.1 (43.1)	24.1 (34.4)	26.7 (44.5)	27.3 (37.3)
PP	13.8 (26.6)	12.6 (22.8)	14.4 (23.3)	16.5 (26.9)	15.6 (25.0)
IPH	16.1 (25.7)	21.9 (27.3)	22.4 (30.0)	16.5 (25.5)	18.5 (25.6)
KL	16.1 (28.0)	15.5 (22.0)	17.0 (24.7)	18.4 (27.0)	17.5 (25.8)
SLG	23.6 (30.3)	18.0 (24.5)	17.9 (25.8)	16.5 (27.1)	17.2 (24.5)
KLG	22.4 (30.6)	18.7 (26.3)	17.1 (25.1)	15.5 (22.9)	13.6 (21.7)
SBN	22.9 (34.5)	19.9 (28.8)	21.3 (30.0)	22.1 (30.4)	19.7 (25.7)
MLK	24.6 (32.9)	23.2 (30.8)	23.6 (32.7)	13.5 (32.1)	19.9 (28.2)
JB	21.2 (32.2)	20.3 (27.7)	22.3 (31.4)	21.4 (30.0)	22.2 (29.9)
KTN	20.1 (30.0)	19.4 (28.5)	17.2 (24.3)	24.1 (34.9)	22.2 (32.2)
KT	24.4 (36.6)	21.3 (30.6)	20.9 (27.2)	18.5 (28.1)	22.0 (32.0)
KB	18.3 (24.5)	19.2 (26.8)	17.8 (24.4)	16.0 (22.6)	15.0 (21.3)
KCH	18.7 (23.8)	15.8 (21.1)	22.1 (29.1)	17.4 (24.3)	18.0 (24.0)
KK	19.5 (35.7)	24.6 (33.5)	20.5 (27.3)	21.7 (34.0)	19.5 (25.3)
SP	29.5 (38.7)	33.3 (43.0)	32.6 (42.2)	26.9 (38.4)	23.3 (32.6)
PJY	20.8 (23.1)	19.3 (23.1)	18.4 (21.9)	16.9 (19.3)	19.9 (22.9)
MUR	16.5 (21.9)	18.8 (24.6)	20.9 (29.2)	24.1 (33.8)	20.7 (24.7)
TI	27.0 (41.1)	21.7 (34.1)	22.4 (35.1)	17.7 (31.9)	21.9 (34.6)
TPG	36.2 (49.5)	38.1 (48.4)	27.0 (43.4)	21.4 (35.3)	19.3 (30.1)
SJ	27.8 (42.2)	22.4 (33.6)	25.2 (35.2)	23.2 (35.5)	29.3 (40.2)
KJG	17.9 (31.3)	16.1 (20.7)	19.6 (27.0)	15.0 (23.8)	15.9 (26.8)
KGR	13.6 (23.1)	21.8 (29.6)	18.1 (25.8)	16.3 (22.1)	18.0 (24.5)
TML	20.0 (28.4)	25.6 (32.5)	19.7 (23.0)	14.7 (21.0)	16.0 (22.5)
KP	32.5 (43.5)	41.9 (46.2)	34.3 (47.1)	28.9 (42.4)	28.7 (38.0)
SMJ	40.4 (46.9)	29.9(39.2)	24.5 (33.2)	24.3 (29.6)	27.6 (32.7)
BP	27.5 (38.8)	18.8 (33.0)	21.4 (32.6)	29.8 (40.7)	22.7 (31.0)
TW	20.0 (29.9)	21.8 (30.3)	15.7 (27.0)	13.7 (24.3)	17.8 (29.6)
MRI	23.7 (30.6)	15.9 (24.2)	22.6 (29.6)	18.3 (24.1)	18.7 (22.0)
KLM	28.5 (35.2)	29.7 (37.6)	30.9 (40.2)	21.0 (32.5)	25.8 (39.0)
SDG	17.5 (24.3)	17.5 (23.5)	18.0 (22.9)	17.7 (25.9)	18.3 (26.3)
SB	-	23.4 (28.9)	24.3 (31.8)	22.8 (30.2)	24.9 (39.5)
DKS	-	48.0 (59.3)	27.8 (30.2)	25.5 (26.8)	26.9 (31.3)
SI	-	26.8 (31.7)	22.1 (28.7)	24.6 (28.6)	21.2 (26.5)
SBL	-	16.0 (23.3)	18.0 (28.5)	17.2 (25.2)	18.6 (26.9)
AMP	-	37.1 (41.8)	35.1 (43.9)	37.9 (47.8)	31.1 (42.1)
LIK	-	1.9 (1.9)	2.9 (3.7)	5.6 (6.5)	4.1 (6.0)
LKW	-	-	-	28.6 (36.2)	17.8 (22.3)
BM	-	-	-	13.2 (21.1)	29.8 (34.8)
SLR	-	-	-	42.8 (52.6)	27.6 (31.1)
PD	-	-	-	14.6 (18.4)	15.9 (23.0)

