Malaysian Registry of Intensive Care

Report for 2012

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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 2012.

The following are the main findings:

1. The total number of ICU beds in the 49 MOH participating units was 589 with a median bed occupancy rate of 86.2%.

2. The number of cases analysed was 33,892, an increase of 13.8% over the previous year.

3. The percentage of patients denied admission due to the unavailability of ICU beds had declined from 48.3% to 32.0% 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 4.8 and 15.5 days respectively.

6. In MOH hospitals, 65.1% of ICU admissions were non-operative patients.

7. Direct admissions to MOH ICUs from the emergency department had increased more than two-fold from 13% in 2007 to 28% in 2012.

8. The percentage of ICU admissions with single or no organ failure (within 24 hours of ICU admission) was 63.5%.

9. Sepsis, head injury and community-acquired pneumonia were the three most common diagnoses leading to ICU admission in MOH hospitals in 2012. The in-hospital mortality rates for this group of patients were 54.4%, 23.1% and 39.0% respectively.

10. The average SAPS II score was 37.3, 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 from 12.1% in 2008 to 20.7% in 2012.

13. The incidence of ventilator-associated pneumonia had decreased by more than half, from 13.5 to 7.2 per 1000 ventilator days, in the last five years.

14. The crude in-ICU and in-hospital mortality rates were 19.4% and 38.1% respectively.

15. The mean standardised mortality ratio was 0.74 (95% C.I. 0.53 – 1.03).

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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 MRIC

FOREWORD

I am honoured to be able to pen a few lines in this 2012 MRIC report. This report is the culmination of hard work, commitment and resourcefulness from a select group of dedicated intensivists. We have been maintaining this registry for a decade now and the data gathered over the years has paved the way for us to improve the delivery of our services in terms of quality, safety and improved outcomes.

A total of 51 hospitals participated in this audit in 2012 and the data was collected from 33,892 ICU admissions. It is interesting to note that there was an increasing trend in the use of non invasive ventilation which reflects current practices worldwide. The decision to withdraw or withhold therapy was made in 37% of patients who died in ICU. I foresee that this will be the future trend in our ICU as awareness is created amongst the healthcare workers with regards this concept. 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 6.4% in 2011 to 5.6% in 2012.

Data on ICU facilities and ICU denial give credence to our request for more ICU beds to be established. It is not unfair to say that the registry has been a major catalyst in advancing intensive care in Ministry of Health and to a certain extent the entire nation. The percentage of patients denied admission due to the unavailability of ICU beds had declined from 48.3% to 32.0% over the past five years. We take the opportunity to thank the Ministry of Health for its continued and unwavering support to us.

Now it only remains for me to thank each and every one who has contributed in one way or another to make this registry a success. I am especially thankful to Dr. Jenny Tong, Dr. Tai Li Ling and Dr. Tan Cheng Cheng for their unwavering support and hard work that has spanned a decade. Their dedication and commitment is unparalleled. I am confident that under their stewardship while ably assisted by the 'new generation' in Dr. Ahmad Shaltut, Dr. Lim Chew Har and Dr. AsNiza, MRIC is in good hands and that it will continue to scale greater heights.

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

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	Dr. Amin Sah Ahmad Senior Principal Assistant Director
	Sister Nor Wati Mohd

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.	Sime Darby Medical Centre Subang Jaya	SDMC
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 2012, for the purpose of MRIC 2012 report

Participating sites with ≥ 1000 admissions

1 Hospital Sultanah Bahiyah Alor Setar
2 Hospital Pulau Pinang
3 Hospital Taiping
4 Hospital Kuala Lumpur
5 Hospital Selayang
6 Hospital Sungai Buloh
7 Hospital Tengku Ampuan Rahimah Klang
8 Hospital Melaka
9 Hospital Sultanah Aminah Johor Bahru
10 Hospital Sultanah Nur Zahirah Kuala Terengganu
11 Hospital Raja Perempuan Zainab II Kota Bharu

Participating sites with 500 - 999 admissions

12 Hospital Raja Permaisuri Bainun Ipoh
13 Hospital Tuanku Ja'afar Seremban
14 Hospital Tengku Ampuan Afzan Kuantan
15 Hospital Umum Sarawak Kuching
16 Hospital Queen Elizabeth Kota Kinabalu
17 Hospital Putrajaya
18 Hospital Seberang Jaya
19 Hospital Pakar Sultanah Fatimah Muar
20 Hospital Serdang
21 Hospital Duchess of Kent Sandakan
22 Hospital Sultan Ismail Johor Bahru
23 Hospital Ampang
24 Hospital Kulim

Participating sites with < 500 admissions

25 Hospital Sultan Haji Ahmad Shah Temerloh
26 Hospital Sultan Abdul Halim Sungai Petani
27 Hospital Teluk Intan
28 Hospital Kajang
29 Hospital Tuanku Fauziah Kangar
30 Hospital Tuanku Ampuan Najihah Kuala Pilah
31 Hospital Sibu
32 Hospital Batu Pahat
33 Hospital Sri Manjung
34 Hospital Tawau
35 Hospital Miri
36 Hospital Wanita dan Kanak-Kanak Sabah

37 Hospital Langkawi

38 Hospital Bukit Mertajam

39 Hospital Slim River

40 Hospital Port Dickson

41 Hospital Kuala Krai

42 Hospital Segamat

43 Hospital Tanah Merah

44 Hospital Kemaman

45 Hospital Kuala Lipis

46 Hospital Labuan

47 Hospital Keningau

48 Hospital Bintulu

49 Hospital Lahad Datu

Private hospital

50 Sime Darby Medical Centre Subang Jaya

University hospital

51 University Malaya Medical Centre

LIST OF SITE INVESTIGATORS AND SOURCE DATA COLLECTORS

January – December 2012

No	Hospital	Site investigator	Source data collectors
1	Sultanah Bahiyah Alor Setar	Dr Ahmad Shaltut bin Othman	Sr Teoh Shook Lian SN Hafisoh bt Ahmad SN Haslina bt Khalid SN Norashikin bt Man SN Noorazimah Bt Salleh
2	Pulau Pinang	Dr Lim Chew Har	SN Rosmalizawati bt Ibrahim SN Siti Hazlina bt Bidin SN Rosmawati bt Yusoff
3	Raja Permaisuri Bainun Ipoh	Dr Azlina bt Muhamad	SN Saadiah bt Bidin SN Ng Pek Yoong
4	Kuala Lumpur	Dr Tai Li Ling	SN Salmizawati bt Serif SN Ismee Bt Jusoh
5	Selayang	Dr Laila Kamariah bt Kamalul Baharin	SN Nor Zaila bt Saad@ Senafi SN Noor Azwati bt Daud
6	Tengku Ampuan Rahimah Klang	Dr Faezah bt Shaari (till July 2012) Dr Sheliza bt Wahab (from July 2012)	SN Latifah bt Omar SN Tai Yoke Ching SN Rosenah bt Abdul Rahman
7	Tuanku Ja'afar Seremban	Dr Jenny Tong May Geok	Sr Chew Bee Ngoh SN Farawahida bt Ahmad
8	Melaka	Dr Anita bt Alias	SN Morni bt Omar SN Noriza Rawi
9	Sultanah Aminah Johor Bahru	Dr Tan Cheng Cheng	Sr Marian Sais ak Sipit SN Aishah bt Abu Bakar AMO Mohd Zakuan bin Mohd Nor AMO Hairizam b Zulkhifli AMO Mohd Adib b Jasni AMO Anand a/l Sivasamy
10	Tengku Ampuan Afzan Kuantan	Dr Rusnah bt Ab. Rahman	Sr Salina bt Sulaiman Sr Gan Soo Heng SN Amimah Bt Abd Hamid SN Nur Azura Hamzah
11	Sultanah Nur Zahirah Kuala Terengganu	Dr Mohd Ridhwan bin Mohd Nor	SN Zauwiah bt Idris SN Norhayati bt Abd Rahman SN Aslinawati bt Chik
12	Raja Perempuan Zainab II Kota Bharu	Dr Wan Nasrudin bin Wan Ismail	Sr Azilah bt Ishak SN Azizum bt Ismail SN Suzana Yusof
13	Umum Sarawak Kuching	Dr Jamaida bt Jamhuri	SN Noreafa bt Daim SN Sabia Lew SN Rosnica Jiton

14	Queen Elizabeth Kota Kinabalu	Dr Lily Ng Mooi Hang Dr Khoo Tien Meng	Sr Safiah bt Mokhtar SN Conny Chong Chiew Fah SN Aslinda Ahmad SN Saihin Maun
15	Sultan Abdul Halim Sungai Petani	Dr Rosman bin Noor Ali	Sr Rafizah Md Zuki Sr Puziah bt Yahya SN Halijah bt Kasim SN Hamiza bt Mohd Noor SN Safilah bt Ismail
16	Putrajaya	Dr Fauziah bt Yusoff	SN Latifah bt Mohd Korib SN Maznah bt Muhamad
17	Pakar Sultanah Fatimah Muar	Dr Suzaliatun Kasbullah	SN Roslina bt Othman SN Mazlidah bt Osman SN Nurazlin bt Jawad SN Fazal Naim bt Ramli
18	Teluk Intan	Dr Noor Azira Bt Haron	SN Azliza bt Zakaria SN Rohayu Dalila bt Yusof SN Puspavali a/p Punusamy
19	Taiping	Dr As-Niza bin Abdul Shukor	SN Ummi Khadijah bt Bani SN Saleha bt Salleh SN Che Zakiah bt Othman
20	Seberang Jaya	Dr Goay Chun Kiat	SN Zuraina bt Muhamad SN Nooraslina bt Othman SN Nur Hasniza bt Abdul Aziz
21	Kajang	Dr Wan Hafizah bt Wan Tajul Ariffin	Sr Normaizana bt Ismail Sr Nurafidah bt Mohamad Rasip SN Saiza bt Mat Yusof
22	Tuanku Fauziah Kangar	Dr Azilah bt Desa	SR Chua Pek Hong SN Zarina Mat Bistaman SN Norazlisyan bt Ramli SN Norshaheera Nalini
23	Sime Darby Medical Center Subang jaya	Dr Wong Ket Hiung	Ms Navjeet Kaur SN Normazimah bt Mohamad Nazar
24	Sultan Haji Ahmad Shah Temerloh	Dr Rahimah bt Haron	Sr Rakiah bt Mohd Noor SN Norliza bt Ismail SN Rohayu bt Yusof SN Joliena bt Jaafar SN Aida Azlina bt Ali
25	Tuanku Ampuan Najihah Kuala Pilah	Dr Zalifah bt Nordin	Sr Lee New SN Norhafidah bt Ismail
26	Sri Manjung	Dr Khairudin bin Zainal Abidin	Sr Rohani bt Ali SN Hartini bt Abd Rahman SN Salbiah bt Abdul Rashid SN Norfaizal bt Abdul Majid
27	Batu Pahat	Dr Nasrudin Bunasir	SN Rosmawati bt Saimin SN Norhaezah Jani SN Norkamila Mokhtar

28	Tawau	Dr Azlina Mazzita bt Mohamed Mokhtar Dr Muzaffar Mohamad	Sr Haliza bt Kasau SN Lilybeth Feliciano Ferez SN Sarwah bt Isa
29	Miri	Dr Rozaini bt Ahmad	SN Noriah bt Ilai SN Zuriha bt Achim
30	Kulim	Dr Chua Kok Boon Dr Loh Hoong Heng	Sr Mahani bt Hassan SN Mohana bt Omar SN Bahayah bt Mohamed Bakari SN Che Asmah bt Haji Md Isa
31	Serdang	Dr Nazarinna bt Muhamad	Sr Norain bt Saad Sr Hamidah Mat Rasip
32	Sibu	Dr Yek Kiung Wei	Sr Wong Chen Chen SN Yong Suk Moi
33	Duchess of Kent Sandakan	Dr Yap Huey Ling	Sr Noorasmah Hassim SN Norahimah bt Dulraman SN Sofiah Bt Yampi
34	Sultan Ismail Johor Bahru	Dr Mohd Zaini bin Laman	Sr Mariah bt Kassim Sr Azleena bt Mohd Yusop SN Huzaimah bt Jahir SN Norwati bt Jamiran
35	Sungai Buloh	Dr Shanti Ratnam	Sr Sri Jayanthi A/P Gobalan SN Zainidah bt Mat Kasim (till Oct 2012) SN Noorhaidah bt Baharuddin
36	Ampang	Dr Sohba A/P Gopala Kurup	SN Normazlin bt Md Derus SN Amiza Dyana bt Abu Amin SN Siti Baizura bt Che Ahmad
37	Wanita dan Kanak-Kanak Sabah	Dr Felicia Su Min Hu (till July 2012) Dr Lorrain Lim (from July 2012)	Sr Haineh bt Amin (till May 2012) SN Siti Rajiah bt Muslimin SN Dayang Noreenz bt Mohd Yusoh SN Yusnita bt Yunus
38	University Malaya Medical Centre	Dr Vineya Rai	MLT Sinthu Bairavi MLT Siti Farhana bt Darus
39	Langkawi	Dr Neoh Eu Bryan (till Aug.2012) Dr Teoh Wei Tsung (from Aug 2012)	Sr Hamiza bt Harun
40	Bukit Mertajam	Dr Nur Sabrina bt Mohd Sabry	Sr Teng Get Sim
41	Slim River	Dr Tin Tin Myint	Sr Khairol Nazimah Musa
42	Port Dickson	Dr Hema Malini a/p Manogharan	Sr Hapisah bt Mat SN Muhazni bt Mohammad
43	Kuala Krai	Dr Mustaza bin Jamaluddin	Sr Norlela bt Ismail SN Mazwani bt Kamarudin
44	Segamat	Dr Wirza Feldi	SN Hasneyza bt Bakar

45	Tanah Merah	Dr Mohd Azmi bin Mamat	Sr Roslawani bt Ghazali SN Fadilah bt Mohd Nor
46	Kemaman	Dr Suryani bin Mohd Zaid	Sr Sabariah bt Embong
47	Kuala Lipis	Dr Zawyah bt Mat Sulaiman	Sr W. Norlizer bt W.Muda
48	Labuan	Dr Betty Shee	Sr Roslin Akiu
49	Keningau	Dr Sein Win	Sr Beatrice Olas Sr Haineh bt Amin
50	Bintulu	Dr Ahmad Afifi B.Mohd Arshad (till Aug 2012) Dr Norizawati bt Dzulkifli (from Aug 2012)	Sr Icung Boi Sr Jennifer Anak Sahim SN Ann Lampung SN Yuhana Galang
51	Lahad Datu	Dr Haslan Ghazali	Sr Juraini bt Mohd Jaffar SN Noorlaila bt Durahman

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
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 nine 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 fifth for MRIC, but tenth 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 10.0.1.

This report is based on all admissions into the 51 participating ICUs from 1st January to 31st December 2012. The total number of admissions in 2012 was 35,975 out of which 2083 (6.1%) 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 33,892 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.

In this report, a special mention was made with regards to dengue infections and 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 2008–2012

Hospital	Number of functional ICU beds (as of 31-12-2012)	ICU bed occupancy rate %				
		2008	2009	2010	2011	2012
AS	24	80.5	88.6	83.2	87.0	96.7
PP	22	94.0	81.3	61.5	89.9	88.7
IPH	22	79.1	103.0	104.0	107.0	106.0
KL	30	112.7	108.6	109.3	107.5	111.7
SLG	20	80.2	72.6	97.7	111.4	99.8
KLG	29	100.5	198.7	91.9	87.8	108.3
SBN	8	110.4	111.8	114.0	118.4	114.6
MLK	22	87.3	84.2	88.1	106.0	107.9
JB	29	106.7	115.1	108.7	106.2	105.6
KTN	14	89.5	102.2	103.0	105.2	106.4
KT	20	109.2	115.2	93.9	102.0	103.6
KB	19	88.9	86.6	88.5	80.8	80.0
KCH	12	96.8	101.5	104.9	116.6	125.9
KK	21	125.3	87.3	100.1	101.7	93.4
SP	7	90.8	79.3	80.9	84.6	84.9
PJY	11	89.2	88.4	89.5	78.2	75.2
MUR	8	108.2	72.6	89.6	82.4	97.5
TI	4	83.0	86.5	91.0	101.3	123.8
TPG	20	83.5	83.6	98.4	103.2	92.7
SJ	8	68.7	101.9	90.7	89.6	99.1
KJG	6	74.2	75.8	75.6	78.9	77.2
KGR	5	79.1	71.8	70.2	63.3	77.3
TML	10	133.8	119.0	110.5	104.0	113.0
KP	8	57.8	51.0	56.2	68.5	61.8
SMJ	8	121.9	71.6	79.0	82.4	92.7
BP	8	86.4	77.0	71.4	69.0	87.0
TW	7	64.5	45.9	82.5	60.6	80.7
MRI	8	87.9	54.5	79.7	72.7	76.1
KLM	7	98.2	121.2	99.2	98.9	100.5
SDG	16	116.0	102.0	87.4	88.2	50.4
SB	13	-	-	102.6	99.2	60
DKS	18	-	-	116.2	87.9	87.9
SI	17	-	-	79.2	87.3	86.2
SBL	32	-	-	118.2	108.1	94.6
AMP	12	-	-	89.0	85.5	45.7
LIK	8	-	-	62.0	76.7	76.9
LKW	4	-	-	-	-	67.0
BM	7	-	-	-	-	65.6

SLR	**7**	**-**	**-**	**-**	**-**	76.0
PD	4	**-**	**-**	**-**	**-**	85.5
KKR	4	**-**	**-**	**-**	**-**	69.8
SGT	4	**-**	**-**	**-**	**-**	58.1
TM	2	**-**	**-**	**-**	**-**	68.7
KEM	2	**-**	**-**	**-**	**-**	59.6
KLP	3	**-**	**-**	**-**	**-**	21.8
LAB	5	**-**	**-**	**-**	**-**	30.7
KEN	4	**-**	**-**	**-**	**-**	90.4
BIN	6	**-**	**-**	**-**	**-**	88.3
LD	4	**-**	**-**	**-**	**-**	104.2
Total	**589**	**-**	**-**	**-**	**-**	
Median	**-**	**89.3**	**87.0**	**90.2**	**88.6**	**86.2**

The total number of ICU beds in the 49 MOH hospitals as of 31st December 2012 was 589 with a median bed occupancy rate (BOR) of 86.2%. There was a 15% increase (70) in the number of ICU beds from the previous year for the cohort of 36 participating centres (excluding the 13 new centres).

There was a wide variation in the BOR across the centers. This was 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.

Table 2 : ICU admissions, by individual hospital 2008 – 2012

Hospital	2008	2009	2010	2011	2012
	n (%)	n (%)	n (%)	n (%)	n (%)
AS	546 (3.2)	1121 (5.3)	1094 (4.1)	1212 (4.1)	1201 (3.5)
PP	568 (3.3)	505 (2.4)	911 (3.4)	1198 (4.0)	1287 (3.8)
IPH	873 (5.1)	924 (4.3)	1143 (4.2)	1140 (3.8)	926 (2.7)
KL	1578 (9.3)	1768 (8.3)	1947 (7.2)	1842 (6.2)	1971 (5.8)
SLG	877 (5.2)	888 (4.2)	1053 (3.9)	1141 (3.8)	1289 (3.8)
KLG	788 (4.6)	1080 (5.1)	1215 (4.5)	1608 (5.4)	2136 (6.3)
SBN	467 (2.7)	510 (2.4)	542 (2.0)	554 (1.9)	537 (1.6)
MLK	1366 (8.0)	1439 (6.8)	1636 (6.1)	1593 (5.3)	1694 (5.0)
JB	1106 (6.5)	1245 (5.9)	1443 (5.3)	1685 (5.7)	1752 (5.2)
KTN	563 (3.3)	613 (2.9)	744 (2.8)	612 (2.1)	641 (1.9)
KT	601 (3.5)	824 (3.9)	1087 (4.0)	1207 (4.1)	1363 (4.0)
KB	847 (5.0)	803 (3.8)	826 (3.1)	1125 (3.8)	1286 (3.8)
KCH	464 (2.7)	461 (2.2)	512 (1.9)	643 (2.2)	854 (2.5)
KK	687 (4.0)	319 (1.5)	808 (3.0)	843 (2.8)	954 (2.8)
SP	183 (1.1)	261 (1.2)	207 (0.8)	270 (0.9)	159 (0.5)
PJY	351 (2.1)	397 (1.9)	523 (1.9)	537 (1.8)	574 (1.7)
MUR	869 (5.1)	774 (3.6)	759 (2.8)	473 (1.6)	636 (1.9)
TI	281 (1.7)	262 (1.2)	276 (1.0)	308 (1.0)	384 (1.1)
TPG	412 (2.4)	867 (4.1)	834 (3.1)	860 (2.9)	1203 (3.5)
SJ	504 (3.0)	599 (2.8)	590 (2.2)	579 (1.9)	644 (1.9)
KJG	142 (0.8)	265 (1.2)	323 (1.2)	341 (1.1)	371 (1.1)
KGR	268 (1.6)	302 (1.4)	294 (1.1)	298 (1.0)	350 (1.1)
SDMC	1900 (10.0)	2085 (9.8)	1578 (5.8)	2018 (6.8)	1467 (4.3)
TML	429 (2.5)	607 (2.9)	624 (2.3)	543 (1.8)	436 (1.3)
KP	193 (1.1)	165 (0.8)	234 (0.9)	359 (1.2)	334 (1.0)
SMJ	347 (2.0)	336 (1.6)	314 (1.2)	380 (1.3)	403 (1.2)
BP	342 (2.0)	397 (1.9)	409 (1.5)	454 (1.5)	415 (1.2)
TW	316 (1.9)	215 (1.0)	238 (0.9)	274 (0.9)	433 (1.3)
MRI	267 (1.6)	212 (1.00	302 (1.1)	385 (1.3)	478 (1.4)
KLM	316 (1.9)	343 (1.6)	474 (1.8)	498 (1.7)	601 (1.8)
SDG	456 (2.7)	679 (3.2)	824 (3.1)	883 (3.0)	875 (2.6)
SB	-	-	471 (1.7)	569 (1.9)	490 (1.4)
DKS	-	-	246 (0.9)	526 (1.8)	526 (1.6)
SI	-	-	568 (2.1)	647 (2.2)	806 (2.4)
SBL	-	-	1234 (4.6)	1260 (4.2)	1583 (4.7)
AMP	-	-	534 (2.0)	553 (1.9)	572 (1.7)
LIK	-	-	160 (0.6)	376 (1.3)	270 (0.8)
UMMC	-	-	-	-	474 (1.4)

LKW	-	-	-	-	157 (0.5)
BM	-	-	-	-	38 (0.1)
SLR	-	-	-	-	154 (0.5)
PD	-	-	-	-	204 (0.6)
KKR	-	-	-	-	149 (0.4)
SGT	-	-	-	-	127 (0.4)
TM	-	-	-	-	17 (0.1)
KEM	-	-	-	-	94 (0.3)
KLP	-	-	-	-	7 (0.0)
LAB	-	-	-	-	107 (0.3)
KEN	-	-	-	-	82 (0.2)
BIN	-	-	-	-	213 (0.6)
LD	-	-	-	-	168 (0.5)
Total	**18907 (100)**	**21266 (100)**	**26977 (100)**	**29794 (100)**	**33892 (100)**