KKR	-	-	-	15.0 (24.4)	23.7 (28.7)
SGT	-	-	-	24.5 (30.4)	21.4 (34.5)
TM	-	-	-	5.9 (11.8)	23.7 (24.4)
KEM	-	-	-	9.9 (12.6)	15.3 (17.1)
KLP	-	-	-	0 (0)	8.6 (11.2)
LAB	-	-	-	29.7 (34.3)	35.7 (40.0)
KEN	-	-	-	11.4 (20.0)	6.8 (12.4)
BIN	-	-	-	17.8 (27.7)	12.7 (17.7)
LD	-	-	-	29.8 (38.1)	23.0 (35.3)
MOH Hospitals	**21.2 (29.7)**	**20.9 (28.1)**	**21.2 (29.5)**	**19.4 (27.9)**	**19.9 (27.7)**
SJMC	3.5 (4.1)	4.2 (4.6)	4.3 (4.8)	4.3 (4.9)	2.4 (3.0)
UMMC	**-**	**-**	**-**	20.3 (31.8)	16.7 (24.8)

The overall in-ICU and in-hospital mortality rates for MOH hospitals in 2013 were 19.9% and 27.7% respectively. UMMC had lower in-ICU and in-hospital mortality rates of 16.7% and 4.8%respectively.SJMC had a very low in-ICU and in-hospital mortality rates of 2.4 and 3.0 respectively.

Figure 26: Crude In-ICU and In-hospital mortality rates, by individual hospital 2013

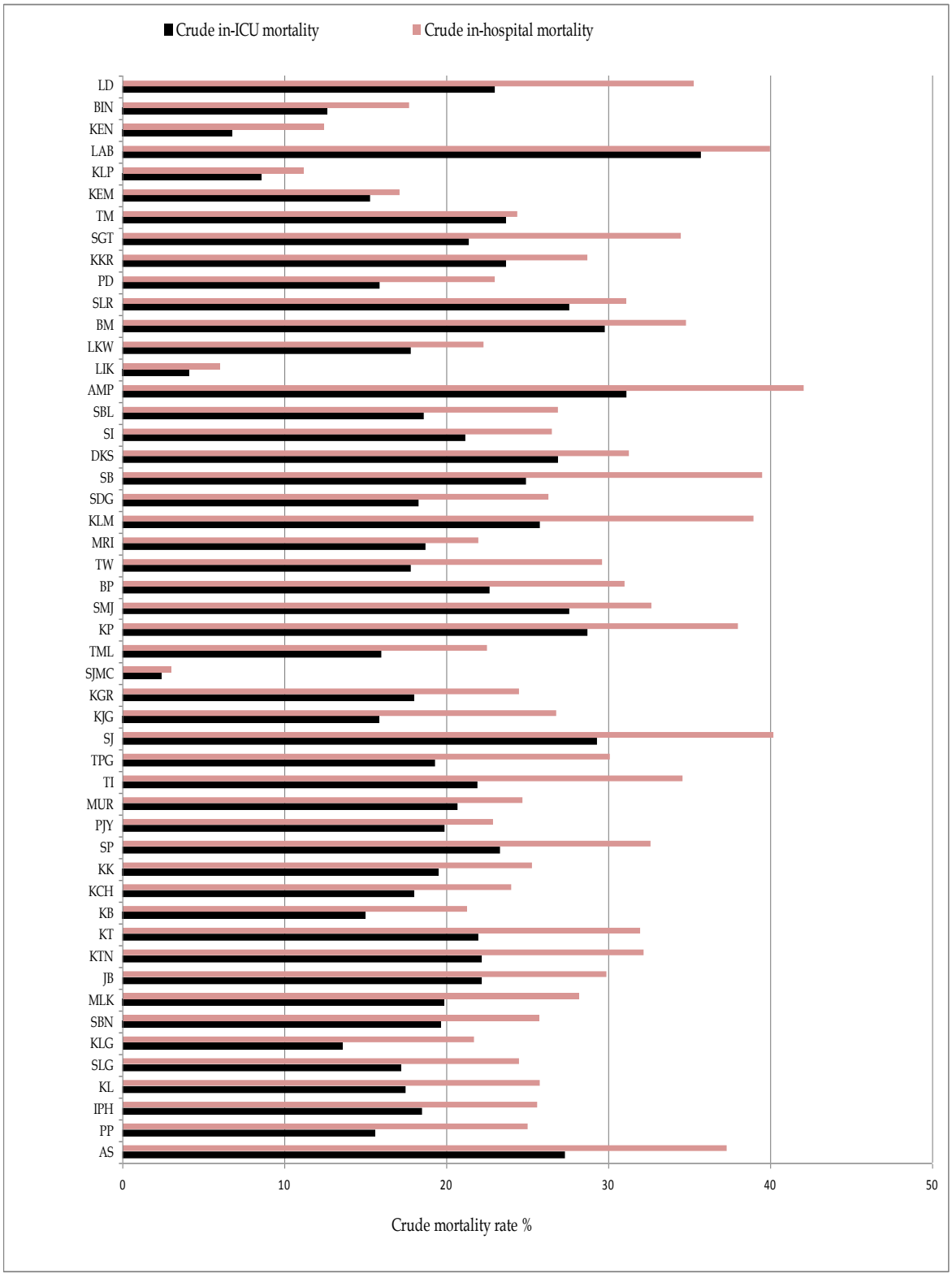


Table 43 : Ten most common diagnoses leading to ICU admission in MOH hospitals and observed in-hospital mortality 2009 – 2013

Diagnosis	Mortality (%)				
	2009	2010	2011	2012	2013
Sepsis	62.2	59.3	58.9	54.4	53.4
Head injury	27.0	27.4	25.2	23.1	22.1
Community-acquired pneumonia	46.3	42.6	40.6	39.0	38.9
Chronic lower respiratory disease	32.4	26.2	24.9	23.6	22.1
Bronchial asthma	10.4	7.8	10.9	7.5	8.1
Non-cardiogenic pulmonary oedema	25.9	29.5	22.3	18.9	21.4
Cerebral vascular disease	-	-	41.9	40.5	45.5
Infection/gangrene of limb (include osteomyelitis, necrotising fasciitis)	39.2	39.1	41.8	39.6	37.7
Dengue infection	10.4	8.6	6.4	5.6	5.6
DKA/HHS	-	-	-	-	21.1

In-hospital mortality for patients with sepsis, community-acquired neumonia, acute exacerbation of chronic lower respiratory disease and dengue infection has steadily improved over the past five years.

Table 44 : Severe sepsis, ARDS and AKI within 24hrs of ICU admission and observed in-hospital mortality 2012-2013

	In-hospital Mortality (%)	
	2012	2013
Severe sepsis	43.1	41.6
ARDS	37.3	36.6
AKI	41.4	43.9
Severe sepsis + ARDS	67.1	60.3
Severe sepsis + AKI	61.3	59.3
Severe sepsis + ARDS + AKI	80.4	73.4

Severe sepsis within 24 hours of ICU admission carries in-hospital mortality above 40%. In 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 renal failure had higher mortality rates than patients without acute renal failure among patients enrolled in the SOAP study (60-day mortality 35.7% versus 16.4%; $P < 0.01$) [15].