Figure 1 : **ICU admissions, 2003 - 2012**

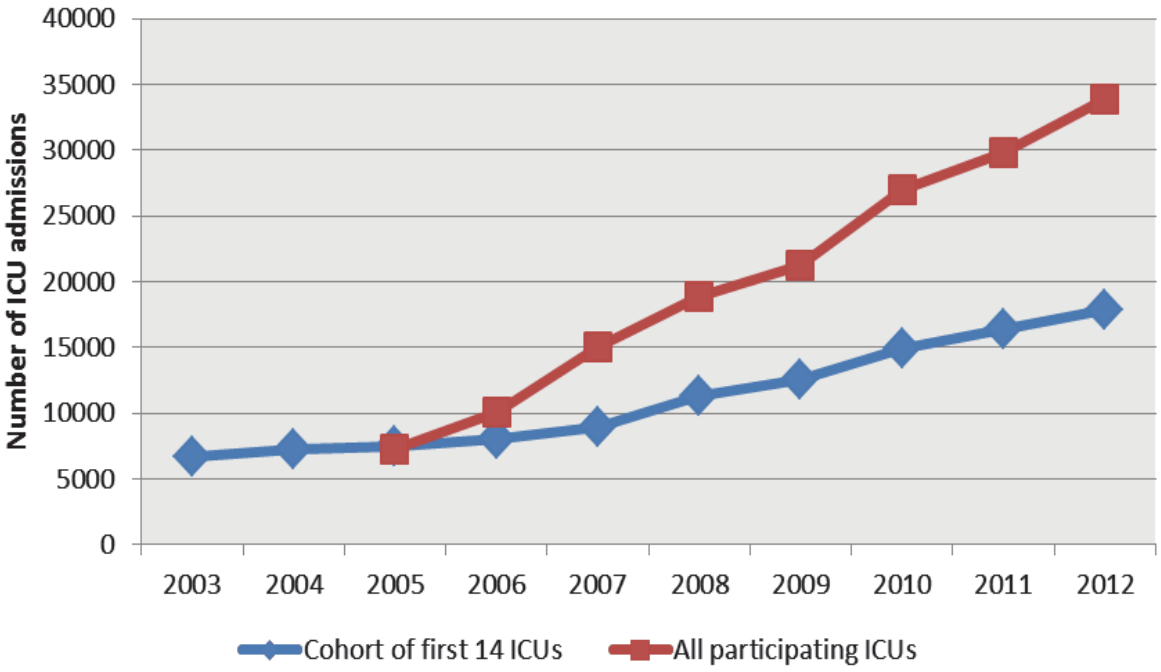
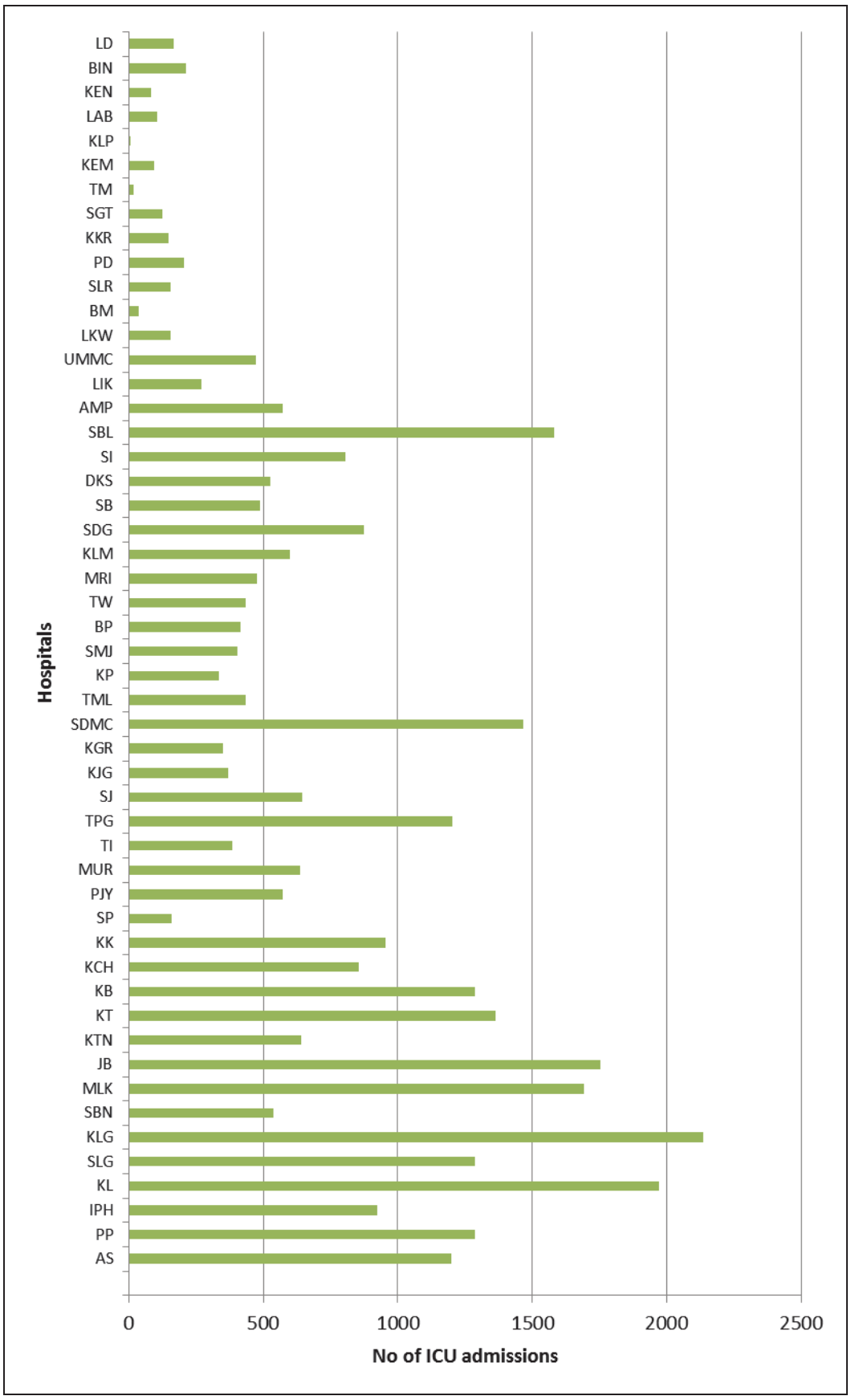


Figure 2 : ICU admissions, by participating centres 2012



The number of admissions had increased over the years in the MOH hospitals. There was an increase of 79% over the past five years from 2008 to 2012. 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 cohort of 31 hospitals recruited from 2002-2006, the number of admissions increased from 17,007 to 26,187 (an increase of 54%) over last 5 years. There was an increase of 19% in the number of ICU beds from 327 to 388 in 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 2012. 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 2008 – 2012

Hospital	2008 %	2009 %	2010 %	2011 %	2012 %
AS	91.3	93	92.2	98.2	93.1
PP	97.4	93	87.4	90.1	96.2
IPH	96.3	96	96.3	99.2	97.5
KL	98.9	95	94.8	98.7	98.5
SLG	99.7	84	94.8	95.0	97.6
KLG	90.9	92	91.1	86.0	97.3
SBN	99.6	97	96.4	99.5	99.3
MLK	99.3	92	94.8	99.5	98.8
JB	99.8	97	97.4	99.8	97.2
KTN	99.6	96	94.8	99.0	97.2
KT	98.2	90	96.1	99.8	99.1
KB	99.3	94	95.7	94.4	98.7
KCH	93.0	89	87.5	94.3	95.3
KK	90.3	60	89.4	95.4	94.9
SP	53.4	50	38.5	53.1	30.8
PJY	80.9	87	96.5	99.1	98.0
MUR	82.6	80	63.0	97.4	94.6
TI	102.2	97	92.0	98.4	91.2
TPG	46.6	95	95.5	94.0	99.3
SJ	99.0	96	95.2	98.5	98.3
KJG	57.7	87	81.4	95.5	99.7
KGR	91.8	94	97.0	98.1	98.6
TML	98.0	86	87.4	81.4	62.6
KP	89.2	98	98.3	100.0	66.4
SMJ	97.2	100	95.4	100.0	99.5
BP	100.0	90	95.1	98.5	97.9
TW	68.5	93	78.3	91.7	98.6
MRI	101.3	65	94.1	88.5	99.2
KLM	98.9	97	95.2	98.9	98.5
SDG	-	94	66.7	94.9	90.5
SB	-	-	74.8	73.1	70.0
DKS	-	-	54.8	99.6	95.5
SI	-	-	92.4	86.3	94.6
SBL	-	-	92.5	100.0	90.7
AMP	-	-	95.5	85.2	100.0
LIK	91.3	-	27.2	60.9	57.4
LKW	-	-	-	-	69.8
BM	-	-	-	-	11.3
SLR	-	-	-	-	42.5

PD	-	-	-	-	84.0
KKR	-	-	-	-	87.1
SGT	-	-	-	-	41.2
TM	-	-	-	-	22.4
KEM	-	-	-	-	75.2
KLP	-	-	-	-	36.8
LAB	-	-	-	-	96.4
KEN	-	-	-	-	16.4
BIN	-	-	-	-	75.5
LD	-	-	-	-	67.2

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 was slightly less than that to the national census, as patients who were still in hospital on 31st January 2012 were excluded in the analysis. The reporting rates for the first 14 participating ICUs were all higher than 90%, while the majority of the new 13 participating ICUs had low reporting rates.

Table 4 : Intensive care referrals and refusal of admission, by individual hospital 2008 – 2012

Hosp	2008		2009		2010		2011		2012	
	No. refer.	% denied adm.	No. refer.	% denied adm.	No. refer.	% denied adm.	No. refer.	% denied adm.	No. refer.	% denied adm.
AS	227	23.4	358	19.0	*	*	*	*	*	*
PP	1478	84.3	1407	82.3	1292	83.3	942	70.2	1329	67.8
IPH	633	79.5	612	82.5	1275	69.3	1525	66.7	1834	63.4
KL	2512	34.4	2230	31.0	2218	34.6	1971	32.8	2364	30.4
SLG	440	40.0	345	33.6	151	40.4	448	27.2	1173	24.2
KLG	1657	73.0	2072	64.2	2155	56.7	2264	33.1	2458	21.2
SBN	1770	65.5	1863	63.3	1862	59.3	2125	60.8	1929	56.0
MLK	940	62.1	981	56.0	1035	70.3	919	55.2	993	61.2
JB	1638	49.0	1111	50.1	2065	50.4	2069	39.8	2205	28.8
KTN	768	28.3	755	20.4	1092	29.1	791	42.4	455	39.6
KT	385	26.8	105	30.5	264	20.1	150	18.0	544	26.3
KB	1067	67.1	1219	66.1	1399	63.3	1431	50.1	1417	41.5
KCH	580	61.4	486	58.4	326	61.4	477	51.4	1132	57.8
KK	294	60.9	378	7.9	992	13.2	1340	16.0	1282	13.0
SP	137	42.3	48	18.8	*	*	*	*	254	44.1
PJY	212	*	*	*	*	*	*	*	36	5.6
MUR	542	32.1	*	*	619	15.8	685	31.4	903	34.3
TI	52	5.8	*	*	186	21.0	54	40.7	170	42.9
TPG	499	15.4	1186	11.6	902	2.0	958	0.5	1498	10.4
SJ	222	21.6	660	15.0	758	23.5	625	31.2	592	34.1
KJG	*	*	*	*	170	5.3	67	19.4	*	*
KGR	335	20.3	165	22.4	230	21.7	201	20.4	405	12.8
TML	303	44.6	68	35.3	800	35.3	921	35.6	875	38.5
KP	334	39.2	346	48.6	372	33.3	412	7.3	412	9.7
SMJ	236	26.7	174	17.8	203	16.3	191	13.1	145	13.8
BP	346	4.3	442	7.0	382	8.6	454	2.6	372	2.2
TW	326	*	*	*	250	0.0	297	*	505	3.2
MRI	168	14.5	126	29.4	141	16.3	81	18.5	132	4.6
KLM	291	12.7	302	10.6	411	2.9	509	2.9	710	5.2
SDG	299	43.1	698	30.8	581	21.5	712	14.2	506	22.9
SB	-	-	-	-	*	*	*	*	*	*
DKS	-	-	-	-	130	38.5	10	50.0	214	33.6
SI	-	-	-	-	478	35.6	635	34.8	547	21.4
SBL	-	-	-	-	119	40.3	*	*	689	17.4
AMP	-	-	-	-	*	*	149	39.6	716	26.7
LIK	-	-	-	-	*	*	*	*	*	*
UMMC	-	-	-	-	-	-	-	-	657	57.5
LKW	-	-	-	-	-	-	-	-	*	*
BM	-	-	-	-	-	-	-	-	*	*
SLR	-	-	-	-	-	-	-	-	55	10.9

PD	-	-	-	-	-	-	-	-	216	7.4
KKR	-	-	-	-	-	-	-	-	49	24.5
SGT	-	-	-	-	-	-	-	-	*	*
TM	-	-	-	-	-	-	-	-	*	*
KEM	-	-	-	-	-	-	-	-	60	1.7
KLP	-	-	-	-	-	-	-	-	*	*
LAB	-	-	-	-	-	-	-	-	*	*
KEN	-	-	-	-	-	-	-	-	46	4.4
BIN	-	-	-	-	-	-	-	-	*	*
LD	-	-	-	-	-	-	-	-	*	*
Total	**18689**	**48.3**	**18365**	**40.0**	**22861**	**36.5**	**25321**	**34.2**	**31341**	**32.0**

* *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 2008 – 2012

Gender	2008 n (%)	2009 n (%)	2010 n (%)	2011 n (%)	2012 n (%)
Male	11081 (58.7)	12489 (58.7)	16040 (59.6)	17788 (59.7)	20295 (60.0)
Female	7811 (41.3)	8768 (41.3)	10875 (40.4)	11968 (40.2)	13554 (40.0)

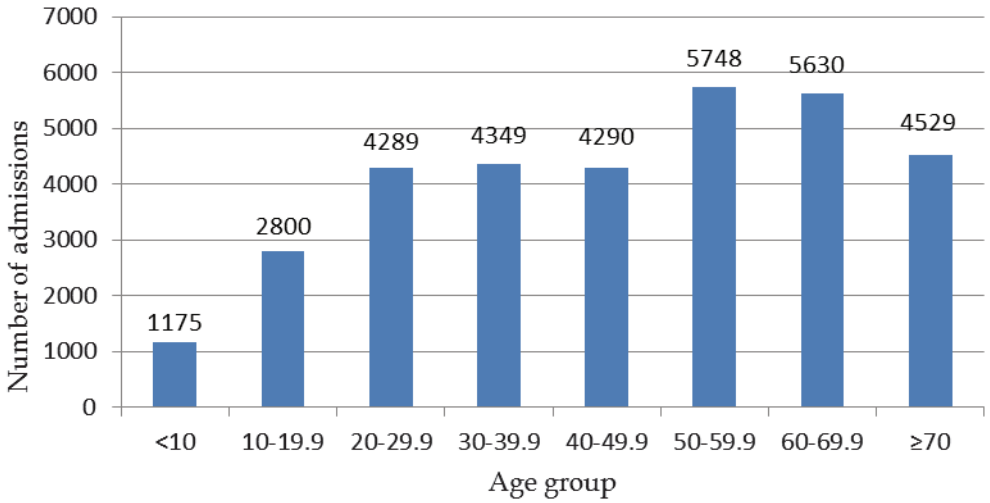
The ratio of male to female patients (3:2) has remained fairly constant over the years.

Table 6 : Mean age (years) 2008 - 2012

Age	2008	2009	2010	2011	2012
All ages, Mean ± SD yrs	46.5 ± 20.9	46.5 ± 20.9	45.6 ± 20.6	46.5± 20.7	46.6 ± 20.7
Age ≥ 18 years Mean ± SD yrs	50.3 ± 18.2	50.3 ± 18.1	49.4 ± 18.1	50.2± 18.0	50.3 ± 17.8

The average age for all age groups was 46.6 ± 20.7 years (median 48.9 years). For adult patients, with age exceeding 18 years, the average age was 50.3 ± 17.8 years (median 52.1 years). The average age of patients admitted to ICUs has remained almost the same over the last 5 years.

Figure 3 : Age groups, 2012

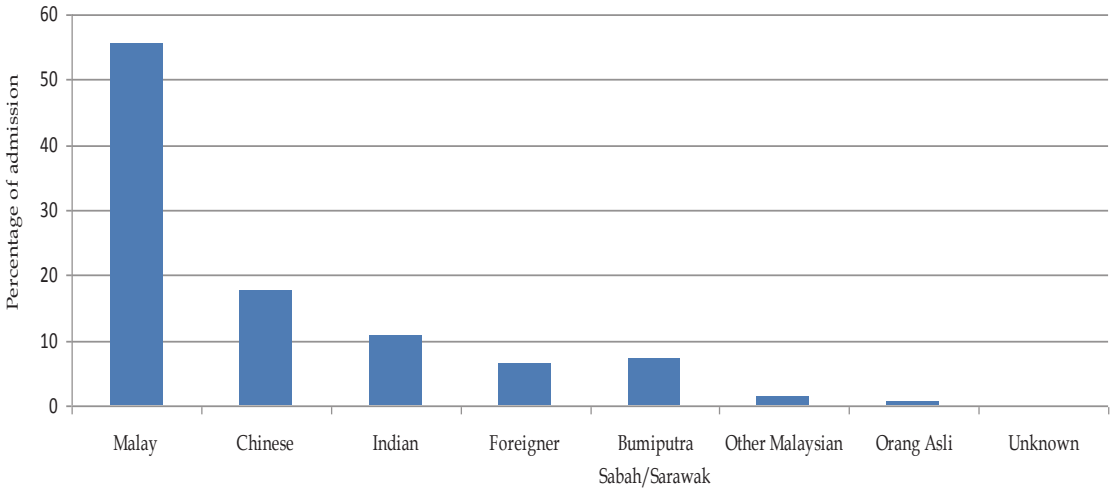


Geriatric patients (age more than 65 years) and paediatric patients (age less than 12 years) accounted for 21.4% and 4.1% of total admissions respectively in 2012.

Table 7 : Ethnic groups 2012

Ethnic group	n	%
Malay	18853	55.7
Chinese	5969	17.6
Indian	3616	10.7
Foreigner	2170	6.4
Bumiputra Sabah/Sarawak	2495	7.3
Other Malaysian	525	1.6
Orang Asli	180	0.5
Unknown	17	0.1
Total	**33892**	**100.0**

Figure 4 : Ethnic groups 2012



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 2008 – 2012

Hospital	Mean (Median), days				
	2008	2009	2010	2011	2012
AS	4.3 (2.4)	3.9 (2.2)	4.1 (2.2)	4.6 (2.8)	5.6 (3.1)
PP	4.6 (2.0)	5.4 (2.5)	5.6 (2.8)	5.1 (2.5)	5.4 (2.6)
IPH	5.1 (2.7)	5.1 (2.8)	5.0 (2.6)	5.3 (2.6)	5.5 (2.9)
KL	4.9 (2.4)	4.9 (2.8)	4.7 (2.5)	4.7 (2.8)	5.1 (2.8)
SLG	4.4 (2.7)	4.4 (2.7)	4.4 (2.1)	4.4 (2.4)	4.5 (2.6)
KLG	4.8 (2.7)	4.9 (2.7)	4.9 (2.7)	3.6 (2.0)	4.1 (2.1)
SBN	5.9 (3.0)	5.3 (2.9)	5.1 (2.8)	4.8 (2.7)	4.9 (2.7)
MLK	4.0 (2.0)	4.3 (2.1)	4.1 (2.1)	4.0 (2.7)	4.1 (2.1)
JB	4.9 (3.8)	4.5 (2.4)	5.0 (2.8)	5.2 (3.0)	5.2 (3.0)
KTN	4.8 (2.5)	4.7 (2.9)	4.4 (2.5)	6.3 (3.4)	6.3 (3.6)
KT	4.2 (2.6)	4.3 (2.7)	4.5 (2.5)	4.0 (2.3)	4.1 (2.2)
KB	4.5 (2.5)	4.4 (2.3)	4.8 (2.0)	4.7 (1.9)	4.7 (2.3)
KCH	5.5 (2.6)	5.4 (2.7)	5.0 (2.7)	5.6 (3.0)	5.2 (2.9)
KK	4.6 (2.0)	5.4 (2.9)	6.2 (3.2)	6.3 (3.7)	6.3 (3.8)
SP	7.3 (4.8)	3.9 (2.4)	4.6 (3.2)	4.0 (2.4)	7.6 (2.2)
PJY	4.5 (1.9)	4.4 (1.9)	3.6 (1.7)	3.2 (1.5)	3.2 (1.5)
MUR	4.4 (3.0)	4.4 (2.0)	3.5 (1.8)	4.8 (2.4)	3.5 (1.8)
TI	3.7 (2.4)	3.5 (2.1)	4.2 (1.8)	4.0 (2.0)	3.5 (2.1)
TPG	4.5 (2.8)	5.4 (2.7)	7.4 (3.5)	7.0 (3.7)	5.1 (2.7)
SJ	5.5 (2.5)	4.3 (2.6)	4.3 (2.3)	4.3 (2.1)	4.2 (2.1)
KJG	4.6 (2.5)	4.9 (2.6)	3.8 (2.1)	4.0 (2.7)	4.6 (2.9)
KGR	5.2 (2.8)	4.0 (2.7)	4.2 (2.2)	3.4 (1.7)	4.3 (2.1)
SDMC	2.5 (1.4)	2.3 (1.2)	2.5 (1.3)	2.4 (1.3)	2.7 (1.6)
TML	4.8 (2.7)	5.0 (2.8)	4.9 (2.8)	5.1 (3.0)	6.4 (3.5)
KP	4.2 (2.4)	4.9 (2.4)	3.5 (2.0)	5.8 (3.1)	5.7 (3.0)
SMJ	4.9 (2.7)	5.3 (3.0)	4.4 (2.2)	3.7 (2.3)	3.9 (2.5)
BP	5.6 (3.2)	4.3 (2.5)	4.8 (2.7)	4.3 (2.2)	5.7 (3.3)
TW	4.4 (2.0)	4.2 (2.2)	4.1 (2.3)	3.5 (2.2)	3.5 (2.4)
MRI	4.8 (2.8)	6.2 (3.0)	5.4 (2.8)	4.4 (2.3)	5.2 (2.5)
KLM	3.6 (2.4)	4.2 (2.6)	3.9 (2.3)	3.6 (2.0)	3.3 (1.9)
SDG	4.5 (2.3)	4.3 (2.1)	4.3 (2.1)	4.8 (2.7)	4.8 (2.8)
SB	-	-	5.3 (2.9)	4.7 (2.4)	5.1 (2.5)
DKS	-	-	6.8 (3.2)	6.0 (3.1)	5.1 (3.1)
SI	-	-	5.2 (2.3)	7.0 (3.7)	6.2 (3.3)
SBL	-	-	5.7 (2.8)	6.0 (3.2)	5.7 (3.1)
AMP	-	-	5.3 (2.9)	5.4 (3.2)	5.0 (2.9)
LIK	-	-	2.4 (1.5)	2.5 (1.6)	3.5 (1.8)
UMMC	-	-	-	-	7.2 (3.8)
LKW	-	-	-	-	5.3 (2.0)
BM	-	-	-	-	-
SLR	-	-	-	-	6.3 (3.2)
PD	-	-	-	-	4.0 (2.5)
KKR	-	-	-	-	5.6 (2.9)

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

The average length of ICU stay was 4.8 days while the median length of stay was 2.6 days. KLP recorded the shortest average length of stay (1.3 days) while UMMC and SP recorded the longest stay of more than 7 days respectively.