Table 45 : Standardised mortality ratio, by individual hospital 2009 – 2013

Hospital	Standardised mortality ratio (95% CI)				
	2009	2010	2011	2012	2013
AS	1.00	0.93	0.82 (0.60-1.11)	1.07 (0.81-1.39)	1.01 (0.76-1.32)
PP	0.78	0.68	0.67 (0.47-0.96)	0.74 (0.51-1.01)	0.71 (0.49-0.99)
IPH	0.86	0.82	0.96 (0.67-1.35)	0.83 (0.58-1.17)	0.74 (0.51-1.04)
KL	0.73	0.62	0.61 (0.43-0.87)	0.63 (0.44-0.88)	0.60 (0.42-0.84)
SLG	0.84	0.76	0.75 (0.52-1.05)	0.75 (0.54-1.05)	0.68 (0.48-0.97)
KLG	0.98	0.85	0.62 (0.43-0.87)	0.60 (0.41-0.86)	0.54 (0.37-0.80)
SBN	0.93	0.74	0.77 (0.55-1.04)	0.73 (0.50-1.03)	0.71 (0.51-0.99)
MLK	0.91	0.97	0.98 (0.71-1.33)	0.81 (0.58 –1.10)	0.86 (0.61-1.21)
JB	0.87	0.71	0.78 (0.56-1.05)	0.71 (0.51-0.97)	0.66 (0.47-0.91)
KTN	0.88	0.90	0.72 (0.50-1.01)	0.84 (0.62-1.21)	0.82 (0.58-1.09)
KT	1.09	0.86	0.67 (0.48-0.94)	0.65 (0.46-0.89)	0.72 (0.53-0.98)
KB	1.41	1.00	0.76 (0.52-1.07)	0.67 (0.46-0.95)	0.62 (0.44-0.92)
KCH	0.80	0.63	0.82 (0.58-1.13)	0.75 (0.51-1.06)	0.69 (0.47-0.98)
KK	1.10	0.83	0.71 (0.50-1.00)	1.00 (0.70-1.38)	0.8 (0.55-1.14)
SP	1.02	0.97	1.00 (0.75-1.30)	0.77 (0.57-1.03)	0.75 (0.54-1.02)
PJY	0.86	0.83	0.76 (0.50-1.10)	0.69 (0.45-1.03)	0.80 (0.54-1.14)
MUR	0.81	0.88	0.78 (0.56-1.06)	0.89 (0.63-1.23)	0.55 (0.37-0.79)
TI	0.91	0.71	0.77 (0.57-1.05)	0.72 (0.53-0.99)	0.65 (0.46-0.88)
TPG	1.16	1.03	0.92 (0.69-1.20)	0.80 (0.58-1.07)	0.64 (0.45-0.89)
SJ	0.84	0.76	0.84 (0.61-1.12)	0.87 (0.64-1.17)	0.95 (0.73-1.25)
KJG	1.00	0.64	0.79 (0.57-1.11)	0.85 (0.55-1.14)	0.88 (0.61-1.20)
KGR	0.71	0.75	0.72 (0.51-1.04)	0.62 (0.42-0.89)	0.64 (0.44-0.90)
TML	0.74	0.86	0.59 (0.41-0.85)	0.64 (0.43-0.90)	0.80 (0.56-1.15)
KP	0.90	0.90	1.06 (0.79-1.37)	0.95 (0.72-1.25)	0.95 (0.71-1.26)
SMJ	1.20	0.93	0.78 (0.57-1.07)	0.70 (0.51-0.97)	0.69 (0.49-0.95)
BP	0.81	0.76	0.69 (0.50-0.94)	0.87 (0.65-1.14)	0.69 (0.47-0.97)
TW	0.54	0.55	0.72 (0.51-0.98)	0.67 (0.47-0.93)	0.76 (0.53-1.03)
MRI	0.90	0.69	0.89 (0.62-1.25)	0.65 (0.42-0.96)	0.62 (0.43-0.89)
KLM	0.86	0.87	0.83 (0.62-1.11)	0.69 (0.50-0.94)	0.75 (0.56-1.00)
SDG	0.86	0.71	0.61 (0.42-0.86)	0.61 (0.44-0.85)	0.65 (0.46-0.90)
SB	-	0.74	0.88 (0.64-1.17)	0.75 (0.54-1.01)	0.87 (0.65-1.14)
DKS	-	1.04	0.76 (0.55-1.02)	0.74 (0.52-1.01)	0.76 (0.52-1.06)
SI	-	0.72	0.77 (0.56-1.07)	0.73 (0.52-1.01)	0.78 (0.55-1.10)
SBL	-	0.73	0.74 (0.53-1.03)	0.63 (0.45-0.90)	0.92 (0.65-1.28)
AMP	-	0.89	0.92 (0.71-1.20)	0.90 (0.69-1.17)	0.89 (0.69-1.15)
LIK	-	0.14	0.19 (0.10-0.45)	0.27 (0.14-0.57)	0.58 (0.30-1.08)
LKW	-	-	-	0.96 (0.71-1.25)	0.74 (0.48-1.08)
BM	-	-	-	0.54 (0.36-0.79)	0.58 (0.41-0.79)
SLR	-	-	-	0.98 (0.76-1.26)	0.71 (0.51-0.99)
PD	-	-	-	0.60 (0.40-0.92)	0.74 (0.51-1.05)

KKR	-	-	-	0.68 (0.47-0.96)	0.64 (046-0.88)
SGT	-	-	-	0.74 (0.51-1.03)	0.73 (0.54-0.99)
TM	-	-	-	0.76 (0.49-1.13)	0.68 (0.46-0.96)
KEM	-	-	-	0.30 (0.17-0.46)	0.44 (0.28-0.65)
KLP	-	-	-	0 (0)	0.53 (0.31-0.83)
LAB	-	-	-	0.87 (0.64-1.16)	0.94 (0.72-1.23)
KEN	-	-	-	0.55 (0.39-0.77)	0.41 (0.25-0.63)
BIN	-	-	-	1.15 (0.84-1.51)	0.6 (0.40-0.87)
LD	-	-	-	0.68 (0.5-0.9)	0.77 (0.54-1.06)
Total MOH					**0.72 (0.51-1.00)**
UMMC	-	-	-	0.83 (0.60-1.14)	0.65 (0.44-0.91)
SJMC	0.39	0.36	0.44 (0.24-0.89)	0.44 (0.23-0.85)	0.28 (0.14-0.68)
Total	**0.89**	**0.80**	**0.77 (0.55 - 1.05)**	**0.74 (0.53 - 1.03)**	**-**

The pooled standardized mortality ratio for MOH ICUs in 2013 was 0.72 (95% CI 0.51 – 1.00). 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:

REPORT ON
DENGUE INFECTION
IN MOH ICUs
2010 - 2013

Report on patients with dengue infection who were admitted to the intensive care units in the Ministry of Health hospitals from 2010 - 2013

In 2013, the number of dengue cases reported by the Ministry of Health increased by 98% from 21,900 in 2012 to 43,346 [18] [19]. The number of dengue cases in 2011 and 2010 were 19,884 and 46,171 respectively [16] [17].

Dengue infections accounted for 3.6%, 4.1%, 4.1% and 3.6% of all CU admissions for 2010, 2011, 2012 and 2013 respectively.

Data over the past 4 years were fairly consistent for most variables such as age, interval from hospital to ICU admission, length of ICU stay, length of hospital stay, mean SAPS II score, percentage being ventilated and main organ failure on admission.

The majority of patients with dengue infection were young with a median age of 31.1 years in 2013. Most patients were admitted fairly early to the ICU with the median interval from hospital to ICU admission of 12 hours. The patients also had shorter duration of ICU and hospital stay (median of 1.9 days and 5.3 days respectively compared to 3.4 days and 9.0 days respectively for all patients in 2013).

Patients with dengue infection were less ill on admission compared to the rest of the patients (mean SAPS II score of 18.6 vs. 36.5).

In 2013, 11.2% of patients were invasively ventilated compared with 9.5% in the previous year. The median length of mechanical ventilation decreased over the last 4 years from 3.8 days in 2010 to 2.9 days in 2013.