Table 9 : Length of hospital stay, by individual hospital 2008 – 2012

Hospital	Mean (Median), days				
	2008	2009	2010	2011	2012
AS	15.5 (9.3)	12.6 (7.9)	13.4 (8.3)	14.5 (9.5)	15.1 (9.2)
PP	21.4 (13.7)	20.4 (11.5)	21.1 (12.0)	19.0 (11.5)	19.5 (12.0)
IPH	17.0 (10.6)	14.5 (10.0)	14.6 (9.4)	15.4 (9.3)	16.0 (10.6)
KL	20.1 (11.4)	18.5 (10.8)	17.8 (10.3)	19.1 (11.0)	17.7 (10.7)
SLG	16.9 (11.1)	17.1 (10.2)	15.3 (9.8)	16.7 (11.0)	17.3 (12.1)
KLG	18.8 (11.3)	15.5 (10.8)	14.1 (9.6)	13.6 (8.4)	12.2 (7.6)
SBN	20.4 (12.4)	16.0 (10.8)	16.7 (10.1)	19.9 (11.0)	17.0 (10.6)
MLK	14.6 (10.0)	13.6 (8.9)	13.6 (8.3)	14.2 (9.3)	16.0 (10.0)
JB	16.1 (10.4)	14.9 (10.0)	14.2 (9.8)	14.6 (10.1)	14.7 (9.9)
KTN	18.5 (12.4)	15.3 (10.9)	14.9 (10.0)	17.1 (12.1)	18.0 (12.3)
KT	16.7 (11.9)	13.2 (8.7)	12.7 (8.9)	12.6 (8.3)	14.5 (9.7)
KB	16.0 (10.9)	17.2 (10.7)	16.6 (10.1)	14.5 (10.0)	16.5 (10.0)
KCH	21.2 (14.1)	19.8 (12.8)	19.6 (12.8)	20.5 (12.6)	21.4 (13.7)
KK	26.2 (15.2)	23.2 (14.9)	21.0 (13.2)	21.4 (14.1)	19.9 (11.7)
SP	14.4 (9.6)	10.5 (7.9)	12.8 (8.3)	10.8 (7.4)	14.0 (8.2)
PJY	13.8 (7.9)	13.5 (8.3)	11.7 (8.1)	11.6 (8.0)	11.7 (8.6)
MUR	17.6 (10.3)	15.8(10.2)	13.3 (8.3)	16.3 (10.3)	22.0 (10.5)
TI	11.7 (8.5)	11.6 (7.6)	12.4 (8.0)	12.5 (8.4)	14.2 (9.6)
TPG	11.6 (7.9)	12.5 (8.3)	14.3 (8.7)	15.1 (10.3)	12.6 (8.3)
SJ	12.9 (9.1)	11.0 (8.7)	11.4 (8.4)	12.9 (9.1)	13.0 (8.2)
KJG	12.6 (9.8)	13.8 (9.2)	12.2 (7.6)	11.2 (7.9)	13.5 (8.3)
KGR	15.6 (10.7)	16.3 (10.7)	12.7 (8.1)	12.6 (8.2)	18.3 (10.9)
SDMC	11.8 (5.9)	8.4 (5.1)	7.3 (5.1)	7.7 (5.3)	8.4 (5.1)
TML	15.5 (11.2)	14.0 (10.4)	13.8 (9.0)	14.6 (9.9)	14.5 (10.7)
KP	11.3 (8.6)	12.9 (8.6)	12.1 (6.0)	12.8 (8.7)	15.5 (9.3)
SMJ	10.6 (6.8)	11.4 (7.9)	12.5 (8.0)	12.1 (7.1)	12.0 (7.2)
BP	14.8 (9.9)	12.0 (8.4)	13.1 (8.3)	11.4 (8.0)	13.6 (9.5)
TW	15.8 (9.7)	13.3 (7.9)	14.1 (9.0)	15.3 (9.1)	13.0 (8.4)
MRI	14.6 (10.0)	15.1 (9.9)	16.6 (10.6)	15.0 (9.6)	14.0 (10.8)
KLM	10.3 (7.7)	10.8 (7.8)	10.6 (7.4)	11.4 (7.3)	12.6 (7.8)
SDG	17.1 (9.6)	15.8 (9.3)	14.6 (8.8)	14.7 (9.0)	14.6 (9.4)
SB	-	-	15.4 (9.0)	13.1 (8.1)	13.1 (8.3)
DKS	-	-	15.8 (9.0)	13.7 (10.1)	12.4 (8.2)
SI	-	-	16.6 (10.9)	19.7 (12.2)	16.0 (9.7)
SBL	-	-	17.1 (9.8)	19.5 (11.2)	19.2 (10.8)
AMP	-	-	15.6 (9.0)	15.1 (10.2)	15.4 (10.5)
LIK	-	-	11.8 (8.1)	11.6 (7.6)	18.4 (9.7)
UMMC	-	-	-	-	25.2 (16.2)
LKW	-	-	-	-	12.7 (6.4)
BM	-	-	-	-	20.9 (10.1)
SLR	-	-	-	-	12.1 (7.9)
PD	-	-	-	-	10.2 (5.9)
KKR	-	-	-	-	12.5 (9.6)

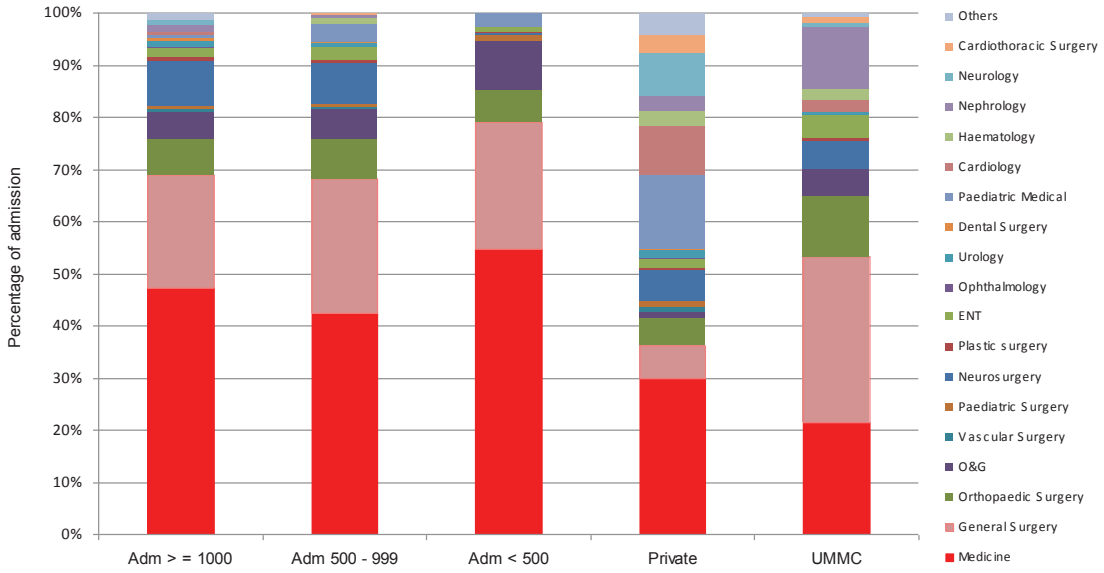
SGT	-	-	-	-	14.8 (8.3)
TM	-	-	-	-	12.0 (8.2)
KEM	-	-	-	-	9.6 (7.8)
KLP	-	-	-	-	6.3 (6.9)
LAB	-	-	-	-	14.4 (6.4)
KEN	-	-	-	-	19.2 (10.4)
BIN	-	-	-	-	21.5 (12.6)
LD	-	-	-	-	12.8 (7.7)
Total	**15.9 (10.3)**	**14.4 (9.0)**	**14.6 (9.0)**	**14.9 (9.3)**	**15.5 (9.5)**

The average length of hospital stay was 15.5 days with a median of 9.5 days. MUR, KCH, UMMC, BM and BIN reported average length of hospital stay that exceeded 20 days.

Table 10 : Referring units, by category of ICU 2012

Referring units	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Medicine	7908 (47.2)	3883 (42.5)	3295 (54.6)	438 (29.9)	100 (21.1)	**15624 (46.1)**
General Surgery	3615 (21.6)	2343 (25.6)	1464 (24.3)	91 (6.2)	149 (31.5)	**7662 (22.6)**
Orthopaedic Surg	1189 (7.1)	717 (7.8)	386 (6.4)	78 (5.3)	54 (11.4)	**2424 (7.2)**
O&G	820 (4.9)	542 (5.9)	564 (9.4)	17 (1.2)	25 (5.3)	**1968 (5.8)**
Vascular Surgery	158 (0.9)	17 (0.2)	1 (0.0)	16 (1.1)	0 (0.0)	**192 (0.6)**
Paediatric Surgery	79 (0.5)	59 (0.6)	67 (1.1)	17 (1.2)	0 (0.0)	**222 (0.7)**
Neurosurgery	1447 (8.6)	716 (7.8)	13 (0.2)	85 (5.8)	25 (5.3)	**2286 (6.8)**
Plastic Surgery	116 (0.7)	62 (0.7)	11 (0.2)	6 (0.4)	2 (0.4)	**197 (0.6)**
ENT	290 (1.7)	220 (2.4)	62 (1.0)	26 (1.8)	21 (4.4)	**619 (1.8)**
Ophthalmology	14 (0.1)	7 (0.1)	3 (0.0)	1 (0.1)	0 (0.0)	**25 (0.1)**
Urology	237 (1.4)	48 (0.5)	0 (0.0)	24 (1.6)	3 (0.6)	**312 (0.9)**
Dental Surgery	88 (0.5)	39 (0.4)	9 (0.1)	1 (0.1)	0 (0.0)	**137 (0.4)**
Paediatric Medical	122 (0.7)	316 (3.5)	149 (2.5)	209 (14.3)	0 (0.0)	**796 (2.4)**
Cardiology	50 (0.3)	6 (0.1)	0 (0.0)	134 (9.2)	11 (2.3)	**201 (0.6)**
Haematology	36 (0.2)	91 (1.0)	0 (0.0)	43 (2.9)	11 (2.3)	**181 (0.5)**
Nephrology	232 (1.4)	56 (0.6)	0 (0.0)	46 (3.1)	55 (11.6)	**389 (1.1)**
Neurology	130 (0.8)	5 (0.1)	5 (0.1)	119 (8.1)	8 (1.7)	**267 (0.8)**
Cardiothoracic Surg	18 (0.1)	8 (0.1)	0 (0.0)	51 (3.5)	6 (1.3)	**83 (0.2)**
Others	208 (1.2)	5 (0.1)	1 (0.0)	62 (4.2)	3 (0.6)	**279 (0.8)**
Total	**16757(100.0)**	**9140 (100.0)**	**6030 (100.0)**	**1464 (100.0)**	**473 (100.0)**	**33864 (100.0)**

Figure 5 : Referring units, by category of ICU 2012



The percentage of patients admitted from the medical-based disciplines increased from 29.5% in 2003 to 48.6% in 2012.

Table 11 : Category of patients, by category of ICU 2012

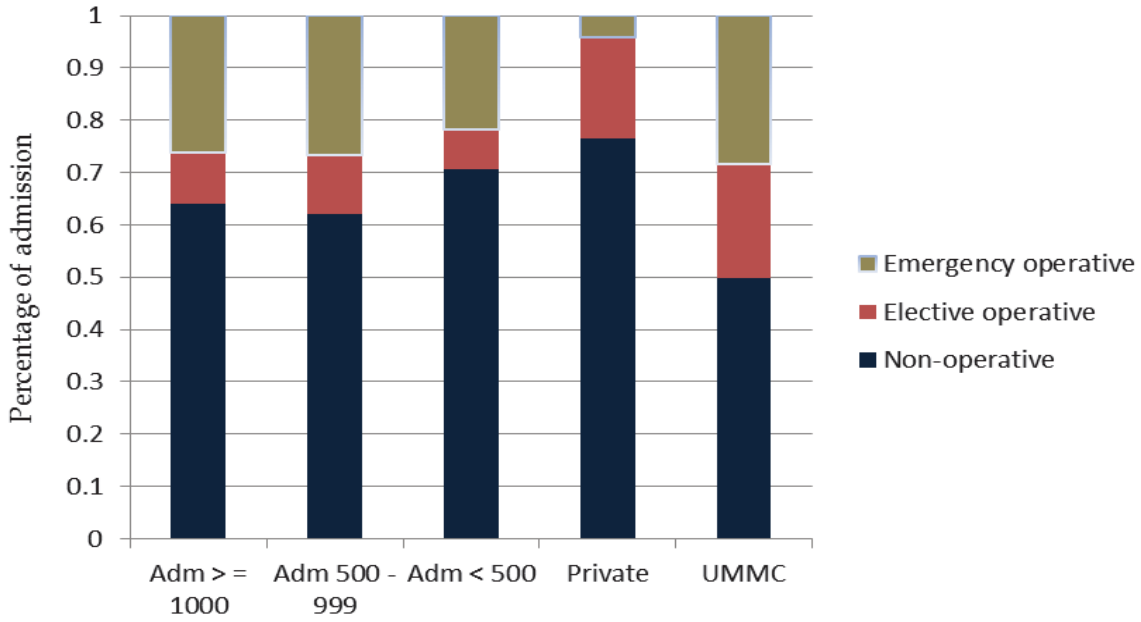
	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC	Total n (%)
Non-operative	10734 (64.1)	5670 (62.1)	4268 (70.7)	1123 (76.6)	236 (49.8)	**22031 (62.6)**
Elective operative	1618 (9.7)	1037 (11.4)	447 (7.4)	282 (19.2)	104 (21.9)	**3488 (10.3)**
Emergency operative	4396 (26.2)	2429 (26.6)	1320 (21.9)	61 (4.2)	134 (28.3)	**8340 (24.6)**
Total	**16748 (100.0)**	**9136 (100.0)**	**6035 (100.0)**	**1466 (100.0)**	**474 (100.0)**	**33859 (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 patients in whom 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 patients in whom 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 2012

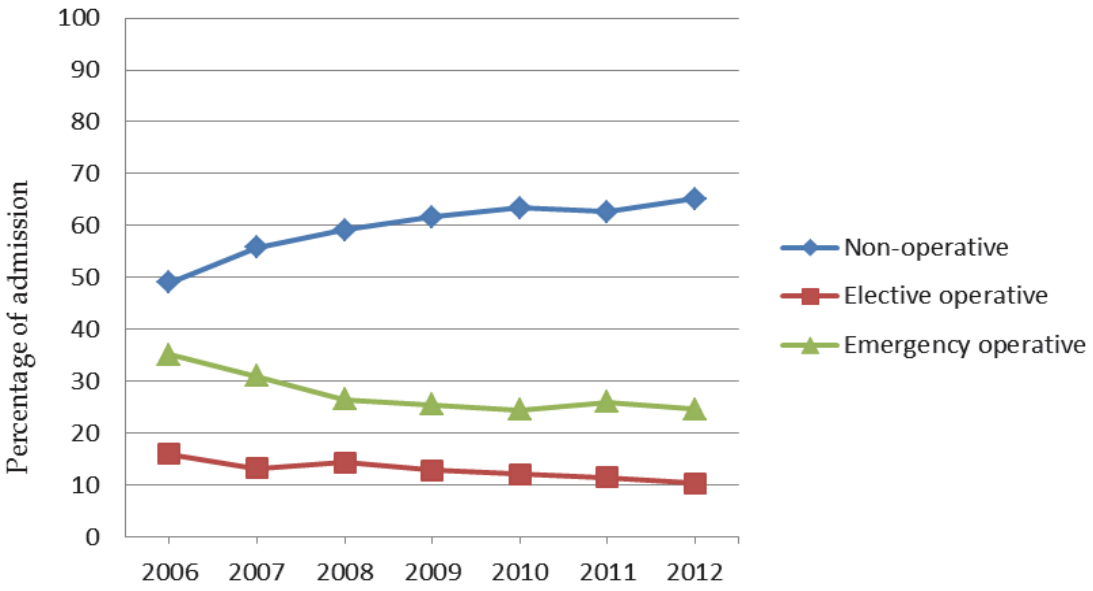


The categories of patients did not differ much among ICUs in MOH hospitals. Non-operative admissions accounted for 65% and 50% of all admissions to MOH ICUs and UMMC respectively. However, the proportion of emergency operative patients in the private hospital was significantly less compared to MOH hospitals.

Table 12 : Category of patients in MOH hospitals 2008 - 2012

Category of patients	2008 (%)	2009 (%)	2010 (%)	2011 (%)	2012 (%)
Non-operative	59.2	61.6	62.9	62.0	65.1
Elective operative	14.3	12.8	11.3	10.5	10.3
Emergency operative	26.5	25.4	25.8	27.5	24.6

Figure 7 : Category of patients in MOH hospitals 2006 – 2012



There was a steady increase in non-operative patients over the past 7 years with a 16% increase from 2006 to 2012, while the percentage of elective operative and emergency operative patients decreased by 5.6% and 10.5% respectively.

Table 13 : Location before ICU admission, by category of ICU 2012

Location	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Ward	5930 (35.4)	3392 (37.1)	2579 (42.7)	339 (23.1)	173 (36.5)	**12413 (36.7)**
OT	4573 (27.3)	2721 (29.8)	1264 (21.0)	267 (18.2)	196 (41.4)	**9021 (26.6)**
A&E	4585 (27.4)	2306 (25.2)	1696 (28.1)	778 (53.1)	90 (19.0)	**9455 (27.9)**
Other critical area	853 (5.1)	213 (2.3)	165 (2.7)	7 (0.5)	4 (0.8)	**1242 (3.7)**
Other location	102 (0.6)	37 (0.4)	22 (0.4)	61 (4.2)	2 (0.4)	**224 (0.7)**
Other hospital	713 (4.3)	472 (5.2)	307 (5.1)	13 (0.9)	9 (1.9)	**1514 (4.5)**
Total	**16756 (100.0)**	**9141 (100.0)**	**6033 (100.0)**	**1465 (100.0)**	**474 (100.0)**	**33869 (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 2012

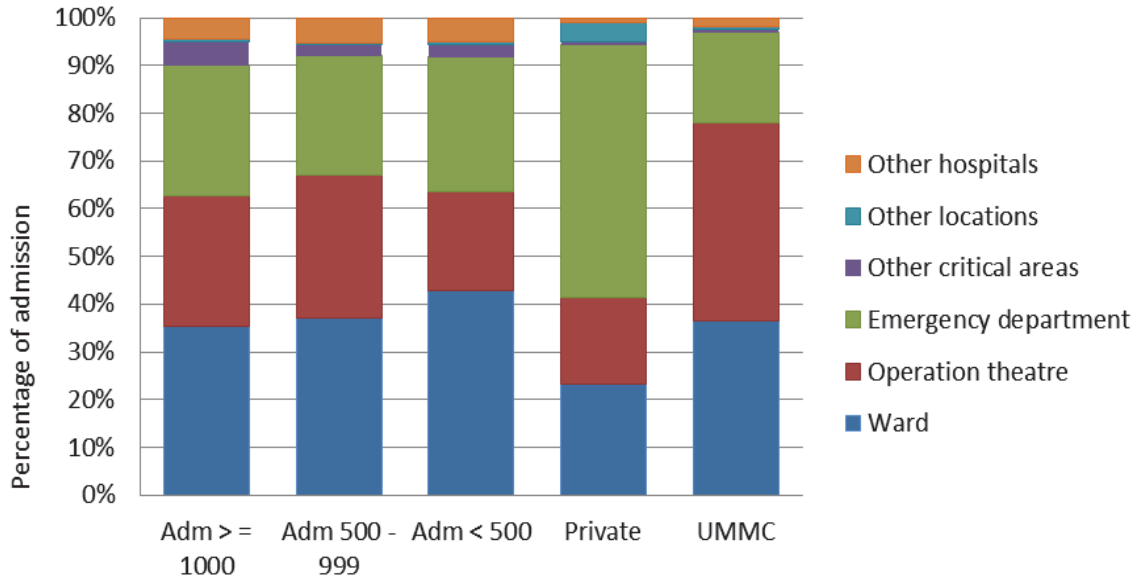
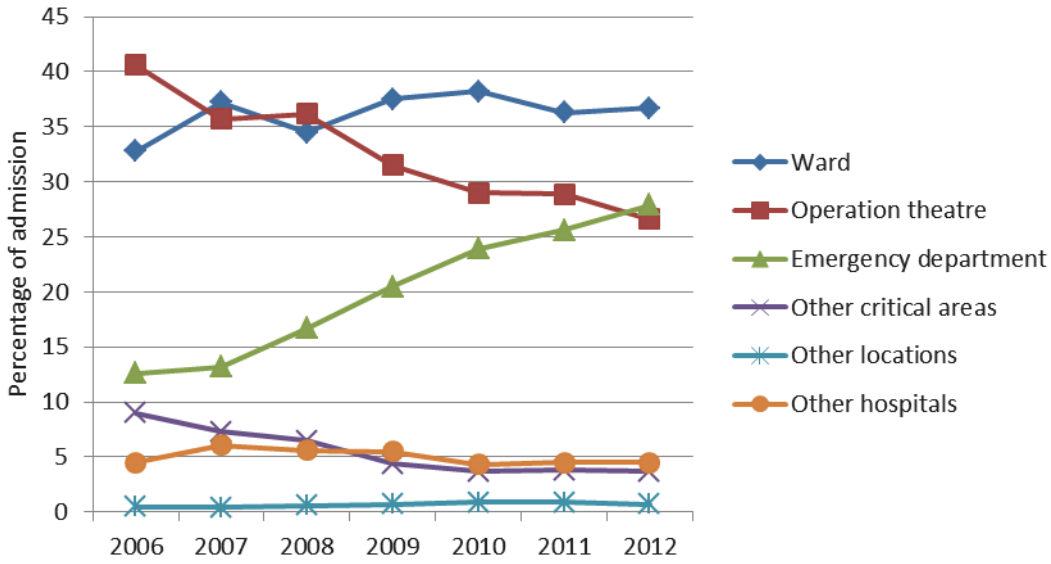


Table 14 : Location before ICU admission in MOH hospitals 2008 - 2012

Location	2008 (%)	2009 (%)	2010 (%)	2011 (%)	2012 (%)
Ward	34.5	37.5	38.2	37.4	36.7
Operation theatre	36.2	31.5	29.0	29.3	26.6
Emergency department	16.7	20.5	23.9	24.0	27.9
Other critical areas	6.5	4.4	3.7	4.1	3.7
Other locations	0.6	0.7	0.9	0.5	0.7
Other hospitals	5.6	5.5	4.3	4.7	4.5

Figure 9 : Location before ICU admission in MOH hospitals 2006 – 2012



The percentage of admissions from the emergency department has increased significantly more than two-fold over the last 7 years. Admissions from the operating theatre had decreased by 14% over the last 7 years.

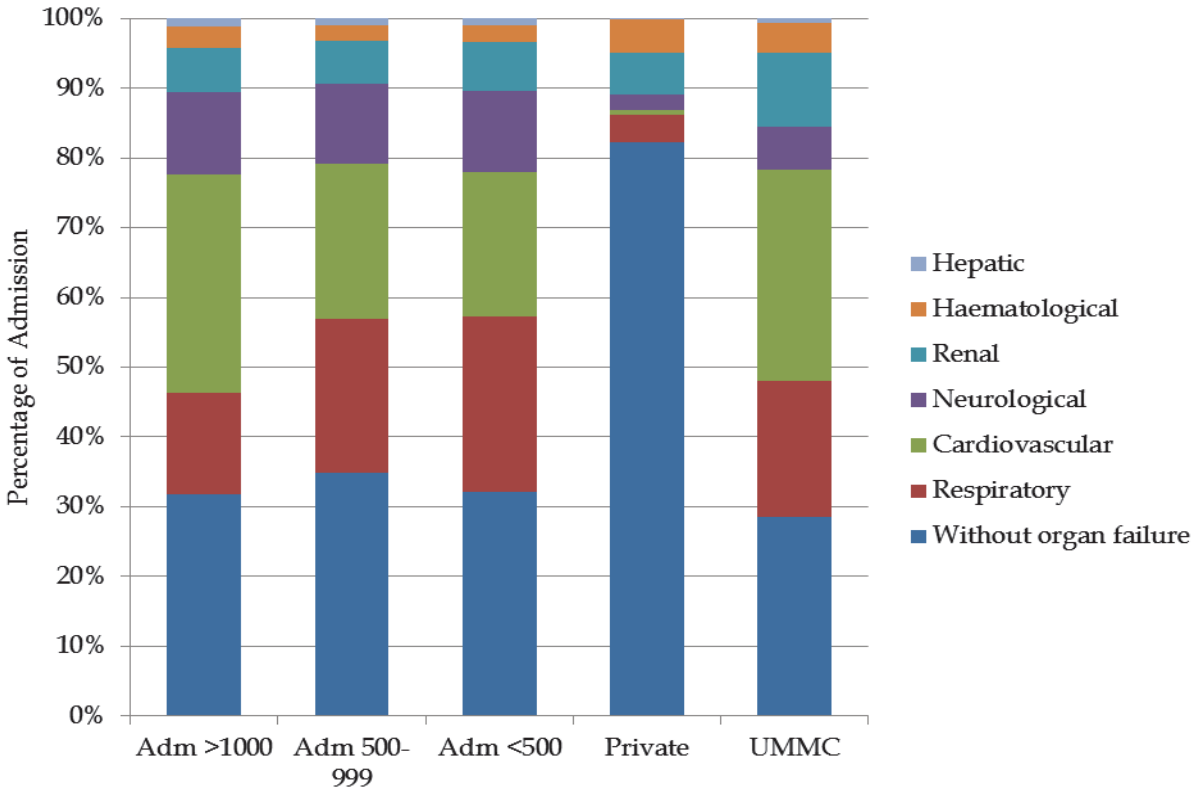
Table 15 : Main organ failure on ICU admission, by category of ICU 2012

Main organ failure	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Without organ failure	4704 (31.8)	2692 (34.9)	1582 (32.1)	933 (82.3)	127 (28.5)	**10038 (34.6)**
Respiratory	2152 (14.5)	1708 (22.1)	1237 (25.1)	45 (4.0)	87 (19.5)	**5229 (18.0)**
Cardiovascular	4644 (31.4)	1714 (22.2)	1024 (20.8)	8 (0.7)	135 (13.3)	**7525 (25.9)**
Neurological	1739 (11.7)	887 (11.5)	571 (11.6)	25 (2.2)	28 (6.3)	**3250 (11.2)**
Renal	945 (6.4)	480 (6.2)	346 (7.0)	67 (5.9)	47 (10.5)	**1885 (6.5)**
Haematological	438 (3.0)	160 (2.1)	118 (2.4)	54 (4.8)	19 (4.8)	**789 (2.7)**
Hepatic	179 (1.2)	81 (1.0)	50 (1.0)	2 (0.2)	3 (0.7)	**315 (2.7)**
Total	**14801 (100.0)**	**7722 (100.0)**	**4928 (100.0)**	**1134 (100.0)**	**446 (100.0)**	**29031 (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.*

Fig 10 : Main organ failure on ICU admission, by category of ICU 2012



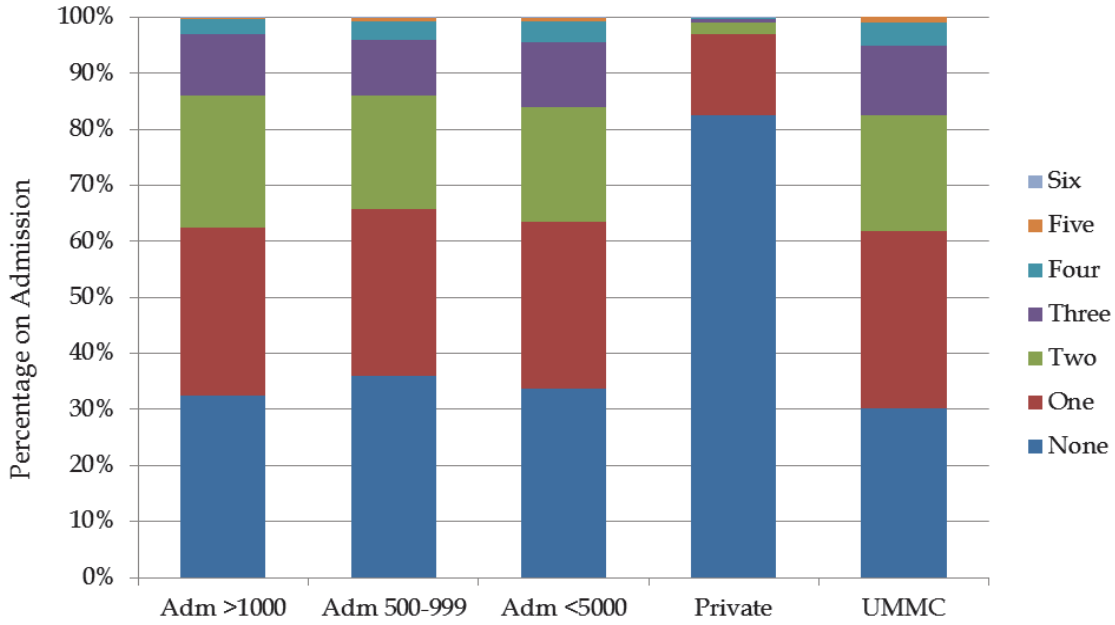
In 2012, about a third of admissions to ICUs in MOH hospitals (32.7%) and UMMC (28.5%) did not have any organ failure in comparison to private hospital ICU where more than two-third (82.3%) were without any organ failure.