Haematological failure remained the main organ failure on ICU admission over the past 4 years.

The percentage of patients having co-morbid diseases was 25% in 2013.

There was a small rise in all-cause mortality for admissions with diagnosis of dengue infection from 5.6% in 2012 to 5.9% in 2013 after a reducing trend from 2010 to 2012. However the SMR for dengue cases remained similar, 0.51 in 2012 and 0.50 in 2013.

Table 46 : General comparison for Dengue infection MOH ICUs 2010 – 2013

	Dengue Infection 2010 n = 1643	Dengue Infection 2011 n = 798	Dengue Infection 2012 n = 906	Dengue Infection 2013 n=1550
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)
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)
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)
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)
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)
Total SAPS II score, mean	19.0 $\pm$ 14.1	19.6 $\pm$ 16.0	17.4 $\pm$ 13.0	18.6 $\pm$ 13.2
% Invasive mechanical ventilation	18.6	13.8	9.5	11.2%
% Co-morbid diseases	18.1	22.3	18.3	25
Main organ failure %				
Without organ failure	32.2	27.3	35.2	36.3
Respiratory failure	4.7	3.0	3.3	2.9
Cardiovascular failure	7.1	7.2	6.9	6.1
Neurological failure	0.6	0.4	0.1	0.7
Renal failure	0.9	0.7	0.8	1.1
Hepatic failure	0.4	0.1	0.1	0.3
Haematological failure	54.0	40.9	53.4	52.5
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)

Table 47 : Dengue infection by individual hospital and crude all-cause in-hospital mortality 2010-2013