In MOH ICUs, cardiovascular failure (40%) was the most common organ failure during the first 24 hours of ICU admission followed by respiratory (28%), neurological (17%), renal (10%), haematological (4%) and hepatic (1%).

Table 16 : Number of organ failure(s) on ICU admission, by category of ICU 2012

Main organ failure	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Without	4802 (32.4)	2777 (36.0)	1665 (33.8)	935 (82.5)	135 (30.3)	**10314 (35.5)**
Single	4430 (29.9)	2304 (29.8)	1461 (29.6)	164 (14.5)	141 (31.6)	**8500 (29.3)**
Two	3509 (23.7)	1560 (20.2)	1016 (20.6)	25 (2.2)	92 (20.6)	**6202 (21.4)**
Three	1600 (10.8)	768 (9.9)	569 (11.5)	5 (0.4)	55 (12.3)	**2997 (10.3)**
Four	403 (2.7)	257 (3.3)	180 (3.7)	3 (0.3)	19 (4.3)	**862 (3.0)**
Five	51 (0.3)	48 (0.6)	33 (0.7)	1 (0.1)	4 (0.9)	**137 (0.5)**
Six	6 (0.0)	8 (0.1)	4 (0.1)	1 (0.1)	0 (0.0)	**19 (0.1)**
Total	**14801 (100)**	**7722 (100)**	**4928 (100)**	**1134 (100)**	**446 (100)**	**29031 (100)**

Figure 11: Number of organ failure(s) on ICU admission by hospitals 2012



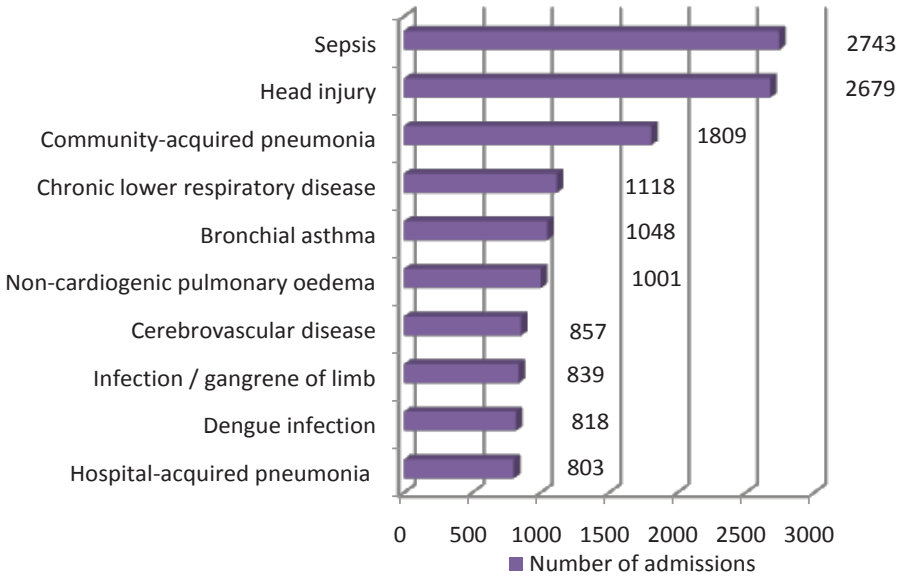
In 2012, about two-thirds (63.5%) of the patients were admitted with one or no organ failure in MOH ICUs. This high percentage could be partly attributed to more ICUs functioning as combined intensive care/high dependency care units.

Table 17 : Ten most common diagnoses leading to ICU admission 2012

Diagnosis	Number	Percentage
Hospitals with admission ≥ 1000		
Sepsis	1771	10.6
Head Injury	1574	9.4
Community acquired pneumonia	780	4.7
Non-cardiogenic pulmonary oedema	576	3.4
Dengue	569	3.4
Bronchial asthma	552	3.3
Chronic lower respiratory disease	503	3.0
Diabetic ketoacidosis / diabetic hyperosmolar hyperglycaemic state (HHS)	481	2.9
Cerebrovascular disease (infarct, thrombosis, haemorrhage)	442	2.7
Infection/gangrene of limb (including osteomyelitis, necrotizing fasciitis)	417	2.5
Hospitals with admission 500 – 999		
Head injury	745	8.1
Community acquired pneumonia	656	7.2
Sepsis	515	5.6
Bronchial asthma	315	3.4
Cerebrovascular disease (infarct, thrombosis, haemorrhage)	303	3.3
Infection / gangrene of limb (including osteomyelitis, necrotizing fasciitis)	283	3.1
Hospital acquired pneumonia	250	2.7
Gastrointestinal perforation (including anastomotic leak)	236	2.6
Non-cardiogenic pulmonary oedema	211	2.3
Intra-abdominal injury	210	2.3
Hospitals with admission < 500		
Sepsis	457	7.6
Community acquired pneumonia	373	6.2
Head injury	360	6.0
Chronic lower respiratory disease	290	4.8
Ischaemic heart disease / acute coronary syndrome	274	4.5
Non-cardiogenic pulmonary oedema	214	3.5
Bronchial asthma Other adverse perioperative events	181	3.0
Gastrointestinal perforation (including anastomotic leak)	171	2.8
Pregnancy induced hypertension/ Eclampsia	156	2.6
Infection / gangrene of limb (including osteomyelitis, necrotizing fasciitis)	139	2.3
Private Hospital		
Seizures (primary, no structural brain disease) Cerebrovascular disease	91	6.2
Gastrointestinal bleeding	84	5.7
Ischaemic heart disease / acute coronary syndrome	83	5.7
Cerebrovascular disease (infarct, thrombosis, haemorrhage)	81	5.5
Other CNS conditions	74	5.0
Other cardiovascular conditions	63	4.3

Dengue	54	3.7
Other abdominal / pelvic conditions	51	3.5
Bronchial asthma	50	3.4
Other respiratory conditions	50	3.4
UMMC		
Gastrointestinal malignancy	31	6.5
Head injury	21	4.4
Bronchial asthma	21	4.4
Community acquired pneumonia	19	4.0
Gastrointestinal perforation (including anastomotic leak)	17	3.6
Sepsis	15	3.2
Urosepsis	15	3.2
Intra-abdominal injury	15	3.2
Infection / gangrene of limb (including osteomyelitis, necrotizing fasciitis)	14	3.0
Hospital acquired pneumonia	13	2.7
Acute renal failure	13	2.7

Figure 12 : Ten most common diagnoses leading to ICU admission in MOH hospitals 2012



Sepsis, head injury and community-acquired pneumonia were the three most common diagnoses leading to ICU admission in MOH hospitals in 2012. 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 2012

Diagnosis	Number	Percentage
Hospitals with admission ≥ 1000		
Non-operative: Sepsis	2384	14.2
Non-operative: Respiratory infection	1263	7.5
Non-operative: Respiratory system as principal reason for admission	1246	7.4
Operative: Respiratory system as principal reason for admission	777	4.6
Non-operative: Multiple trauma	722	4.3
Operative: Multiple trauma	720	4.3
Non-operative: Neurologic system as principal reason for admission	675	4.0
Operative: Cardiovascular system as principal reason for admission	638	3.8
Non-operative: Cardiovascular system as principal reason for admission	567	3.4
Non-operative: Head trauma	498	3.0
Hospitals with admission 500 – 999		
Non-operative: Respiratory infection	970	10.6
Non-operative: Sepsis	967	10.6
Non-operative: Respiratory system as principal reason for admission	599	6.5
Operative: Respiratory insufficiency after surgery	473	5.2
Operative: Respiratory system as principal reason for admission	433	4.7
Operative: Gastrointestinal perforation / obstruction	339	3.7
Non-operative: Metabolic/ renal system as principal reason for admission	335	3.7
Operative: Cardiovascular system as principal reason for admission	323	3.5
Operative: Craniotomy for ICH / SDH / SAH	300	3.3
Non-operative: Asthma / allergy	295	3.2
Hospitals with admission < 500		
Non-operative: Respiratory infection	700	11.6
Non-operative: Sepsis	589	9.8
Non-operative: Respiratory system as principal reason for admission	576	9.5
Non-operative: Neurologic system as principal reason for admission	276	4.6
Non-operative: Metabolic/ renal system as principal reason for admission	249	4.1
Non-operative: Cardiovascular system as principal reason for admission	232	3.8
Operative: Respiratory insufficiency after surgery	209	3.5
Non-operative: Pulmonary oedema (non-cardiogenic)	207	3.4
Operative: Respiratory system as principal reason for admission	200	3.3
Non-operative: COPD	200	3.3
Private Hospital		
Non-operative: Metabolic/ renal system as principal reason for admission	192	13.1
Non-operative: Respiratory system as principal reason for admission	171	11.7
Non-operative: Neurologic system as principal reason for admission	128	8.7
Operative: Cardiovascular system as principal reason for admission	88	6.0
Non-operative: Seizure disorder	84	5.7
Non-operative: Gastrointestinal bleeding	77	5.2

Non-operative: Coronary artery disease	75	5.1
Non-operative: Gastrointestinal system as principal reason for admission	65	4.4
Non-operative: Respiratory infection	62	4.2
Operative: Gastrointestinal system as principal reason for admission	58	4.0
UMMC		
Non-operative: Respiratory infection	51	10.8
Operative: GI surgery for neoplasm	38	8.0
Non-operative: Respiratory system as principal reason for admission	30	6.3
Operative: Gastrointestinal perforation / obstruction	28	5.9
Non-operative: Metabolic/ renal system as principal reason for admission	24	5.1
Non-operative: Sepsis	22	4.6
Operative: Multiple trauma	22	4.6
Non-operative: Asthma /allergy	20	4.2
Operative: Respiratory insufficiency after surgery	20	4.2
Operative: Cardiovascular system as principal reason for admission	18	3.8

Table 19 : Severe sepsis, ARDS and AKI within 24hrs of ICU admission 2012

	ICUs					
	Adm ≥ 1000 n (%)	**Adm 500 - 999 n (%)**	**Adm < 500 n (%)**	**Private n (%)**	**UMMC n (%)**	**Total n (%)**
Severe sepsis*	4212 (25.1)	1681 (18.4)	842 (14.0)	7 (0.5)	136 (28.8)	**6878 (20.3)**
ARDS#	1112 (6.6)	1358 (14.9)	493 (8.2)	12 (0.8)	75 (15.8)	**3050 (9.0)**
AKI^	2501 (14.9)	1204 (13.2)	738 (12.2)	15 (1.0)	135 (28.5)	**4593 (13.6)**

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

1) Temperature >38.3 or < than 36°C
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 injuryl 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 - 2012

Hospital	2011			2012		
	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)
PP	358 (29.9)	113 (9.4)	326(27.2)	449 (34.9)	115 (8.9)	397 (30.9)
IPH	74 (6.5)	131 (11.5)	50 (4.4)	60 (6.6)	61 (6.6)	46 (5.0)
KL	578 (31.5)	473 (25.8)	707 (38.5)	1073 (54.5)	192 (9.8)	589 (29.9)
SLG	222 (19.5)	146 (12.8)	148 (13.0)	352 (27.3)	106 (8.2)	228 (17.7)
KLG	268 (16.7)	62 (3.9)	176 (11.0)	208 (9.7)	22 (1.0)	122 (5.7)
SBN	185 (33.5)	88 (15.9)	100 (18.1)	153 (28.5)	141 (26.3)	90 (16.8)
MLK	346 (21.7)	36 (2.3)	296 (18.6)	93 (5.5)	13 (0.8)	125 (7.4)
JB	457 (27.1)	105 (6.2)	350 (20.8)	478 (27.3)	71 (4.1)	364 (20.8)
KTN	63 (10.3)	39 (6.4)	54 (8.8)	117 (18..3)	66 (10.3)	127 (19.8)
KT	49 (4.1)	3 (0.2)	5 (0.4)	7 (0.5)	1 (0.1)	2 (0.1)
KB	143 (12.7)	33 (2.9)	74 (6.6)	155 (12.1)	185 (14.4)	174 (13.5)
KCH	82 (12.8)	25 (3.9)	59 (19.2)	111 (13.0)	14 (1.6)	59 (6.9)
KK	146 (17.3)	274 (32.6)	86 (10.2)	248 (26.0)	390 (40.9)	164 (17.2)
SP	34 (12.6)	26 (9.6)	13 (4.8)	19 (11.9)	1 (0.6)	10 (6.3)
PJY	71 (13.2)	49 (9.1)	33 (6.2)	63 (11.0)	54 (9.4)	57 (8.0)
MUR	62 (13.1)	13 (2.7)	23 (4.9)	7 (1.1)	22 (3.5)	51 (8.0)
TI	81 (26.3)	199(64.6)	60 (19.5)	65 (17.0)	88 (22.9)	48 (12.5)
TPG	590 (68.6)	3 (0.3)	40 (4.7)	788 (65.5)	18 (1.5)	57 (4.7)
SJ	163 (28.2)	15 (2.6)	91 (15.7)	138 (21.4)	29 (4.5)	113 (17.5)
KJG	38 (11.1)	9 (2.6)	35 (10.3)	14 (3.8)	9 (2.4)	16 (4.3)
KGR	12 (4.0)	2 (0.7)	0 (0.0)	6 (1.7)	-	-
SDMC	13 (0.6)	9 (0.4)	15 (0.7)	7 (0.5)	12 (0.8)	15 (1.0)
TML	60 (11.1)	15 (2.8)	22 (4.1)	48 (11.0)	21 (4.8)	57 (13.1)
KP	111 (30.9)	15 (4.2)	61 (17.0)	110 (32.9)	14 (4.2)	83 (24.9)
SMJ	4 (1.1)	1 (0.3)	0 (0.0)	0 (0)	1 (0.2)	2 (0.5)
BP	145 (32.0)	114 (25.2)	150 (33.1)	86 (20.7)	57 (13.7)	85 (20.5)
TW	33 (12.0)	30 (10.9)	29 (10.6)	84 (19.4)	55 (12.7)	66 (15.3)
MRI	0 (0.0)	1 (0.3)	0 (0.0)	30 (6.3)	7 (1.5)	5 (1.1)
KLM	106 (21.3)	24 (4.8)	35 (7.0)	94 (15.6)	32 (5.3)	28 (4.7)
SDG	42 (4.8)	156 (17.7)	74 (8.4)	51 (5.8)	260 (29.7)	158 (18.1)
SB	97 (17.1)	43 (7.6)	117 (20.6)	78 (15.9)	38 (7.8)	95 (19.5)
DKS	64 (12.2)	22 (4.2)	36 (6.9)	67 (12.7)	26 (4.9)	53 (10.1)
SI	194 (30.1)	67 (10.4)	129 (20.0)	277 (34.6)	76 (9.5)	156 (19.5)
SBL	69 (5.5)	108 (8.6)	102 (8.1)	199 (12.6)	111 (7.0)	230 (14.6)
AMP	237 (42.9)	206 (37.3)	81 (14.6)	295 (51.6)	187 (32.7)	102 (17.8)
LIK	10 (2.7)	15 (4.0)	4 (1.1)	18 (6.7)	7 (2.6)	10 (3.7)

UMMC	-	-	-	136 (28.8)	75 (15.8)	135 (28.5)
LKW	-	-	-	45 (28.7)	30 (19.1)	40 (25.5)
BM	-	-	-	3 (7.9)	0 (0)	7 (18.4)
SLR	-	-	-	43 (27.9)	27 (17.5)	37 (24.0)
PD	-	-	-	40 (19.6)	2 (1.0)	27 (13.2)
KKR	-	-	-	6 (4.0)	7 (4.7)	16 (10.7)
SGT	-	-	-	34 (27.0)	10 (7.9)	33 (26.2)
TM	-	-	-	0 (0)	1 (5.9)	1 (5.9)
KEM	-	-	-	7 (7.4)	5 (5.3)	10 (10.6)
KLP	-	-	-	0 (0)	0 (0)	0 (0)
LAB	-	-	-	17 (15.9)	15 (14.0)	11 (10.3)
KEN	-	-	-	8 (9.9)	7 (8.6)	5 (6.2)
BIN	-	-	-	51 (23.9)	67 (31.6)	29 (13.6)
LD	-	-	-	30 (18.0)	24 (14.3)	45 (26.8)
Total	**5566 (18.7)**	**2957 (9.9)**	**3779 (12.7)**	**6878 (20.3)**	**3050 (9.0)**	**4593 (13.6)**

During the first 24 hours of ICU admission, 20.3%, 9% and 13.6% of patients had severe sepsis, acute respiratory distress syndrome and acute kidney injury respectively.

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 2008 - 2012

Hospital	SAPS II score (mean)				
	2008	2009	2010	2011	2012
AS	42.2	47.2	42.4	39.4	40.1
PP	36.2	37.8	34.9	38.0	36.5
IPH	31.0	32.9	33.7	33.0	32.0
KL	37.5	38.3	34.5	38.3	38.9
SLG	39.5	38.2	33.2	34.5	36.0
KLG	35.0	34.3	34.5	38.2	36.9
SBN	42.4	39.1	38.0	39.2	39.2
MLK	35.3	36.6	31.9	33.4	36.8
JB	37.5	39.0	38.2	39.1	40.7
KTN	36.6	35.9	33.4	34.5	39.8
KT	37.6	36.0	36.2	39.0	41.5
KB	29.7	25.4	30.0	33.4	34.4
KCH	33.3	33.9	32.4	35.0	33.0
KK	34.7	34.0	37.4	36.4	33.2
SP	43.8	38.1	41.0	40.1	43.3
PJY	33.5	30.8	29.6	28.7	28.0
MUR	30.3	31.2	32.1	37.9	37.6
TI	43.6	43.3	42.6	41.7	41.1
TPG	45.6	42.0	43.5	42.2	40.4
SJ	39.6	42.6	40.6	40.3	38.9
KJG	35.4	35.5	34.9	36.0	31.7
KGR	35.0	34.5	36.3	33.9	35.3
SDMC	21.0	19.7	18.3	18.0	18.8
TML	36.6	40.6	38.3	37.3	34.5
KP	43.0	43.3	43.0	40.0	41.2
SMJ	37.1	39.9	39.6	38.8	40.0
BP	43.5	45.4	41.0	43.3	43.4
TW	46.6	52.9	51.4	40.0	41.4
MRI	34.2	37.5	33.5	34.9	35.5
KLM	41.0	40.6	41.0	42.8	42.7
SDG	34.2	33.7	35.5	37.6	41.9
SB	-	-	39.6	39.2	40.4
DKS	-	-	51.0	41.3	38.0
SI	-	-	40.1	38.3	38.1
SBL	-	-	33.2	37.6	39.1
AMP	-	-	45.9	46.5	48.6
LIK	-	-	17.0	21.6	21.1
UMMC	-	-	-	-	36.5
LKW	-	-	-	-	41.2
BM	-	-	-	-	42.8
SLR	-	-	-	-	47.9
PD	-	-	-	-	31.3
KKR	-	-	-	-	36.0

SGT	-	-	-	-	39.9
TM	-	-	-	-	25.3
KEM	-	-	-	-	39.2
KLP	-	-	-	-	8.4
LAB	-	-	-	-	40.0
KEN	-	-	-	-	44.9
BIN	-	-	-	-	33.5
LD	-	-	-	-	48.8
Total	**37.7**	**35.8**	**35.1**	**36.1**	**37.3**

The average SAPS II score has remained the same over the years. The average SAPS II score in MOH hospitals for 2012 was 37.3; which carries predicted in-hospital mortality of 30.4% [8].