Hospital	Year							
	2010		2011		2012		2013	
	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	10 (0.6)	0 (0)	14 (1.8)	0 (0.0)	20 (2.2)	0 (0.0)	18	1 (5.6)
PP	56 (3.4)	2 (3.6)	73 (9.1)	1 (1.4)	14 (1.5)	1 (7.1)	53	5 (9.4)
IPH	78 (4.7)	6 (7.7)	26 (3.2)	3 (11.5)	18 (2.0)	2 (11.1)	57	3 (5.3)
KL	165 (10.0)	5 (3.0)	71 (8.9)	2 (2.8)	127 (14.0)	2 (1.6)	141	4 (2.8)
SLG	98 (6.0)	5 (3.0)	40 (5.0)	1 (2.5)	19 (2.1)	0 (0.0)	76	2 (2.6)
KLG	164 (10.0)	16 (9.8)	98 (12.3)	6 (6.1)	186 (20.5)	10 (5.4)	190	9 (4.8)
SBN	34 (2.1)	5 (14.7)	15 (1.9)	3 (20.0)	11 (1.2)	1 (9.1)	24	1 (4.8)
MLK	256 (15.6)	18 (7.0)	48 (6.0)	4 (8.3)	38 (4.2)	3 (7.9)	212	14 (6.6)
JB	84 (5.1)	7 (8.3)	22 (2.8)	3 (13.6)	23 (2.5)	2 (8.6)	83	17 (20.5)
KTN	25 (1.5)	2 (8.0)	11 (1.4)	1 (9.1)	3 (0.3)	0 (0.0)	23	2 (8.6)
KT	13 (0.8)	0 (0.0)	30 (3.8)	4 (13.3)	24 (2.6)	1 (4.2)	19	1 (5.3)
KB	36 (2.2)	11 (30.6)	13 (1.6)	1 (7.7)	3 (0.3)	0 (0.0)	25	2 (8.0)
KCH	22 (1.3)	8 (36.4)	10 (1.3)	1 (10.0)	13 (1.4)	1 (7.7)	25	3 (12.0)
KK	17 (1.0)	4 (23.5)	19 (2.4)	0 (0.0)	12 (1.3)	0 (0.0)	23	2 (8.7)
SP	6 (0.4)	2 (33.3)	5 (0.6)	0 (0.0)	11 (1.2)	0 (0.0)	21	1 (4.8)
PJY	10 (0.6)	1 (10.0)	11 (1.4)	1 (9.1)	10 (1.1)	1 (10.0)	29	1 (3.4)
MUR	52 (3.2)	0 (0.0)	2 (0.3)	0 (0.0)	4 (0.4)	0 (0.0)	15	1 (6.7)
TI	2 (0.1)	0 (0.0)	6 (0.8)	0 (0.0)	4 (0.4)	1 (25.0)	6	0 (0.0)
TPG	8 (0.5)	2 (25.0)	26 (3.3)	2 (7.7)	43 (4.7)	4 (9.5)	32	1 (3.1)
SJ	-	-	3 (0.4)	0 (0.0)	1 (0.1)	0 (0.0)	5	0 (0.0)
KJG	53 (3.2)	5 (9.4)	17 (2.1)	2 (11.8)	23 (2.5)	1 (4.3)	27	0 (0.0)
KGR	1 (0.1)	0 (0.0)	1 (0.1)	0 (0.0)	6 (0.7)	1 (16.7)	11	1 (9.1)
SJMC	-	-	-	-	54 (6.0)	0 (0.0)	-	-
TML	47 (2.9)	3 (6.4)	28 (3.5)	3 (10.7)	8 (0.9)	0 (0.0)	15	1 (6.7)
KP	3 (0.2)	2 (66.7)	3 (0.4)	1 (33.3)	-	-	1	0 (0.0)
SMJ	17 (1.0)	1 (5.9)	7 (0.9)	1 (14.3)	13 (1.4)	4 (30.8)	5	0 (0.0)
BP	16 (1.0)	2 (12.5)	9 (1.1)	0 (0.0)	6 (0.7)	0 (0.0)	21	2 (9.5)
TW	2 (0.1)	1 (50.0)	2 (0.3)	0 (0.0)	9 (1.0)	0 (0.0)	37	2 (5.4)
MRI	7 (0.4)	1 (14.3)	-	-	5 (0.6)	3 (60.0)	16	1 (6.2)
KLM	6 (0.4)	1 (16.7)	8 (1.0)	1 (12.5)	9 (1.0)	1 (11.1)	4	1 (25.0)
SDG	97 (5.9)	15 (15.5)	50 (6.3)	6 (12.0)	33 (3.6)	0 (0.0)	63	6 (9.5)
SB	38 (2.3)	10 (26.3)	1 (0.1)	0 (0.0)	9 (1.0)	1 (11.1)	8	1 (12.5)
DKS	3 (0.2)	1 (33.3)	19 (2.4)	2 (10.5)	5 (0.6)	0 (0.0)	15	1 (6.7)
SI	15 (0.9)	2 (13.3)	24 (3.0)	3 (12.5)	23 (2.5)	3 (13.0)	96	1 (1.0)
SBL	164 (10.0)	11 (6.7)	62 (7.8)	3 (4.8)	95 (10.5)	4 (4.2)	74	3 (4.1)
AMP	36 (2.2)	1 (2.8)	19 (2.4)	0 (0.0)	4 (0.4)	2 (50.0)	12	1 (8.3)
LIK	1 (0.1)	0 (0.0)	5 (0.6)	0 (0.0)	2 (0.2)	0 (0.0)	3	0 (0.0)

UMMC	-	-	-	-	3 (0.3)	0 (0.0)	-	-
BM	-	-	-	-	-	-	1	0 (0.0)
SLR	-	-	-	-	2 (0.2)	0 (0.0)	4	0 (0.0)
PD	-	-	-	-	4 (0.4)	0 (0.0)	12	0 (0.0)
KKR	-	-	-	-	-	-	3	0 (0.0)
SGT	-	-	-	-	1 (0.1)	0 (0.0)	1	0 (0.0)
TM	-	-	-	-	-	-	8	0 (0.0)
KLP	-	-	-	-	-	-	1	0 (0.0)
LAB	-	-	-	-	1 (0.1)	1 (100.0)	3	0 (0.0)
KEN	-	-	-	-	1 (0.1)	0 (0.0)	9	0 (0.0)
BIN	-	-	-	-	2 (0.2)	1 (50.0)	13	1 (7.7)
LD	-	-	-	-	4 (0.4)	0 (0.0)	13	0 (0.0)
Total	**1643 (100)**	**150 (9.1)**	**853 (100)**	**55 (6.4)**	**906 (100)**	**51 (5.6)**	**1550**	**92 (5.9)**

SUMMARY

1. The total number of ICU beds in the 49 MOH participating centres was 600, with a median bed occupancy of 90.2%.

2. The number of cases analysed for year 2013 was 73,436, an increase of 10.5% over the previous year.

3. The percentage of patients denied admission due to the unavailability of ICU beds had declined from 40.0% to 29.4% in the last five years.

4. The average age of patients excluding those below 18 years was 50.3 years.

5. In MOH hospitals, foreigners constituted 6.7% of all ICU admissions.

6. The average lengths of ICU and hospital stay were 4.7 and 14.4 days respectively.

7. In MOH hospitals, 66.0% of admissions were non-operative patients, an increase of 4% in the last five years.

8. Direct admission to MOH ICUs from the emergency department had steadily increased over the past 10 years from 9% in 2004 to 30% in 2013.

9. Inter-hospital ICU admissions decreased from 5.5% to 4.6% in the last five years.

10. 63.6% of admissions had single or no organ failure within 24 hours of ICU admission.

11. In MOH ICUs, cardiovascular failure (37%) was the most common organ failure during the first 24 hours of ICU admission, followed by respiratory (28%), neurological (19%), renal (10%), haematological (5%) and hepatic (1%).

12. Sepsis, head injury, and community-acquired pneumonia were the three most common diagnoses leading to ICU admission. The in-hospital mortality for this group of patients was 53.4%, 22.1% and 38.9% respectively.

13. During the first 24 hours of ICU admission, 19.2%, 8.1% and 13.7% of patients had severe sepsis, acute respiratory distress syndrome and acute kidney injury respectively.

14. The average SAPS II score was 36.5, which carries a predicted risk of in-hospital mortality of 30.4%.

15. The average Sequential Organ Failure Assessment (SOFA) score was 6.4 in 2013.

16. 77% of patients in MOH hospitals and 71% of patients in UMMC received invasive ventilation with an average duration of 4.5 days while 1.9% of ICU

admissions in the private hospital were mechanically ventilated with average duration of 4.8 days.

17. The percentage of patients who received non-invasive ventilation increased from 13.3% in 2009 to 22.3% in 2013.

18. In MOH hospitals, 13% of ICU admissions had renal replacement therapy, with intermittent haemodialysis being the most common modality of therapy.

19. Among patients who were invasively ventilated, 10.5% had tracheostomy performed, with the median time from initiation of ventilation to tracheostomy being 8.3 days.

20. The decision to withdraw or withhold therapy was made in 35.1% of patients who died in ICU.

21. The incidence of VAP had decreased by more than half from 13.5 to 5.4 per 1000 ventilator days over the last five years.

22. The majority (87.2%) of the organisms causing VAP were Gram-negative. *Acinetobacter spp*., *Klebsiella spp*., and *Pseudomonas spp*. remained the 3 most common organisms causing VAP over the last 7 years in MOH ICUs. 58% of organisms causing VAP were multi-drug resistant.

23. The ventilator care bundle compliance rates for MOH hospitals improved from 90.6% in 2009 to 98.1% in 2013.

24. The unplanned extubation rate was 0.3 per 100 intubated days in 2013.

25. The mean incidence of pressure ulcers was 6.6 per 1000 ICU days.

26. The incidence of central venous catheter-related bloodstream infection in MOH ICUs was 0.8 per 1000 catheter days.

27. 82.2%, 13.7% and 4.1% of the organisms isolated for CVC-BSI were gram-negative, gram-positive and fungal respectively.

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

29. The crude in-ICU and in-hospital mortality rates were 19.9% and 27.7% respectively.

30. The mean standardised mortality ratio was 0.72 (95% CI 0.51 – 1.00).

31. The average all cause in-hospital mortality rate for patients admitted for dengue infection in MOH ICUs had improved from 9.1% in 2010 to 5.9% in 2013.

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