Table 22 : Sequential Organ Failure Assessment (SOFA) [4] by individual hospital 2008 – 2012

Hospital	SOFA score Mean (Median)				
	2008	2009	2010	2011	2012
AS	7.3 (7)	7.9 (7)	8.0 (8)	7.3 (7)	7.3 (7)
PP	6.6 (6)	7.1 (7)	6.3 (6)	6.2 (5)	6.7 (6)
IPH	4.8 (4)	5.9 (5)	5.9 (5)	5.4 (5)	5.4 (5)
KL	6.6 (6)	6.7 (6)	6.4 (6)	6.5 (6)	7.0 (7)
SLG	7.6 (7)	7.1 (6)	6.3 (5)	6.5 (6)	6.7 (6)
KLG	6.6 (6)	6.5 (6)	6.6 (6)	7.5 (7)	7.4 (7)
SBN	7.3 (7)	7.1 (7)	6.9 (6)	7.1 (7)	7.0 (7)
MLK	5.5 (5)	6.1 (6)	5.6 (5)	5.6 (5)	6.1 (6)
JB	7.2 (7)	7.3 (7)	7.4 (7)	7.2 (7)	7.4 (7)
KTN	6.6 (6)	6.3 (6)	5.7 (5)	5.9 (5)	7.0 (7)
KT	6.3 (6)	5.9 (5)	6.0 (6)	6.1 (6)	6.6 (6)
KB	3.9 (3)	3.6 (2)	4.7 (3)	5.1 (4)	5.3 (4)
KCH	5.6 (5)	5.9 (5)	5.6 (4)	6.0 (5)	5.4 (4)
KK	4.9 (4)	5.5 (5)	6.0 (5)	6.0 (6)	5.7 (5)
SP	7.1 (7)	5.3 (4)	6.8 (6)	6.9 (6)	6.8 (6)
PJY	5.2 (4)	4.4 (3)	4.2 (3)	4.1 (3)	4.2 (3)
MUR	5.7 (5)	5.3 (5)	5.1 (4)	5.9 (6)	5.5 (5)
TI	7.4 (7)	7.4 (7)	8.0 (8)	7.3 (7)	7.4 (7)
TPG	8.0 (8)	7.7 (8)	8.2 (8)	7.6 (8)	7.1 (7)
SJ	6.5 (6)	7.3 (7)	6.3 (6)	6.6 (6)	6.2 (6)
KJG	6.6 (6)	5.7 (5)	6.0 (5)	7.3 (7)	5.6 (5)
KGR	6.3 (6)	6.0 (6)	5.9 (5)	5.5 (4)	5.5 (5)
SDMC	2.0 (1)	1.6 (0)	1.3 (0)	1.4 (0)	1.4 (0)
TML	6.0 (5)	6.8 (6)	6.4 (6)	6.2 (5)	6.1 (5)
KP	7.7 (7)	7.7 (7)	7.6 (7)	7.3 (7)	7.3 (7)
SMJ	7.0 (7)	8.3 (8)	7.3 (7)	6.9 (7)	7.3 (7)
BP	7.0 (7)	6.7 (6)	6.7 (6)	6.9 (6)	7.1 (7)
TW	8.3 (8)	9.0 (9)	8.8 (9)	7.2 (6)	7.2 (6)
MRI	6.4 (6)	6.2 (6)	5.2 (4)	5.5 (5)	5.9 (6)
KLM	7.4 (7)	7.3 (7)	8.4 (8)	8.5 (8)	7.8 (7)
SDG	6.1 (6)	5.7 (5)	6.3 (5)	6.5 (6)	7.2 (7)
SB	-	-	7.8 (7)	7.8(7)	7.6 (7)
DKS	-	-	9.2 (9)	6.5 (6)	5.8 (5)
SI	-	-	6.6 (6)	6.5 (6)	6.8 (6)
SBL	-	-	6.6 (7)	7.0 (8)	7.3 (8)
AMP	-	-	8.6 (9)	8.8 (9)	8.9 (9)
LIK	-	-	1.3 (0)	2.2 (1)	2.6 (1)
UMMC	-	-	-	-	7.6 (7)
LKW	-	-	-	-	5.7 (5)
BM	-	-	-	-	9.5 (10)
SLR	-	-	-	-	7.9 (8)

PD	-	-	-	-	4.7 (4)
KKR	-	-	-	-	6.8 (6)
SGT	-	-	-	-	6.4 (6)
TM	-	-	-	-	3.1 (3)
KEM	-	-	-	-	6.0 (5)
KLP	-	-	-	-	0.8 (1)
LAB	-	-	-	-	4.2 (2)
KEN	-	-	-	-	5.9 (5)
BIN	-	-	-	-	5.7 (5)
LD	-	-	-	-	8.7 (9)
Overall	**5.9 (5)**	**6.0 (5)**	**6.2 (5)**	**6.2 (6)**	**6.4 (6)**

The average SOFA score in 2012 was 6.4. BM had the highest score of 9.5 while SDMC had the lowest score of 0.8.

SECTION C:

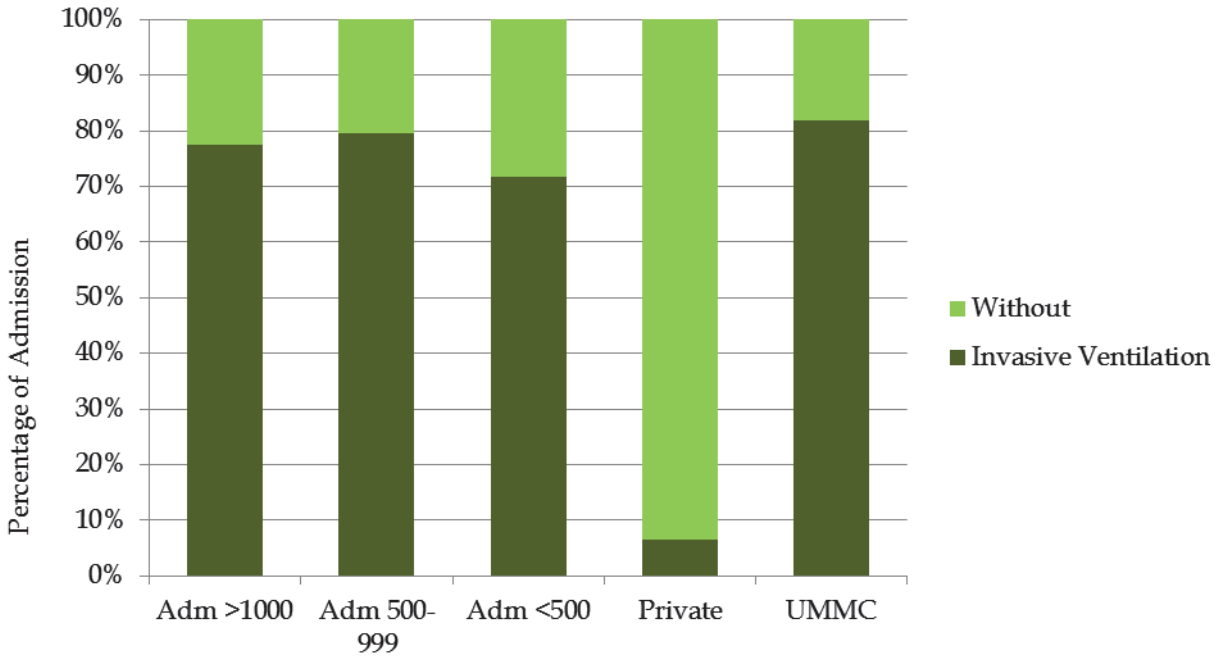
INTERVENTIONS

Table 23 : Invasive ventilation, non-invasive ventilation and reintubation, by category of ICU 2012

	ICUs					
	Adm ≥ 1000 n (%)	**Adm 500 - 999 n (%)**	**Adm < 500 n (%)**	**Private n (%)**	**UMMC n (%)**	**Total n (%)**
Invasive ventilation	12989 (77.5)	7269 (79.5)	4331 (71.7)	94 (6.4)	388 (81.9)	**25071 74%**
Non-invasive ventilation	2796 (16.7)	1924 (21.1)	972 (16.1)	10 (0.7)	157 (33.1)	**5859 17.3%**
Reintubation	901 (7.0)	412 (5.7)	246 (5.7)	1 (1.1)	47 (12.1)	**1607 6.4%**

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

Fig 13 : Invasive ventilation, by category of ICU 2012



77% and 82% of ICU admission to MOH hospitals and UMMC received invasive mechanical ventilation respectively. In contrast, majority of patients (94%) in private hospital were not mechanically ventilated.

Fig 14 : Non-invasive ventilation, by category of ICU 2012

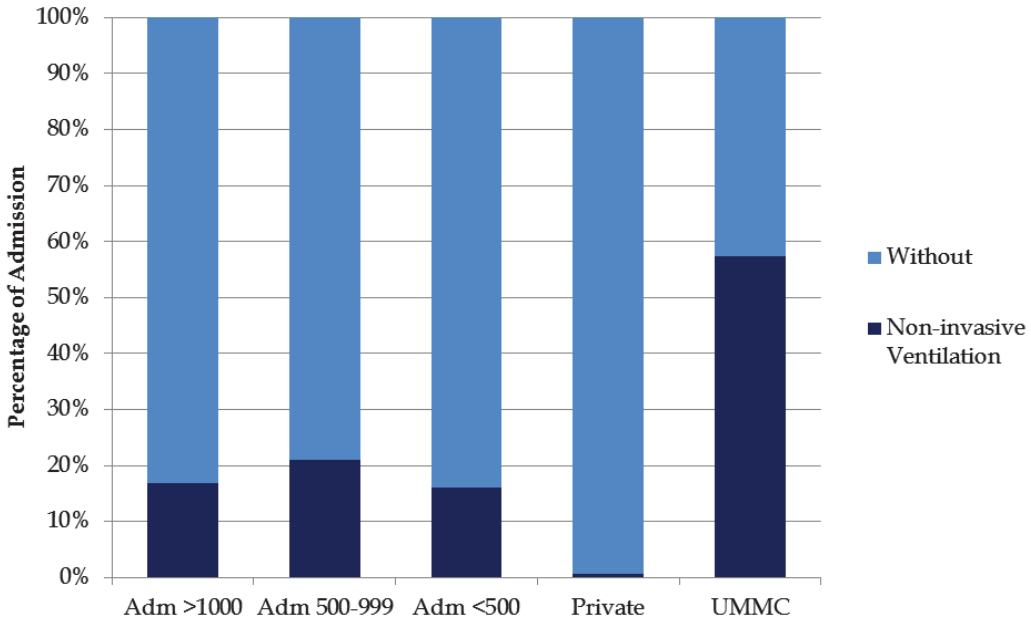
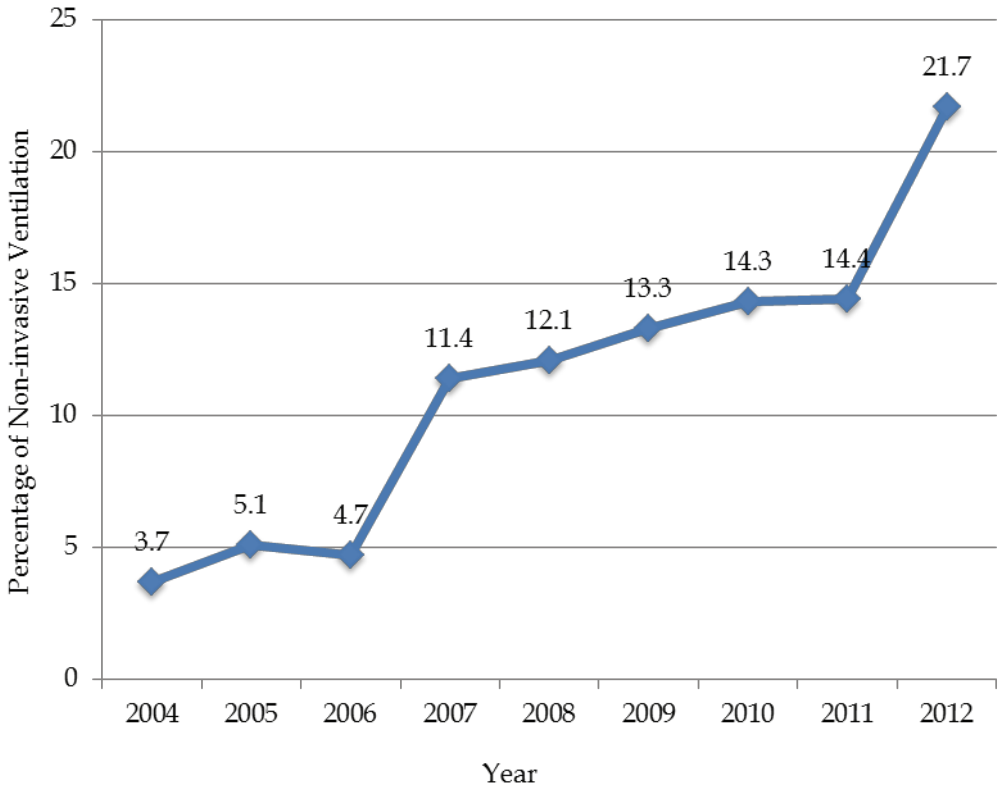
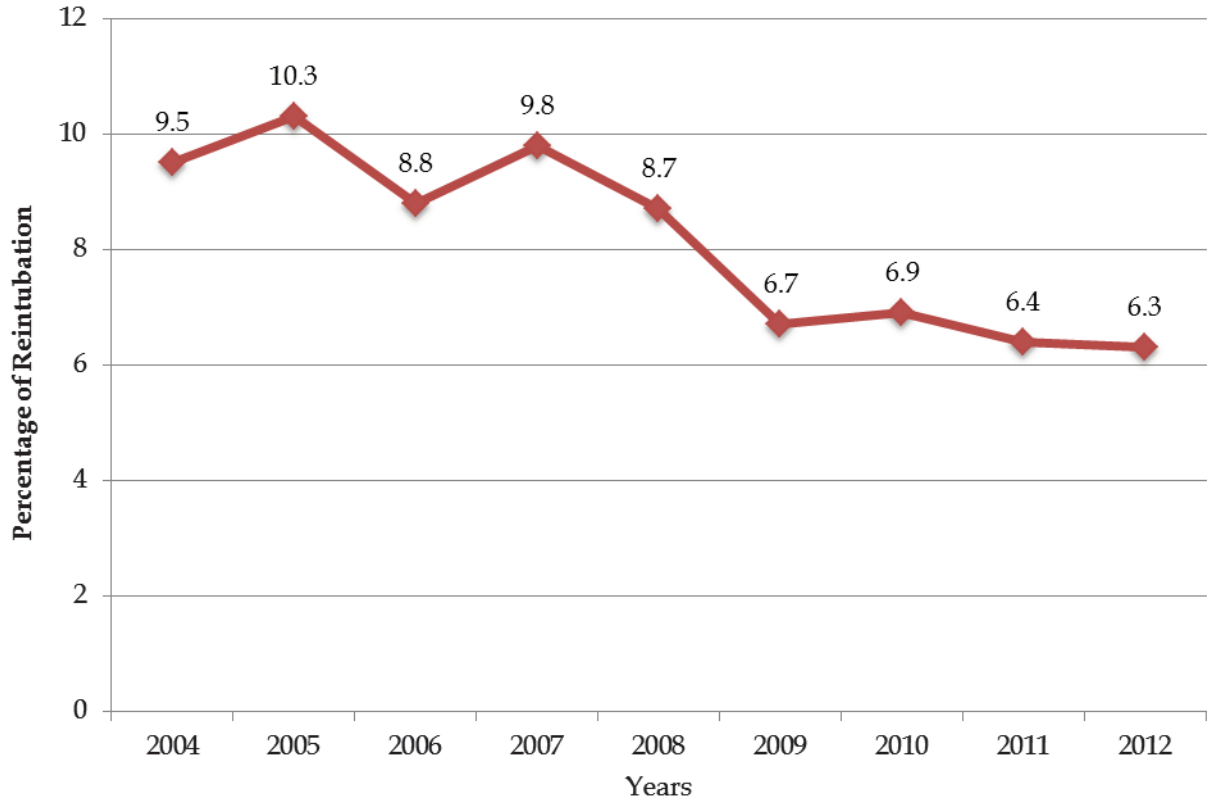


Figure 15 : Non-invasive ventilation, MOH hospitals 2004 – 2012



The percentage of patients receiving non-invasive ventilation in MOH ICUs increased by almost six fold from 3.7% in 2004 to 21.7% in 2012. Thirty three percent of ICU admissions in UMMC received non-invasive ventilation while 0.7% of ICU patients in the SDMC received non-invasive ventilation.

Fig 16 : Reintubation, MOH hospitals 2004 - 2012



The reintubation rate in MOH participating centres and UMMC was 6.3% and 12.1% respectively.

Table 24 : Duration of invasive mechanical ventilation, by individual hospital 2008 - 2012

Hospital	Mean ± SD days				
	2008	2009	2010	2011	2012
AS	3.6 ± 4.5	3.4. ± 6.1	3.2 ± 4.5	3.6 ± 4.8	4.8 ± 6.0
PP	4.2 ± 6.9	5.0 ± 8.6	4.8 ± 7.6	5.1 ± 7.1	5.2 ± 7.8
IPH	4.7 ± 6.9	4.6 ± 6.2	4.3 ± 5.9	5.3 ± 7.2	5.1 ± 6.7
KL	3.7 ± 6.6	3.8 ± 6.4	3.7 ± 6.4	3.9 ± 5.8	4.5 ± 7.1
SLG	4.1 ± 5.6	4.3 ± 5.4	4.1 ± 6.4	4.5 ± 6.3	4.9 ± 5.9
KLG	4.7 ± 8.6	4.7 ± 7.3	4.1 ± 5.3	2.9 ± 4.3	2.7 ± 4.5
SBN	5.3 ± 10.5	4.7 ± 6.8	4.4 ± 6.9	5.1 ± 7.4	4.9 ± 6.8
MLK	4.1 ± 5.3	4.6 ± 6.7	4.2 ± 5.2	4.0 ± 1.7	4.3 ± 5.7
JB	4.6 ± 7.2	4.2 ± 6.5	4.2 ± 5.7	4.8 ± 6.3	4.9 ± 6.2
KTN	3.8 ± 6.5	3.3 ± 4.5	2.9 ± 3.8	4.9 ± 7.1	5.6 ± 6.9
KT	3.6 ± 5.1	4.2 ± 6.7	3.6 ± 4.3	3.5 ± 4.6	3.4 ± 4.6
KB	3.3 ± 5.2	3.5 ± 5.5	3.6 ± 6.0	3.9 ± 7.3	3.6 ± 6.3
KCH	4.9 ± 7.9	4.6 ± 6.7	4.1 ± 6.2	5.4 ± 7.4	5.0 ± 7.2
KK	4.7 ± 9.5	4.9 ± 6.1	4.7 ± 7.1	5.2 ± 7.0	5.5 ± 7.2
SP	6.5 ± 6.8	3.5 ± 3.3	3.6 ± 4.0	3.9 ± 5.3	3.9 ± 4.0
PJY	3.8 ± 5.7	4.1 ± 6.3	3.0 ± 5.7	3.3 ± 5.5	3.1 ± 4.9
MUR	5.6 ± 10.2	4.5 ± 6.4	2.9 ± 4.0	5.1 ± 8.1	3.8 ± 6.8
TI	3.7 ± 6.3	3.5 ± 5.7	3.0 ± 8.0	3.7 ± 5.8	4.0 ± 8.0
TPG	4.1 ± 5.2	5.3 ± 7.6	7.0 ± 10.1	7.3 ± 9.6	5.2 ± 8.0
SJ	4.9 ± 7.4	4.1 ± 5.6	3.7 ± 4.8	4.0 ± 6.3	4.3 ± 7.2
KJG	3.3 ± 4.5	5.3 ± 7.3	3.6 ± 4.4	4.8 ± 15.3	4.9 ± 7.3
KGR	4.0 ± 7.8	3.4 ± 4.3	3.1 ± 4.7	3.5 ± 6.3	3.8 ± 6.5
SDMC	4.1 ± 5.3	3.8 ± 4.5	4.2 ± 5.4	2.9 ± 4.7	2.5 ± 4.1
TML	4.4 ± 5.6	4.4 ± 6.0	4.5 ± 6.3	5.5 ± 8.9	4.9 ± 6.7
KP	3.9 ± 5.5	4.1 ± 5.9	2.6 ± 3.5	5.6 ± 8.2	5.0 ± 7.5
SMJ	5.0 ± 6.5	4.9 ± 7.5	3.9 ± 6.0	3.0 ± 4.9	3.2 ± 4.1
BP	5.5 ± 8.7	4.7 ± 6.4	4.5 ± 7.0	4.4 ± 6.1	5.2 ± 6.4
TW	4.3 ± 6.0	4.5 ± 9.5	3.1 ± 3.7	2.9 ± 3.9	3.2 ± 6.3
MRI	4.6 ± 5.5	6.1 ± 7.7	4.7 ± 5.7	4.6 ± 5.3	4.7 ± 5.4
KLM	2.7 ± 3.3	3.4 ± 5.5	3.2 ± 3.8	3.6 ± 5.6	3.3 ± 4.3
SDG	4.7 ± 7.5	4.1 ± 6.1	3.2 ± 4.8	4.6 ± 6.0	4.5 ± 5.4
SB	-	-	4.6 ± 7.3	5.1 ± 7.0	5.3 ± 9.1
DKS	-	-	5.8 ± 8.5	6.3 ± 11.2	5.2 ± 8.1
SI	-	-	4.3 ± 6.5	7.1 ± 13.6	5.9 ± 10.3
SBL	-	-	5.8 ± 6.6	6.2 ± 7.0	5.7 ± 6.3
AMP	-	-	3.8 ± 5.5	5.1 ± 7.7	4.4 ± 5.9
LIK	-	-	1.4 ± 1.7	1.8 ± 2.2	3.6 ± 5.2
UMMC	-	-	-	-	8.1 ± 11.4
LKW	-	-	-	-	4.2 ± 7.6
BM	-	-	-	-	-
SLR	-	-	-	-	5.3 ± 6.3
PD	-	-	-	-	2.8 ± 3.4

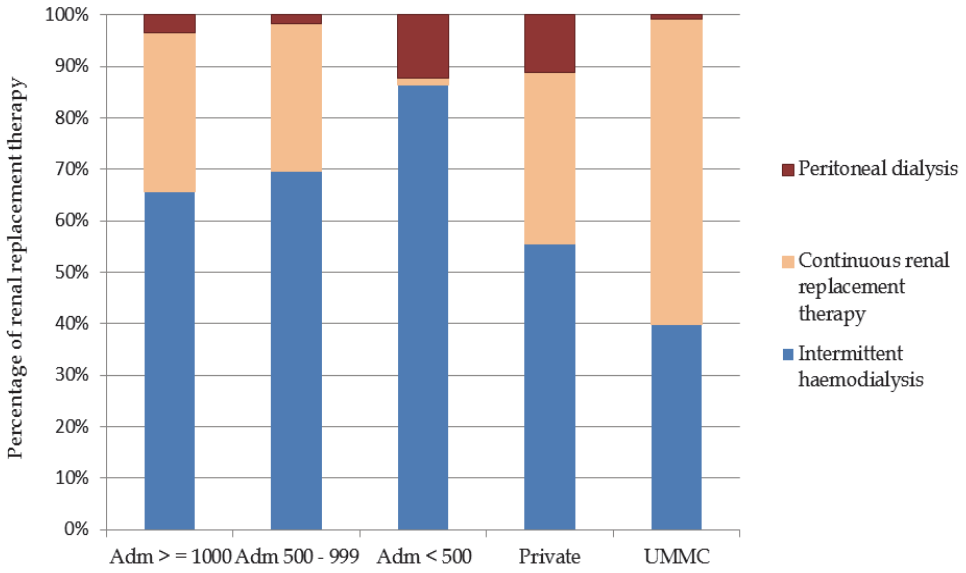
KKR	-	-	-	-	4.8 ± 6.3
SGT	-	-	-	-	4.3 ± 7.1
TM	-	-	-	-	-
KEM	-	-	-	-	-
KLP	-	-	-	-	-
LAB	-	-	-	-	4.6 ± 6.6
KEN	-	-	-	-	-
BIN	-	-	-	-	6.2 ± 8.3
LD	-	-	-	-	5.2 ± 14.0
Total	**4.2 ± 6.9**	**4.3 ± 6.5**	**4.1 ± 6.1**	**4.6 ± 7.1**	**4.5 ± 6.8**

The average duration of mechanical ventilation was 4.5 days in 2012. KLG had the shortest duration of invasive mechanical ventilation at 2.7 days while UMMC had the longest at 8.0 days. Data for this variable was excluded for hospitals BM, TM, KEM, KLP and KEN as their submitted number of ICU admissions was less than 100 for 2012.

Table 25 : Renal replacement therapy and modalities of therapy, by category of ICU 2012

	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Renal replacement therapy	2497 (15.0)	1311 (14.4)	690 (11.4)	9 (0.6)	96 (20.3)	**4603 (13.6)**
Modalities of therapy						
Intermittent haemodialysis	1830 (65.6)	981 (69.4)	608 (86.3)	5 (55.5)	41 (39.8)	**3465 (69.0)**
CRRT	858 (30.7)	407 (28.8)	10 (1.4)	3 (33.3)	61 (59.2)	**1339 (26.6)**
Peritoneal dialysis	100 (3.5)	24 (1.6)	86 (12.2)	1 (11.1)	1 (0.9)	**212 (4.2)**
Total	**2788 (100)**	**1412 (100)**	**704 (100)**	**9 (100)**	**103 (100)**	**5016 (100)**

Figure 17 : Modalities of renal replacement therapy, by category of ICU 2012



In MOH ICUs, 15% of admissions received renal replacement therapy in 2012. 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.

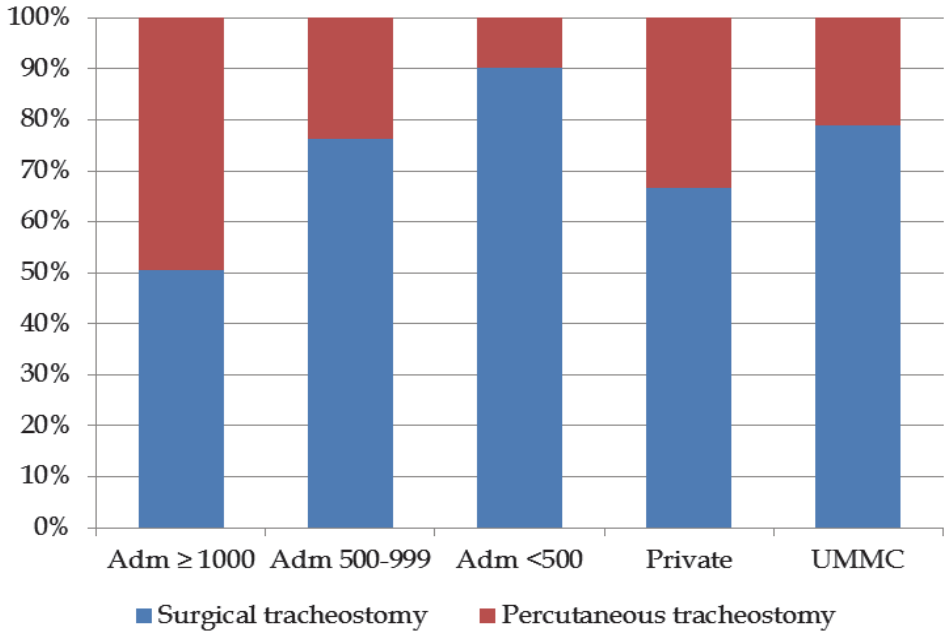
Intermittent haemodialysis and continuous renal replacement therapy were the most common modalities of renal replacement therapy performed in MOH ICUs and UMMC respectively.

Table 26 : Tracheostomy 2012

	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Tracheostomy	1634 (12.6)	858 (11.8)	365 (8.4)	3 (3.2)	76 (19.6)	**2936 (11.7)**
Tracheostomy technique						
Surgical	826 (50.6)	669 (78.0)	329 (90.1)	2 (66.7)	60 (78.9)	**1886 (64.2)**
Percutaneous	808 (49.4)	189 (22.0)	36 (9.9)	1 (33.3)	16 (21.1)	**1050 (35.8)**

Tracheostomy: Refers to the procedure done during ICU stay

Figure 18 : Techniques of tracheostomy, by category of ICU 2012



Percutaneous tracheostomy (49.4%) was more commonly performed in ICUs with more than 1000 admissions.

Table 27 : Tracheostomy, by individual hospital 2012

Hospital	Tracheostomy performed n (%)	Tracheostomy in relation to days of ventilation mean (median)	Type of tracheostomy	
			Surgical n (%)	Percutaneous n (%)
AS	150 (13.8)	8.8 (7.3)	115 (76.7)	35 (23.3)
PP	210 (20.5)	7.2 (6.0)	72 (34.3)	138 (65.7)
IPH	109 (14.1)	8.1 (4.7)	91 (83.5)	18 (16.5)
KL	149 (10.4)	9.5 (7.2)	36 (24.2)	113 (75.8)
SLG	102 (10.0)	9.8 (8.8)	73 (71.6)	29 (28.4)
KLG	155 (9.9)	5.0 (4.2)	37 (23.9)	118 (76.1)
SBN	55 (12.0)	8.7 (7.4)	55 (100.0)	0 (0.0)
MLK	88 (7.2)	9.1 (7.6)	88 (100.0)	0 (0.0)
JB	332 (22.8)	5.9 (4.9)	89 (26.8)	243 (73.2)
KTN	112 (19.5)	8.2 (7.3)	107 (95.5)	5 (4.5)
KT	88 (8.0)	7.4 (6.5)	55 (62.5)	33 (37.5)
KB	27 (2.6)	17.0 (15.6)	17 (63.0)	10 (37.0)
KCH	71 (9.6)	10.5 (9.7)	54 (76.1)	17 (23.9)
KK	104 (13.7)	8.9 (6.4)	78 (75.0)	26 (25.0)
SP	11 (10.2)	6.9 (7.1)	11 (100.0)	0 (0.0)
PJY	26 (6.5)	9.3 (7.9)	26 (100.0)	0 (0.0)
MUR	40 (8.5)	9.4 (8.7)	39 (97.5)	1 (2.5)
TI	24 (8.5)	9.7 (7.3)	24 (100)	0 (0.0)
TPG	127 (13.6)	8.0 (6.2)	126 (99.2)	1 (0.8)
SJ	57 (10.8)	7.6 (5.7)	44 (77.2)	13 (22.8)
KJG	14 (6.0)	10.4 (8.0)	14 (100.0)	0 (0.0)
KGR	19 (6.6)	10.1 (8.6)	19 (100.0)	0 (0.0)
SDMC	3 (3.2)	10.3 (10.3)	2 (66.7)	1 (33.3)
TML	29 (8.3)	8.3 (7.6)	28 (96.6)	1 (3.4)
KP	24 (8.8)	12.9 (11.1)	24 (100.0)	0 (0.0)
SMJ	16 (5.9)	9.4 (7.8)	4 (25.0)	12 (75.0)
BP	36 (9.9)	10.6 (10.2)	36 (100.0)	0 (0.0)
TW	25 (8.1)	5.1 (4.1)	25 (100.0)	0 (0.0)
MRI	33 (9.1)	9.5 (7.6)	27 (81.8)	6 (18.2)
KLM	78 (16.8)	4.8 (4.4)	78 (100.0)	0 (0.0)
SDG	56 (9.7)	9.3 (8.3)	38 (67.9)	18 (32.1)
SB	56 (15.3)	8.7 (7.5)	54 (96.4)	2 (3.6)
DKS	25 (6.6)	9.9 (8.5)	5 (20.0)	20 (80.0)
SI	66 (10.3)	12.2 (12.1)	50 (75.8)	16 (24.2)
SBL	206 (19.1)	8.6 (7.2)	118 (57.3)	88 (42.7)
AMP	59 (11.8)	7.9 (7.2)	4 (6.8)	55 (93.2)
LIK	5 (6.3)	12.3 (11.1)	5 (100.0)	0 (0.0)
UMMC	76 (19.6)	12.3 (10.2)	60 (78.9)	16 (21.1)
LKW	10 (8.5)	9.6 (8.5)	10 (100.0)	0 (0.0)
BM	11 (34.4)	7.2 (6.6)	11 (100.0)	0 (0.0)
SLR	5 (3.8)	15.9 (16.2)	5 (100.0)	0 (0.0)
PD	5 (6.3)	11.4 (10.3)	5 (100.0)	0 (0.0)

KKR	6 (5.0)	14.3 (15.9)	6 (100.0)	0 (0.0)
SGT	7 (7.5)	6.3 (4.0)	7 (100.0)	0 (0.0)
TM	0 (0.0)	-	0 (0.0)	0 (0.0)
KEM	1 (1.5)	3.0 (3.0)	1 (100.0)	0 (0.0)
KLP	0 (0.0)	-	0 (0.0)	0 (0.0)
LAB	6 (9.1)	12.5 (10.1)	6 (100.0)	0 (0.0)
KEN	0 (0.0)	-	0 (0.0)	0 (0.0)
BIN	12 (7.6)	12.5 (12.7)	5 (41.7)	7 (58.3)
LD	10 (7.7)	11.2 (11.2)	2 (20.0)	8 (80.0)
Total	**2936 (11.7)**	**8.4 (6.9)**	**1886 (64.2)**	**1050 (35.8)**

Among invasively ventilated patients, 11.7% had tracheostomies performed. The median time from initiation of invasive ventilation to tracheostomy was 6.9 days. KEM had the shortest interval of 3.0 days while KB had the longest interval of 17 days.

Table 28 : Tracheostomy, by individual hospital 2008 – 2012

	Total tracheostomy (% percutaneous tracheostomy) n (%)				
	2008	**2009**	**2010**	**2011**	**2012**
AS	64 (48.4)	125 (41.6)	105 (42.9)	126 (23.0)	150 (23.3)
PP	99 (35.4)	86 (29.1)	135 (63.0)	199 (64.8)	210 (65.7)
IPH	117 (23.9)	124 (12.9)	153 (3.9)	140 (2.9)	109 (16.5)
KL	133 (72.9)	104 (79.8)	142 (78.2)	128 (75.0)	149 (75.8)
SLG	84 (8.3)	58 (6.9)	66 (8.0)	77 (18.2)	102 (28.4)
KLG	88 (4.5)	117 (1.7)	110 (21.8)	190 (73.7)	155 (76.1)
SBN	57 (0.0)	58 (0.0)	59 (0.0)	68 (1.5)	55 (0.0)
MLK	124 (2.4)	134 (0.0)	105 (0.0)	100 (1.0)	88 (0.0)
JB	242 (83.9)	225 (83.6)	325 (77.8)	465 (79.4)	332 (73.2)
KTN	53 (13.2)	50 (8.0)	40 (5.0)	80 (7.5)	112 (4.5)
KT	64 (73.4)	53 (67.9)	60 (78.3)	67 (50.7)	88 (37.5)
KB	21 (4.8)	12 (8.3)	14 (14.3)	29 (24.1)	27 (37.0)
KCH	49 (8.2)	23 (13.0)	47 (17.0)	63 (36.5)	71 (23.9)
KK	55 (1.8)	28 (0.0)	58 (24.1)	46 (8.7)	104 (25.0)
SP	23 (0.0)	26 (3.8)	8 (0.0)	23 (0)	11 (0.0)
PJY	5 (0.0)	10 (0.0)	11 (0.0)	21 (0)	26 (0.0)
MUR	34 (55.9)	26 (0.0)	26 (3.8)	36 (0)	40 (2.5)
TI	16 (62.5)	12 (83.3)	8 (0.0)	18 (0)	24 (0.0)
TPG	53 (0.0)	140 (0.0)	145 (0.7)	149 (0)	127 (0.8)
SJ	44 (2.3)	56 (0.0)	60 (8.3)	61 (37.7)	57 (22.8)
KJG	19 (0.0)	25 (0.0)	26 (0.0)	19 (5.3)	14 (0.0)
KGR	20 (0.0)	33 (15.2)	11 (0.0)	7 (0)	19 (0.0)
SDMC	15 (33.3)	9 (44.4)	2 (0.0)	6 (16.7)	3 (33.3)
TML	29 (0.0)	40 (0.0)	45 (0.0)	38 (0)	29 (3.4)
KP	10 (0.0)	18 (0.0)	7 (0.0)	27 (0)	24 (0.0)
SMJ	8 (12.5)	19 (57.9)	9 (66.7)	9 (88.9)	16 (75.0)

BP	46 (2.2)	39 (0.0)	46 (0.0)	54 (0)	36 (0.0)
TW	11 (9.1)	13 (15.4)	10 (0.0)	21 (0)	25 (0.0)
MRI	23 (4.3)	29 (0.0)	10 (20.0)	8 (0)	33 (18.2)
KLM	34 (0.0)	34 (0.0)	47 (0.0)	55 (0)	78 (0.0)
SDG	39 (41.0)	51 (64.7)	44 (43.2)	52 (42.3)	56 (32.1)
SB	-	-	22 (18.2)	36 (0)	56 (3.6)
DKS	-	-	13 (53.8)	21 (76.2)	25 (80.0)
SI	-	-	30 (26.7)	64 (26.6)	66 (24.2)
SBL	-	-	212 (87.3)	262 (68.3)	206 (42.7)
AMP	-	-	33 (97.0)	55 (92.7)	59 (93.2)
LIK	-	-	0 (0.0)	1 (0)	5 (0.0)
UMMC					76 (21.1)
LKW					10 (0.0)
BM					11 (0.0)
SLR					5 (0.0)
PD					5 (0.0)
KKR					6 (0.0)
SGT					7 (0.0)
TM					-
KEM					1 (0.0)
KLP					-
LAB					6 (0.0)
KEN					-
BIN					12 (58.3)
LD					10 (80.0)
Total	**1671 (31.1)**	**1821 (28.4)**	**2244 (39.0)**	**2821 (41.7)**	**2936 (35.8)**

The percentage of percutaneous tracheostomies has increased over the past 5 years. In 2012, 35.8% of all tracheostomies were performed percutaneously.

Table 29 : Withdrawal / withholding therapy, by individual hospital 2009 – 2012

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

LIK	-	0 (0.0)	1 (9.1)	0 (0.0)
UMMC	-	-	-	63 (66.3)
LKW	-	-	-	11 (25.0)
BM	-	-	-	0 (0.0)
SLR	-	-	-	2 (3.4)
PD	-	-	-	7 (26.9)
KKR	-	-	-	8 (38.1)
SGT	-	-	-	1 (3.8)
TM	-	-	-	0 (0.0)
KEM	-	-	-	3 (33.3)
KLP	-	-	-	-
LAB	-	-	-	5 (16.7)
KEN	-	-	-	0 (0.0)
BIN	-	-	-	6 (16.7)
LD	-	-	-	2 (4.2)
Total	**1007 (21.8)**	**1591 (29.6)**	**1778 (30.8)**	**2359 (36.9)**

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

* *Data excluded from analysis*

Therapy was withheld or withdrawn in 37% of deaths in ICU. There was a wide variability of this practice ranging from 0% (SP, PJY, SDG, TM, LIK, BM, KEN) to 91% (PP).

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 - 2012

Hospital	VAP per 1000 ventilator days				
	2008	2009	2010	2011	2012
AS	0.68	4.4	9.6	7.5	3.0
PP	18.6	10.8	12.9	10.1	6.9
IPH	2.9	22.1	12.3	3.7	7.2
KL	18.9	12.3	15.2	13.6	13.5
SLG	32.9	21.4	13.5	8.4	4.6
KLG	9.5	4.4	3.5	3.8	3.6
SBN	6.1	7.3	8.7	4.4	2.4
MLK	11.9	2.8	8.5	9.1	7.0
JB	13.2	5.5	9.0	5.4	4.3
KTN	5.4	3.4	3.3	1.6	2.7
KT	8.2	1.6	8.7	4.1	7.2
KB	3.5	3.4	4.1	5.6	9.2
KCH	15.2	10.7	5.0	2.4	6.3
KK	2.1	-	0.4	-	0.8
SP	33.1	39.5	23.4	23.6	8.3
PJY	16.8	18.3	14.4	9.3	3.8
MUR	4.0	7.1	4.9	1.7	0.6
TI	4.7	5.4	8.8	1.4	2.0
TPG	21.7	28.8	3.0	0.6	1.1
SJ	58.3	28.4	14.7	5.4	3.5
KJG	22.8	15.7	10.9	6.0	10.3
KGR	20.4	6.0	10.8	8.7	21.0
SDMC	4.4	0.0	3.4	8.0	0
TML	2.9	2.6	4.0	0.5	0
KP	21.2	4.1	2.2	0.7	0.8
SMJ	25.5	28.7	37.3	3.2	2.9
BP	3.6	1.6	2.3	0.7	1.7
TW	0.0	3.2	8.7	4.3	8.3
MRI	8.8	10.5	2.8	1.8	3.2
KLM	21.8	18.8	36.7	24.7	28.3
SDG	11.4	21.7	13.5	13.4	9.3
SB	-	-	7.7	10.4	11.3
DKS	-	-	7.0	0.4	1.6
SI	-	-	11.1	12.5	16.6
SBL	-	-	22.7	9.9	7.1
AMP	-	-	18.4	33.0	35.0
LIK	-	-	0.0	0.0	4.1
UMMC	-	-	-	-	8.5
LKW	-	-	-	-	16.2
BM	-	-	-	-	-
SLR	-	-	-	-	24.9
PD	-	-	-	-	17.5
KKR	-	-	-	-	9.5

SGT	-	-	-	-	16.8
TM	-	-	-	-	-
KEM	-	-	-	-	-
KLP	-	-	-	-	-
LAB	-	-	-	-	3.6
KEN	-	-	-	-	-
BIN	-	-	-	-	22.4
LD	-	-	-	-	3.2
Total	**13.5**	**11.6**	**10.1**	**6.8**	**7.2**

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 2008 - 2012

Hospital	Interval from initiation of ventilation to VAP Mean (Median) days				
	2008	**2009**	**2010**	**2011**	**2012**
AS	-	9.1	7.6	7.9	11.0 (9.0)
PP	8.2	13.1	10.0	11.0	11.2 (7.8)
IPH	9.1	5.9	4.3	7.7	9.1 (7.7)
KL	12.2	9.7	11.2	11.8	10.3 (8.9)
SLG	5.2	8.0	11.9	11.2	11.4 (8.0)
KLG	8.0	10.5	14.0	11.0	12.9 (12.0)
SBN	8.4	9.7	10.1	15.4	7.7 (8.3)
MLK	7.4	10.7	7.8	7.2	7.8 (5.5)
JB	6.8	9.4	8.8	8.4	10.5 (5.7)
KTN	9.5	11.6	7.0	9.5	11.5 (10.9)
KT	6.5	10.7	7.2	8.6	10.9 (10.0)
KB	16.7	12.3	9.1	11.9	13.6 (11.3)
KCH	8.7	6.5	11.5	11.4	9.3 (6.6)
KK	18.1	-	11.2	*	7.7 (7.1)
SP	6.9	7.3	7.2	7.0	6.5 (6.5)
PJY	8.1	10.7	9.9	13.9	12.3 (10.9)
MUR	15.7	13.0	10.3	12.2	-
TI	6.5	10.1	25.0	19.5	16.8 (16.8)
TPG	6.5	8.1	7.9	9.6	16.3 (13.1)
SJ	5.2	6.5	6.5	9.3	12.0 (10.3)
KJG	5.2	12.7	6.4	6.2	7.6 (6.7)
KGR	8.4	8.5	7.2	3.9	9.6 (7.2)
SDMC	8.9	-	2.0	5.4	-
TML	11.8	6.9	10.3	9.0	-
KP	9.5	9.7	6.5	20.3	21.3 (21.3)
SMJ	6.4	6.0	5.7	13.2	12.6 (12.6)
BP	17.0	9.7	21.5	7.1	32.0 (32.0)

TW	-	4.8	6.1	10.1	5.6 (4.1)
MRI	6.2	15.2	8.9	4.0	6.8 (6.8)
KLM	5.6	7.3	5.9	7.6	6.4 (4.6)
SDG	6.0	8.5	6.6	7.9	12.4 (12.1)
SB	-	-	7.8	6.0	10.6 (7.2)
DKS	-	-	7.7	7.1	7.0 (5.5)
SI	-	-	12.8	12.1	11.5 (10.0)
SBL	-	-	9.1	10.7	9.6 (7.8)
AMP	-	-	7.1	8.5	6.5 (5.3)
LIK	-	-	-	-	3.0 (3.0)
UMMC	-	-	-	-	15.2 (10.8)
LKW	-	-	-	-	6.0 (4.4)
BM	-	-	-	-	2.2 (2.2)
SLR	-	-	-	-	8.5 (5.9)
PD	-	-	-	-	9.5 (9.5)
KKR	-	-	-	-	8.8 (9.5)
SGT	-	-	-	-	10.0 (7.3)
TM	-	-	-	-	-
KEM	-	-	-	-	-
KLP	-	-	-	-	-
LAB	-	-	-	-	10.1 (10.1)
KEN	-	-	-	-	-
BIN	-	-	-	-	12.2 (11.2)
LD	-	-	-	-	10.5 (10.5)
Total	**7.8**	**8.7**	**8.8**	**9.7**	**10.1 (7.8)**

Figure 19 : VAP per 1000 ventilator days 2004 – 2012

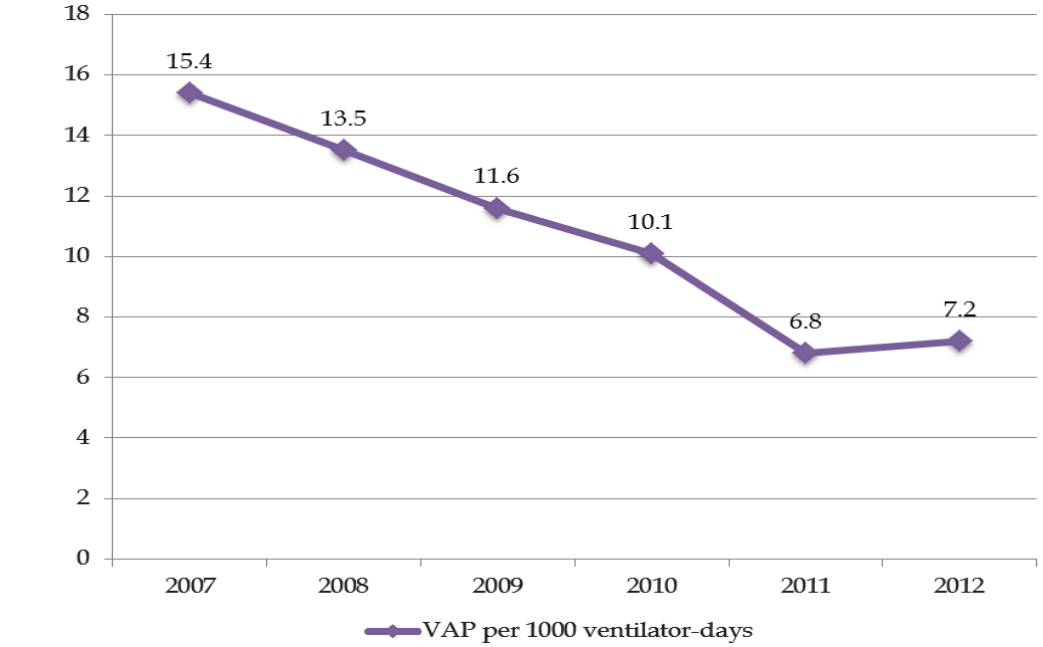


Figure 20 : VAP per 1000 ventilator days, by individual hospital 2012

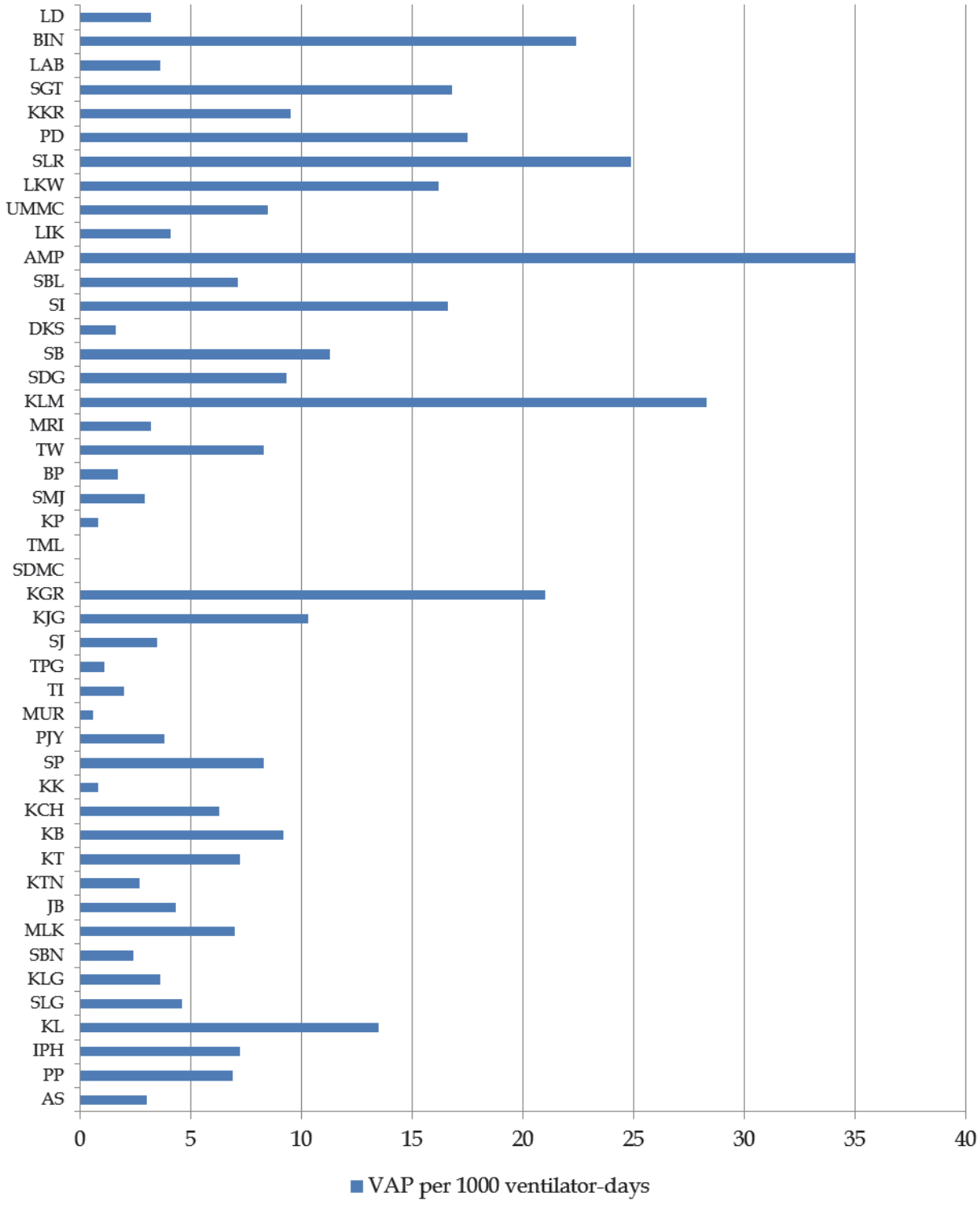


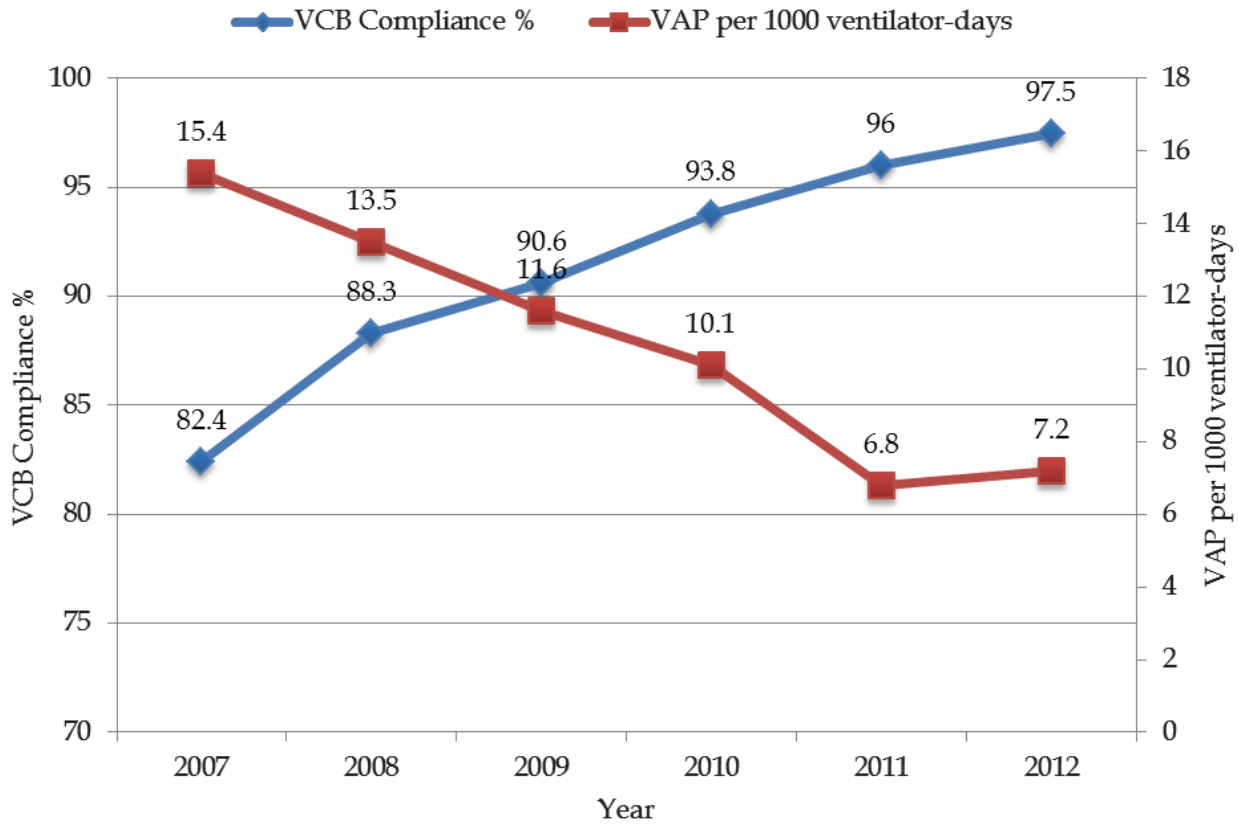
Table 32 : Ventilator Care Bundle Compliance 2010 - 2012

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

KKR	-	-	100
SGT	-	-	100
KEM	-	-	100
LAB	-	-	100
KEN	-	-	100
BIN	-	-	97.6
LD	-	-	100
Total	**94.13**	**96.00**	**97.5**

The overall VCB compliance rate for 2012 was 97.5%. VCB compliance is one of the key performance indicators for the Anaesthesia program in MOH. All centres except for LGW have VCB compliance rates above 85%, which is the target set for this indicator.

Figure 21 : VCB compliance and VAP 2007 – 2012



National Healthcare Safety Network (NHSN) report, data summary for 2011							
Types of ICU	**Ventilator utilisation ratio**	**VAP per 1000 ventilator days**					
		Pooled mean	**Percentile**				
			10th	**25th**	**50th**	**75th**	**90th**
Mixed medical/ surgical > 15 beds	0.35	1.0	0.0	0.0	0.6	1.6	2.8
Mixed medical/ surgical ≤ 15 beds	0.24	1.1	0.0	0.0	0.0	1.2	4.3
Neurosurgical	0.30	2.3	0.0	0.0	0.7	3.0	5.9
Surgical	0.35	2.0	0.0	0.0	0.1	2.8	4.7
Trauma	0.47	4.7	0.0	0.9	3.1	7.5	13.5

The incidence of VAP had decreased by more than half, from 15.4 per 1000 ventilator days in 2007 to 6.8 in 2011. In 2012, the rate increased slightly to 7.2 per 1000 ventilator days.

The mean rate of VAP (7.2 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 0.71, which is more than two times higher than the ICUs in US.

The onset of VAP was 10.1 days from the initiation of invasive ventilation. Onset of VAP in all centres (except TW, KLM, LGW, BM)) exceeded 5 days of ventilation, indicating that VAPs in MOH ICUs were mostly of late onset.

Table 33 : Bacteriological cultures in VAP, by category of ICU 2012

Organisms	ICUs				
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	UMMC n (%)	Total n (%)
Acinetobacter spp.	148 (46.2)	132 (41.2)	64 (50.0)	7 (31.8)	**351 (44.4)**
MRO	133 (89.8)	115 (87.1)	43 (67.1)	5 (71.4)	**296 (84.3)**
Non-MRO	15 (10.1)	17 (12.8)	21 (32.8)	2 (28.5)	**55 (15.6)**
Pseudomonas spp.	60 (18.7)	48 (15.0)	26 (20.3)	5 (22.7)	**139 (17.5)**
MRO	28 (46.6)	15 (31.2)	8 (30.7)	0 (0.0)	**51 (36.6)**
Non-MRO	32 (53.3)	33 (68.7)	18 (69.2)	5 (100)	**88 (63.3)**
Klebsiella spp.	74 (23.1)	69 (21.5)	19 (14.8)	3 (13.6)	**165 (20.8)**
ESBL	51 (68.9)	50 (72.4)	7 (36.8)	2 (66.6)	**110 (66.6)**
Non-ESBL	23 (31.0)	19 (27.5)	12 (63.1)	1 (33.3)	**55 (33.3)**
MRSA	1 (0.3)	7 (2.1)	2 (1.5)	2 (9.0)	**12 (1.5)**
MSSA	10 (3.1)	9 (2.8)	0 (0.0)	0 (0.0)	**19 (2.4)**
Stenotrophomonas maltophilia	6 (1.8)	12 (3.7)	2 (1.5)	0 (0.0)	**20 (2.5)**
Coagulase negative *Staphylococcus*	4 (1.2)	3 (0.9)	1 (0.7)	2 (9.0)	**10 (1.2)**
Other gram negative bacteria	6 (1.8)	8 (2.5)	1 (0.7)	1 (4.5)	**16 (2.0)**
Fungal	3 (0.9)	14 (4.3)	5 (3.9)	0 (0.0)	**22 (2.7)**
Others	8 (2.5)	18 (5.6)	8 (6.2)	2 (9.0)	**36 (4.5)**
Total	**320 (100.0)**	**320 (100.0)**	**128 (100.0)**	**22 (100.0)**	**790 (100.0)**

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

Figure 22 : Bacteriological cultures in VAP 2012

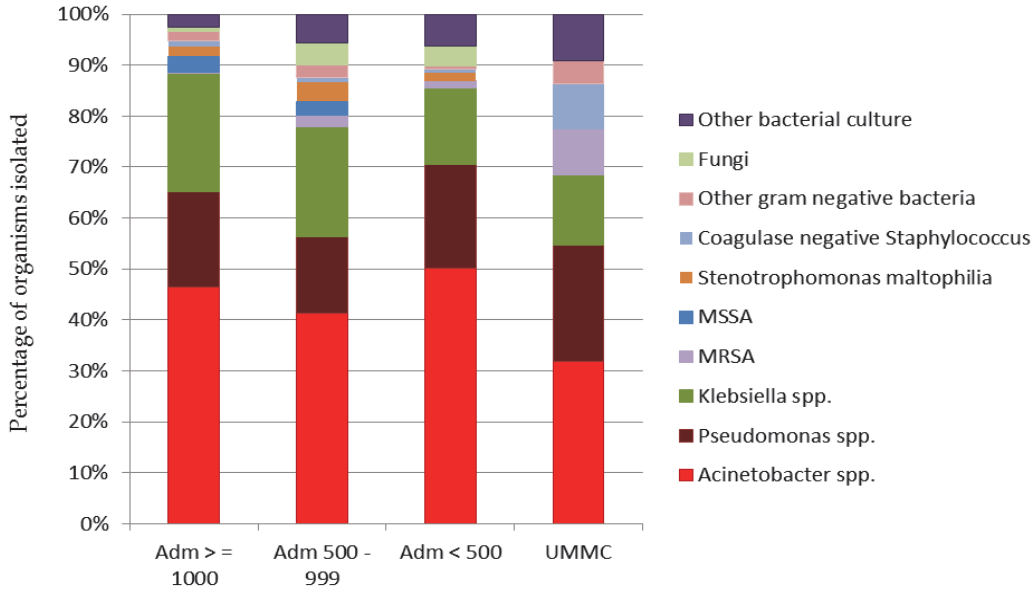
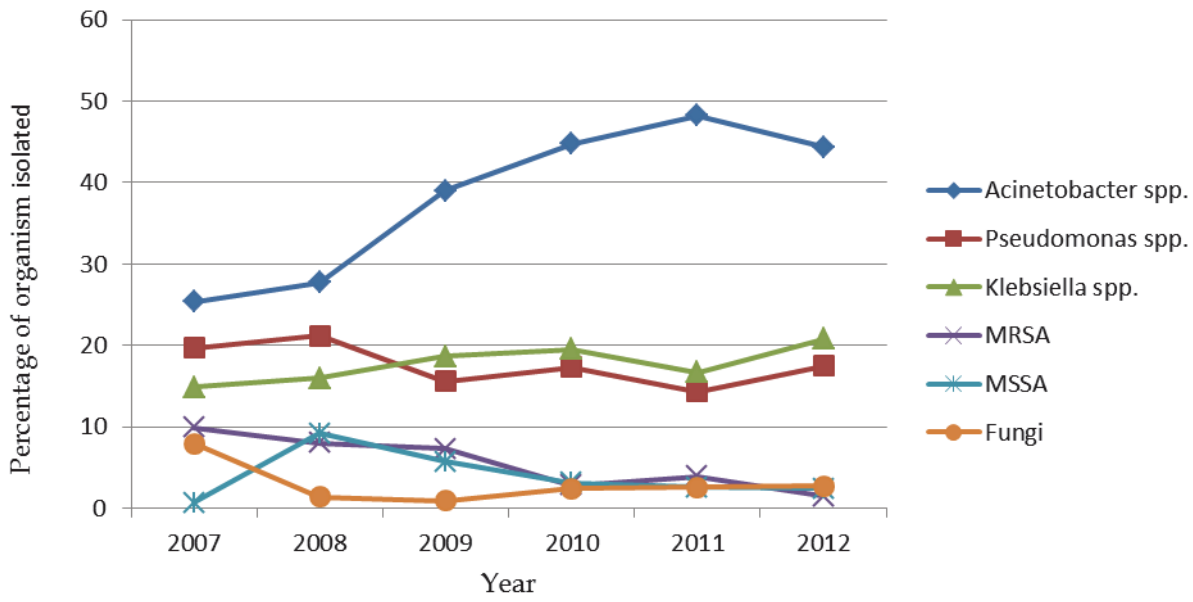


Table 34 : Bacteriological cultures in VAP 2008 – 2012

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

Figure 23 : Common bacteriological cultures in VAP 2007 – 2012



In 2012, 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 spp*. *Acinetobacter spp*. was the leading causative organism in VAP, accounting for 44.4%.

Fifty eight percent of the causative organisms in VAP were of multi-drug resistant strains. *Acinetobacter spp*, *Klebsiella spp* and *Pseudomonas spp* constituted 84.3%, 66.6% and 36.6% of multi-drug resistant strains respectively. Methicillin-resistant *Staphyloccus aureus* accounted for 38.7% of all *Staphyloccus aureus* isolated.

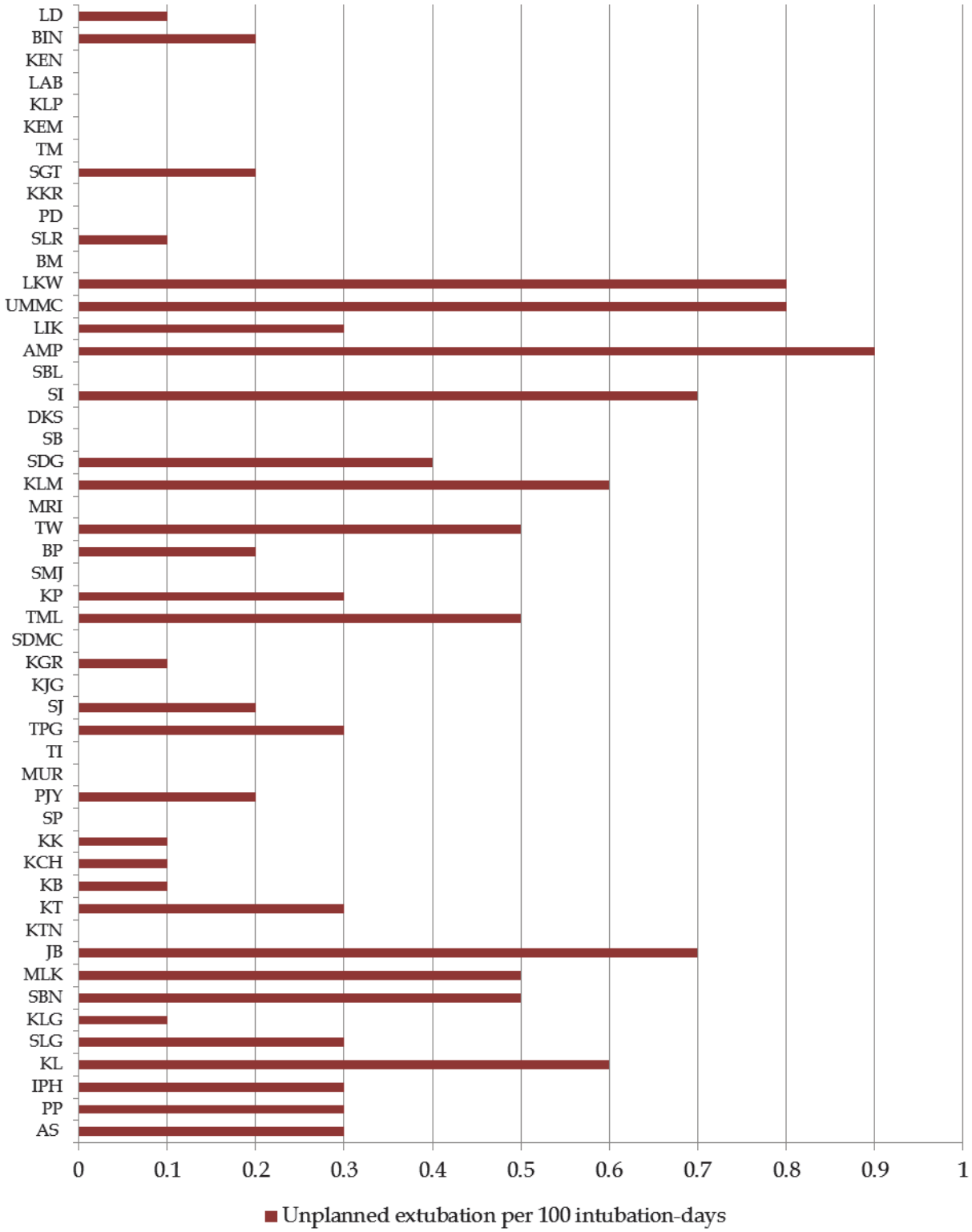
In the INICC report [12], 66.3% of *Acinetobacter spp* isolates in patients with VAP were carbapenem-resistant , 68.9% of *Klebsiella pneumonia* isolates were cephalosporin-resistant and 73.2% of *Staphyloccus aureus* isolates were were methicillin-resistant.

Table 35 : Unplanned extubation per 100 intubated days, by individual hospital 2008 - 2012

Hospital	Unplanned extubation per 100 intubated days				
	2008	2009	2010	2011	2012
AS	0.2	0.5	0.4	0.3	0.3
PP	2.0	0.2	0.3	0.2	0.3
IPH	2.3	0.9	0.4	0.4	0.3
KL	4.1	1.4	1.4	1.0	0.6
SLG	2.7	1.3	0.8	0.6	0.3
KLG	0.6	0.2	0.3	0.2	0.1
SBN	1.5	0.7	0.6	0.8	0.5
MLK	2.9	0.8	0.5	0.8	0.5
JB	4.8	1.8	0.9	1.2	0.7
KTN	2.0	0.1	0.6	0.1	0.0
KT	1.8	0.1	0.6	0.6	0.3
KB	0.1	0.0	0.2	0.1	0.1
KCH	0.5	0.1	0.2	0.1	0.1
KK	0.5	0.1	0.2	0.2	0.1
SP	0	0.3	0.4	0.5	0.0
PJY	0.4	0.0	0.5	0.1	0.2
MUR	0.3	0.1	0.2	0.0	0.0
TI	2.0	1.3	0.9	0.2	0.0
TPG	4.7	0.4	0.4	0.5	0.3
SJ	2.2	0.5	0.5	0.4	0.2
KJG	3.6	0.2	0.7	0.0	0.0
KGR	0	0.0	0.3	0.0	0.1
SDMC	0	0.0	0.3	0.2	0.0
TML	0.9	0.0	0.4	0.2	0.5
KP	4.3	0.0	0.6	0.3	0.3
SMJ	0	0.0	0.2	0.0	0.0
BP	1.9	0.2	0.2	0.1	0.2
TW	0.5	0.0	0.2	0.0	0.5
MRI	0	0.0	0.3	0.1	0.0
KLM	1.5	0.5	1.0	0.6	0.6
SDG	1.4	0.4	0.3	0.4	0.4
SB	-	-	0.3	0.1	0.0
DKS	-	-	0.2	0.0	0.0
SI	-	-	0.5	0.4	0.7
SBL	-	-	0.2	0.0	0.0
AMP	-	-	0.7	1.0	0.9
LIK	-	-	0.0	0.0	0.3
UMMC					0.8
LKW					0.8
BM					0.0

SLR					0.1
PD					0.0
KKR					0.0
SGT					0.2
TM					0.0
KEM					0.0
KLP					0.0
LAB					0.0
KEN					0.0
BIN					0.2
LD					0.1
Total	**1.9**	**0.6**	**0.5**	**0.4**	**0.3**

Figure 24 : Unplanned extubation, by individual hospital 2012



The rate of unplanned extubation has decreased over the past 5 years with a rate of 0.3 per 100 intubated days in 2012.

Table 36 : Pressure ulcer, by individual hospital 2008 - 2012

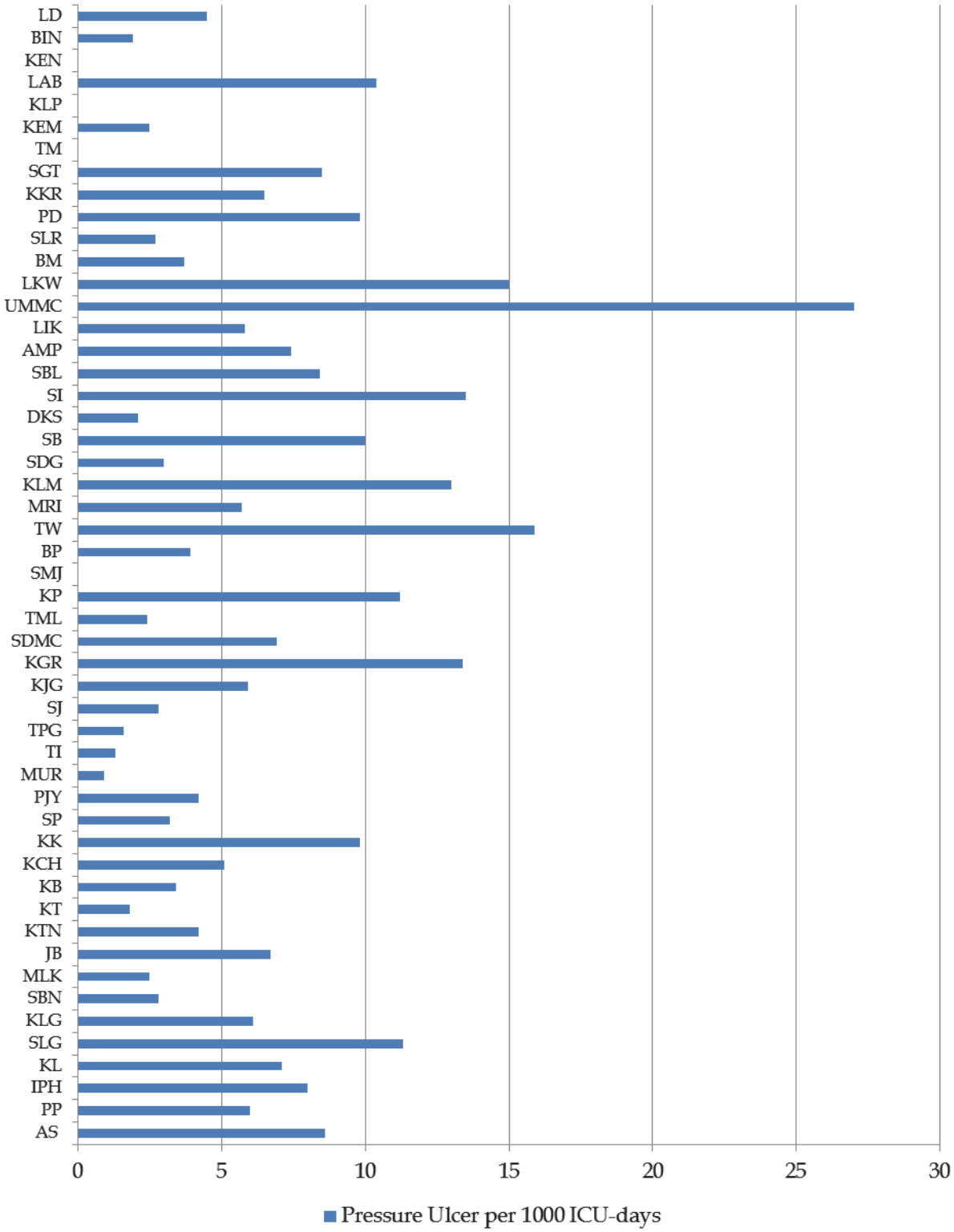
Hospital	Pressure ulcer per 1000 ICU days				
	2008	2009	2010	2011	2012
AS	0.0	4.6	14.9	15.2	8.6
PP	9.9	14.0	6.6	3.4	6.0
IPH	0.4	0.4	9.0	6.4	8.0
KL	20.9	31.6	8.3	7.9	7.1
SLG	18.5	15.3	13.5	14.4	11.3
KLG	0.5	1.3	2.4	5.6	6.1
SBN	2.2	3.7	2.6	1.1	2.8
MLK	5.0	7.6	4.5	3.8	2.5
JB	18.8	13.0	8.2	6.9	6.7
KTN	2.2	1.4	1.8	0.8	4.2
KT	0.0	0.3	4.3	2.5	1.8
KB	2.1	5.1	3.0	3.2	3.4
KCH	3.1	1.6	10.9	5.0	5.1
KK	0.3	0.0	5.2	5.1	9.8
SP	2.2	2.0	3.2	2.7	3.2
PJY	3.2	0.6	2.2	1.7	4.2
MUR	2.1	2.9	0.4	1.3	0.9
TI	3.9	0.0	3.5	1.6	1.3
TPG	17.3	10.5	9.7	5.4	1.6
SJ	10.1	6.6	9.1	3.2	2.8
KJG	4.6	5.4	10.6	14.5	5.9
KGR	1.4	1.6	4.1	2.9	13.4
SDMC	0.8	1.0	4.3	6.8	6.9
TML	0.5	0.0	1.0	0.7	2.4
KP	2.5	6.2	6.1	5.7	11.2
SMJ	0.6	1.1	0.0	0.0	0.0
BP	4.7	3.5	14.7	10.1	3.9
TW	9.3	9.0	4.1	11.2	15.9
MRI	29.2	18.3	2.5	12.2	5.7
KLM	2.7	3.5	8.1	11.0	13.0
SDG	10.2	7.1	8.7	4.5	3.0
SB	-	-	9.2	9.3	10.0
DKS	-	-	7.2	0.0	2.1
SI	-	-	8.1	9.7	13.5
SBL	-	-	5.6	2.2	8.4
AMP	-	-	6.0	7.2	7.4
LIK	-	-	0.0	1.0	5.8
UMMC	-	-	-	-	27.0
LKW	-	-	-	-	15.0
BM	-	-	-	-	3.7
SLR	-	-	-	-	2.7

PD	-	-	-	-	9.8
KKR	-	-	-	-	6.5
SGT	-	-	-	-	8.5
TM	-	-	-	-	0.0
KEM	-	-	-	-	2.5
KLP	-	-	-	-	0.0
LAB	-	-	-	-	10.4
KEN	-	-	-	-	0.0
BIN	-	-	-	-	1.9
LD	-	-	-	-	4.5
Total	**7.1**	**7.7**	**6.6**	**5.8**	**6.8**

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 to 27.0 per 1000 ICU days with a mean of 6.8.

Fig 25 : Pressure ulcers, by individual hospital 2012



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 37 : ICU outcome, by category of ICU 2012

ICU outcome	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Alive	13277 (79.2)	6907 (75.5)	4606 (76.3)	1394 (95.0)	372 (78.5)	**26556 (78.4)**
Died	3132 (18.7)	1945 (21.3)	1161 (19.2)	62 (4.2)	95 (20.0)	**6395 (18.9)**
Discharged with grave prognosis	173 (1.0)	90 (1.0)	111 (1.8)	5 (0.3)	2 (0.4)	**381 (1.1)**
Transfer to another hospital	183 (1.1)	204 (2.2)	162 (2.7)	6 (0.4)	5 (1.1)	**560 (1.7)**
Total	**16765 (100.0)**	**9146 (100.0)**	**6040 (100.0)**	**1467 (100.0)**	**474 (100.0)**	**33892 (100.0)**

Table 38 : Hospital outcome, by category of ICU 2012

Hospital outcome	ICUs					
	Adm ≥ 1000 n (%)	Adm 500 - 999 n (%)	Adm < 500 n (%)	Private n (%)	UMMC n (%)	Total n (%)
Alive	11209 (66.9)	5950 (65.1)	4048 (67.0)	1385 (94.4)	318 (67.1)	**22910 (67.6)**
Died	4486 (26.8)	2573 (28.1)	1585 (26.2)	71 (4.8)	148 (31.2)	**8863 (26.2)**
Discharged with grave prognosis	283 (1.7)	130 (1.4)	138 (2.3)	5 (0.3)	3 (0.6)	**559 (1.6)**
Transfer to another hospital	787 (4.7)	493 (5.4)	269 (4.5)	6 (0.4)	5 (1.1)	**1560 (4.6)**
Total	**16765 (100.0)**	**9146 (100.0)**	**6040 (100.0)**	**1467 (100.0)**	**474 (100.0)**	**33892 (100.0)**

Table 39 : Crude in-ICU and in-hospital mortality rate, by individual hospital 2008 – 2012

Hospital	Crude in-ICU mortality (in-hospital mortality) %				
	2008	2009	2010	2011	2012
AS	33.7 (40.3)	39.0 (52.7)	32.1 (43.1)	24.1 (34.4)	26.7 (44.5)
PP	13.9 (28.0)	13.8 (26.6)	12.6 (22.8)	14.4 (23.3)	16.5 (26.9)
IPH	14.3 (22.9)	16.1 (25.7)	21.9 (27.3)	22.4 (30.0)	16.5 (25.5)
KL	16.2 (25.5)	16.1 (28.0)	15.5 (22.0)	17.0 (24.7)	18.4 (27.0)
SLG	19.8 (29.6)	23.6 (30.3)	18.0 (24.5)	17.9 (25.8)	16.5 (27.1)
KLG	20.8 (26.0)	22.4 (30.6)	18.7 (26.3)	17.1 (25.1)	15.5 (22.9)
SBN	25.9 (37.3)	22.9 (34.5)	19.9 (28.8)	21.3 (30.0)	22.1 (30.4)
MLK	22.6 (31.0)	24.6 (32.9)	23.2 (30.8)	23.6 (32.7)	13.5 (32.1)
JB	23.0 (30.8)	21.2 (32.2)	20.3 (27.7)	22.3 (31.4)	21.4 (30.0)
KTN	20.2 (31.6)	20.1 (30.0)	19.4 (28.5)	17.2 (24.3)	24.1 (34.9)
KT	16.5 (24.8)	24.4 (36.6)	21.3 (30.6)	20.9 (27.2)	18.5 (28.1)
KB	18.2 (23.3)	18.3 (24.5)	19.2 (26.8)	17.8 (24.4)	16.0 (22.6)
KCH	19.6 (24.4)	18.7 (23.8)	15.8 (21.1)	22.1 (29.1)	17.4 (24.3)
KK	22.2 (31.5)	19.5 (35.7)	24.6 (33.5)	20.5 (27.3)	21.7 (34.0)
SP	35.0 (38.3)	29.5 (38.7)	33.3 (43.0)	32.6 (42.2)	26.9 (38.4)
PJY	23.9 (26.5)	20.8 (23.1)	19.3 (23.1)	18.4 (21.9)	16.9 (19.3)
MUR	16.1 (26.9)	16.5 (21.9)	18.8 (24.6)	20.9 (29.2)	24.1 (33.8)
TI	23.8 (33.1)	27.0 (41.1)	21.7 (34.1)	22.4 (35.1)	17.7 (31.9)
TPG	36.7 (46.8)	36.2 (49.5)	38.1 (48.4)	27.0 (43.4)	21.4 (35.3)
SJ	21.4 (25.6)	27.8 (42.2)	22.4 (33.6)	25.2 (35.2)	23.2 (35.5)
KJG	23.9 (29.6)	17.9 (31.3)	16.1 (20.7)	19.6 (27.0)	15.0 (23.8)
KGR	26.1 (32.5)	13.6 (23.1)	21.8 (29.6)	18.1 (25.8)	16.3 (22.1)
SDMC	5.6 (7.3)	3.5 (4.1)	4.2 (4.6)	4.3 (4.8)	4.3 (4.9)
TML	19.1 (23.1)	20.0 (28.4)	25.6 (32.5)	19.7 (23.0)	14.7 (21.0)
KP	24.9 (32.6)	32.5 (43.5)	41.9 (46.2)	34.3 (47.1)	28.9 (42.4)
SMJ	31.4 (34.0)	40.4 (46.9)	29.9(39.2)	24.5 (33.2)	24.3 (29.6)
BP	24.9 (36.5)	27.5 (38.8)	18.8 (33.0)	21.4 (32.6)	29.8 (40.7)
TW	26.3 (35.1)	20.0 (29.9)	21.8 (30.3)	15.7 (27.0)	13.7 (24.3)
MRI	27.3 (33.3)	23.7 (30.6)	15.9 (24.2)	22.6 (29.6)	18.3 (24.1)
KLM	24.7 (32.0)	28.5 (35.2)	29.7 (37.6)	30.9 (40.2)	21.0 (32.5)
SDG	22.4 (28.7)	17.5 (24.3)	17.5 (23.5)	18.0 (22.9)	17.7 (25.9)
SB	-	-	23.4 (28.9)	24.3 (31.8)	22.8 (30.2)
DKS	-	-	48.0 (59.3)	27.8 (30.2)	25.5 (26.8)
SI	-	-	26.8 (31.7)	22.1 (28.7)	24.6 (28.6)
SBL	-	-	16.0 (23.3)	18.0 (28.5)	17.2 (25.2)
AMP	-	-	37.1 (41.8)	35.1 (43.9)	37.9 (47.8)
LIK	-	-	1.9 (1.9)	2.9 (3.7)	5.6 (6.5)
UMMC	-	-	-	-	20.3 (31.8)
LKW	-	-	-	-	28.6 (36.2)

BM	-	-	-	-	13.2 (21.1)
SLR	-	-	-	-	42.8 (52.6)
PD	-	-	-	-	14.6 (18.4)
KKR	-	-	-	-	15.0 (24.4)
SGT	-	-	-	-	24.5 (30.4)
TM	-	-	-	-	5.9 (11.8)
KEM	-	-	-	-	9.9 (12.6)
KLP	-	-	-	-	0 (0)
LAB	-	-	-	-	29.7 (34.3)
KEN	-	-	-	-	11.4 (20.0)
BIN	-	-	-	-	17.8 (27.7)
LD	-	-	-	-	29.8 (38.1)
Total	**19.9 (27.2)**	**21.2 (29.7)**	**20.9 (28.1)**	**21.2 (29.5)**	**19.4 (27.9)**

The overall in-ICU and in-hospital mortality rates for 2012 were 19.4% and 27.9% respectively.

Figure 26: Crude In-ICU and In-hospital mortality rates, by individual hospital 2012

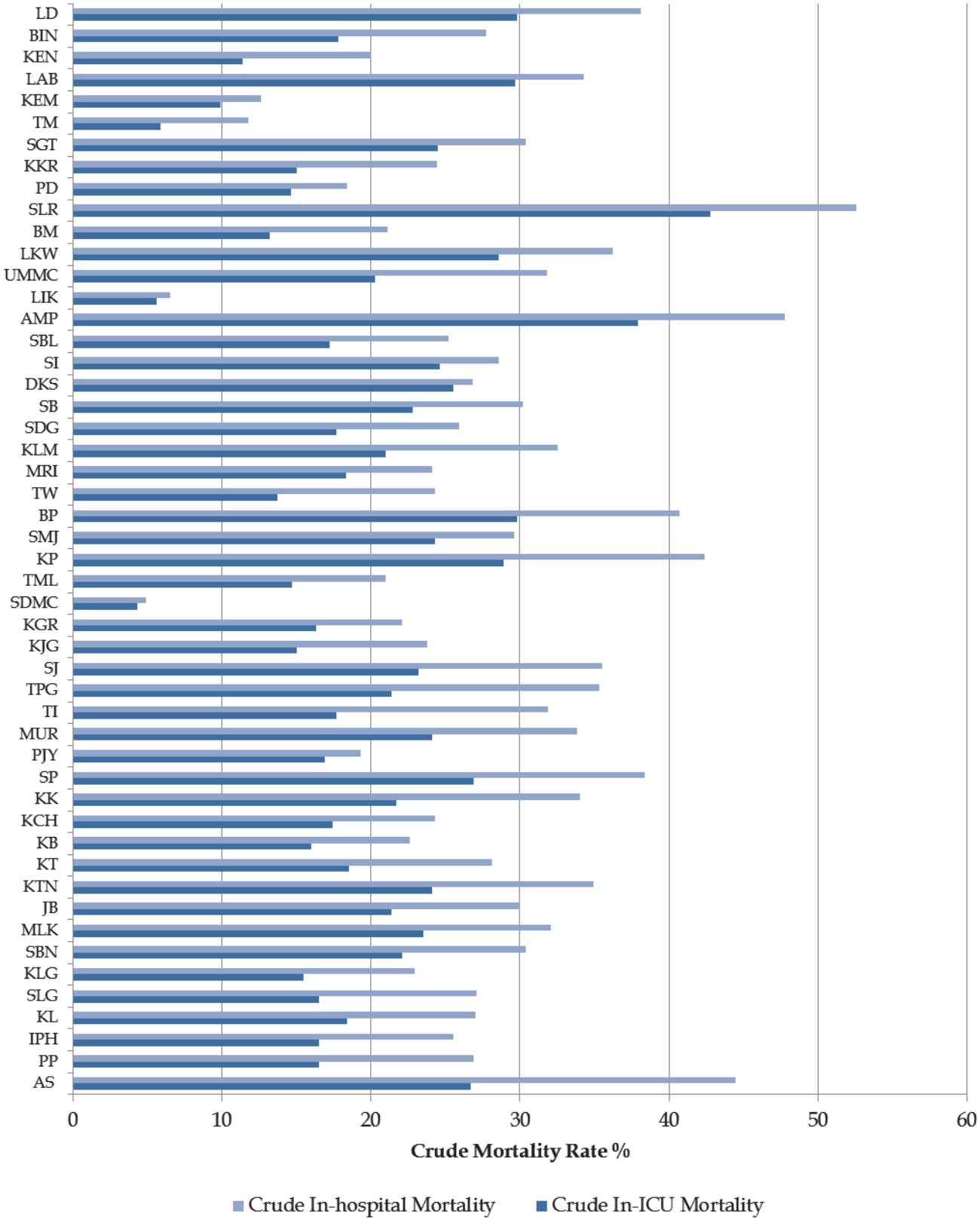


Table 40 : Ten most common diagnoses leading to ICU admission in MOH hospitals and observed in-hospital mortality 2009 - 2012

Diagnosis	Mortality (%)			
	2009	2010	2011	2012
Sepsis	62.2	59.3	58.9	54.4
Head injury	27.0	27.4	25.2	23.1
Community-acquired pneumonia	46.3	42.6	40.6	39.0
Chronic lower respiratory disease	32.4	26.2	24.9	23.6
Bronchial asthma	10.4	7.8	10.9	7.5
Non-cardiogenic pulmonary oedema	25.9	29.5	22.3	18.9
Cerebral vascular disease	-	-	41.9	40.5
Infection / gangrene of limb (including osteomyelitis, necrotising fasciitis)	39.2	39.1	41.8	39.6
Dengue infection	10.4	8.6	6.4	5.6
Hospital-acquired pneumonia	-	-	-	47.6

In-hospital mortality for patients with sepsis, community-acquired pneumonia, chronic lower respiratory disease and dengue infection has steadily improved over the years.

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

	In-hospital Mortality (%)
Severe sepsis	43.1
ARDS	37.3
AKI	41.4
Severe sepsis + ARDS	67.1
Severe sepsis + AKI	61.3
Severe sepsis + ARDS + AKI	80.4

Severe sepsis within 24 hours of ICU admission carries in-hospital mortality of 43.1%. In the Sepsis Occurrence in Acutely Ill Patients (SOAP) study, the in-ICU mortality was 27% in patients 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 42: Standardised mortality ratio, by individual hospital 2008 – 2012

Hospital	Standardised mortality ratio (95% CI)				
	2008	2009	2010	2011	2012
AS	0.94	1.00	0.93	0.82 (0.60-1.11)	1.07 (0.81-1.39)
PP	0.88	0.78	0.68	0.67 (0.47-0.96)	0.74 (0.51-1.01)
IPH	0.90	0.86	0.82	0.96 (0.67-1.35)	0.83 (0.58-1.17)
KL	0.70	0.73	0.62	0.61 (0.43-0.87)	0.63 (0.44-0.88)
SLG	0.77	0.84	0.76	0.75 (0.52-1.05)	0.75 (0.54-1.05)
KLG	0.80	0.98	0.85	0.62 (0.43-0.87)	0.60 (0.41-0.86)
SBN	0.87	0.93	0.74	0.77 (0.55-1.04)	0.73 (0.50-1.03)
MLK	0.98	0.91	0.97	0.98 (0.71-1.33)	0.81 (0.58 –1.10)
JB	0.88	0.87	0.71	0.78 (0.56-1.05)	0.71 (0.51-0.97)
KTN	0.94	0.88	0.90	0.72 (0.50-1.01)	0.84 (0.62-1.21)
KT	0.74	1.09	0.86	0.67 (0.48-0.94)	0.65 (0.46-0.89)
KB	1.01	1.41	1.00	0.76 (0.52-1.07)	0.67 (0.46-0.95)
KCH	0.84	0.80	0.63	0.82 (0.58-1.13)	0.75 (0.51-1.06)
KK	1.00	1.10	0.83	0.71 (0.50-1.00)	1.00 (0.70-1.38)
SP	0.87	1.02	0.97	1.00 (0.75-1.30)	0.77 (0.57-1.03)
PJY	0.85	0.86	0.83	0.76 (0.50-1.10)	0.69 (0.45-1.03)
MUR	1.06	0.81	0.88	0.78 (0.56-1.06)	0.89 (0.63-1.23)
TI	0.77	0.91	0.71	0.77 (0.57-1.05)	0.72 (0.53-0.99)
TPG	1.00	1.16	1.03	0.92 (0.69-1.20)	0.80 (0.58-1.07)
SJ	0.67	0.84	0.76	0.84 (0.61-1.12)	0.87 (0.64-1.17)
KJG	0.94	1.00	0.64	0.79 (0.57-1.11)	0.85 (0.55-1.14)
KGR	0.90	0.71	0.75	0.72 (0.51-1.04)	0.62 (0.42-0.89)
SDMC	0.59	0.39	0.36	0.44 (0.24-0.89)	0.44 (0.23-0.85)
TML	0.76	0.74	0.86	0.59 (0.41-0.85)	0.64 (0.43-0.90)
KP	0.76	0.90	0.90	1.06 (0.79-1.37)	0.95 (0.72-1.25)
SMJ	1.00	1.20	0.93	0.78 (0.57-1.07)	0.70 (0.51-0.97)
BP	0.93	0.81	0.76	0.69 (0.50-0.94)	0.87 (0.65-1.14)
TW	0.78	0.54	0.55	0.72 (0.51-0.98)	0.67 (0.47-0.93)
MRI	0.99	0.90	0.69	0.89 (0.62-1.25)	0.65 (0.42-0.96)
KLM	0.75	0.86	0.87	0.83 (0.62-1.11)	0.69 (0.50-0.94)
SDG	0.96	0.86	0.71	0.61 (0.42-0.86)	0.61 (0.44-0.85)
SB	-	-	0.74	0.88 (0.64-1.17)	0.75 (0.54-1.01)
DKS	-	-	1.04	0.76 (0.55-1.02)	0.74 (0.52-1.01)
SI	-	-	0.72	0.77 (0.56-1.07)	0.73 (0.52-1.01)
SBL	-	-	0.73	0.74 (0.53-1.03)	0.63 (0.45-0.90)
AMP	-	-	0.89	0.92 (0.71-1.20)	0.90 (0.69-1.17)
LIK	-	-	0.14	0.19 (0.10-0.45)	0.27 (0.14-0.57)
UMMC	-	-	-	-	0.83 (0.60-1.14)
LKW	-	-	-	-	0.96 (0.71-1.25)
BM	-	-	-	-	0.54 (0.36-0.79)
SLR	-	-	-	-	0.98 (0.76-1.26)

PD	-	-	-	-	0.60 (0.40-0.92)
KKR	-	-	-	-	0.68 (0.47-0.96)
SGT	-	-	-	-	0.74 (0.51-1.03)
TM	-	-	-	-	0.76 (0.49-1.13)
KEM	-	-	-	-	0.30 (0.17-0.46)
KLP	-	-	-	-	0 (0)
LAB	-	-	-	-	0.87 (0.64-1.16)
KEN	-	-	-	-	0.55 (0.39-0.77)
BIN	-	-	-	-	1.15 (0.84-1.51)
LD	-	-	-	-	0.68 (0.5-0.9)
Total	**0.85**	**0.89**	**0.80**	**0.77 (0.55 - 1.05)**	**0.74 (0.53 - 1.03)**

The pooled standardized mortality ratio in 2012 was 0.74 (95% CI 0.53 – 1.03). 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 - 2012

Report on patients with dengue infection who were admitted to the intensive care units in the Ministry of Health hospitals from 2010 - 2012

In 2012, the number of dengue cases reported by the Ministry of Health was at 21,900 [18], which was 10% higher compared to the number reported in 2011 at 19, 884 [16]. Selangor state recorded the highest number of cases and contributed to 42% of the total cases. The number of dengue cases in 2012 and 2011 were much lower compared to the number reported in 2010 at 46,171 [17].

The number of admissions with diagnosis of dengue infection admitted to ICUs in MOH hospitals in 2012 was 906, which showed a 13.5% increase compared to 798 cases in 2011. The number of admissions with diagnosis of dengue infection was 1643 cases in 2010.

The majority of the patients with dengue infection were young but in 2012, the median age of the patients admitted with dengue infection was slightly older with a median age of 32.8 years, compared to a median age of 29.5 years in 2011 and 28.8 years in 2010. 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 durations of ICU and hospital stay (median of 1.9 days and 5.2 days respectively compared to 2.5 days and 9.5 days in all patients).

In 2012, there was a lower percentage of patients invasively ventilated, 9.5% compared to 13.8% in 2011 and 18.6% in 2010. The median duration of ventilation was longer at 4.2 days compared to 3.6 days in 2011 and 3.8 days in 2010.

Patients with dengue infection were less ill compared to the rest of the patients (mean SAPS II score of 17.4 vs. 37.3). The mean SAPS II score in 2012 was lower (17.4) compared to 19.6 in 2011 and 19.0 in 2010. There was a lower percentage of patients with co-morbidities in 2012 (18.3% vs. 22.3% in 2011). The percentage of patients with haematological failure was 53.4% and it remained as the main organ failure on ICU admission in 2012, 2011 and 2010.

All-cause mortality for admissions with diagnosis of dengue infection had shown a reducing trend since 2010. The all-cause in-hospital mortality for 2012 was 5.6% compared to 6.4% in 2011 and 9.1% in 2010. The SMR for dengue cases in 2012 was 0.51 and it was similar with the SMR for dengue cases in 2011 (0.50) and much lower compared to the SMR for dengue cases in 2010, which was 0.75.

Table 43 : General comparison for Dengue infection MOH ICUs 2010 - 2012

	Dengue Infection 2010 n = 1643	Dengue Infection 2011 n = 798	Dengue Infection 2012 n = 906
Age, years median (IQR)	28.8 (22.5 – 47.3)	29.5 (21.0 – 44.1)	32.8 (21.5-41.8)
Interval from hospital to ICU admission, days median (IQR)	Not available	0.5 (0.1 – 1.3)	0.5 (0.1-1.3)
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)
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)
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)
Total SAPS II score, mean	19.0 $\pm$ 14.1	19.6 $\pm$ 16.0	17.4 $\pm$ 13.0
% Invasive mechanical ventilation	18.6	13.8	9.5
% Co-morbid diseases	18.1	22.3	18.3
Main organ failure %			
Without organ failure	32.2	27.3	35.2
Respiratory failure	4.7	3.0	3.3
Cardiovascular failure	7.1	7.2	6.9
Neurological failure	0.6	0.4	0.1
Renal failure	0.9	0.7	0.8
Hepatic failure	0.4	0.1	0.1
Haematological failure	54.0	40.9	53.4
SMR (95% CI)	0.75 (0.42-1.20)	0.50 (0.26 – 0.86)	0.51 (0.26 - 0.94)

Table 44: Dengue infection by individual hospital and crude all-cause in-hospital mortality 2010-2012

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

UMMC	-	-	-	-	3 (0.3)	0 (0.0)
SLR	-	-	-	-	2 (0.2)	0 (0.0)
PD	-	-	-	-	4 (0.4)	0 (0.0)
SGT	-	-	-	-	1 (0.1)	0 (0.0)
LAB	-	-	-	-	1 (0.1)	1 (100.0)
KEN	-	-	-	-	1 (0.1)	0 (0.0)
BIN	-	-	-	-	2 (0.2)	1 (50.0)
LD	-	-	-	-	4 (0.4)	0 (0.0)
Total	**1643 (100)**	**150 (9.1)**	**853 (100)**	**55 (6.4)**	**906 (100)**	**51 (5.6)**

SECTION G:

REPORT ON
CVC CARE BUNDLE COMPLIANCE
AND
INCIDENCE OF CVC-BSI
IN
MOH ICUs
2012

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 [19, 20].

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. 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. Therefore, the CVC-BSI rate should be interpreted with caution.

Table 45 : Compliance rate to CVC care bundle and incidence of CVC-BSI Oct - Dec 2012

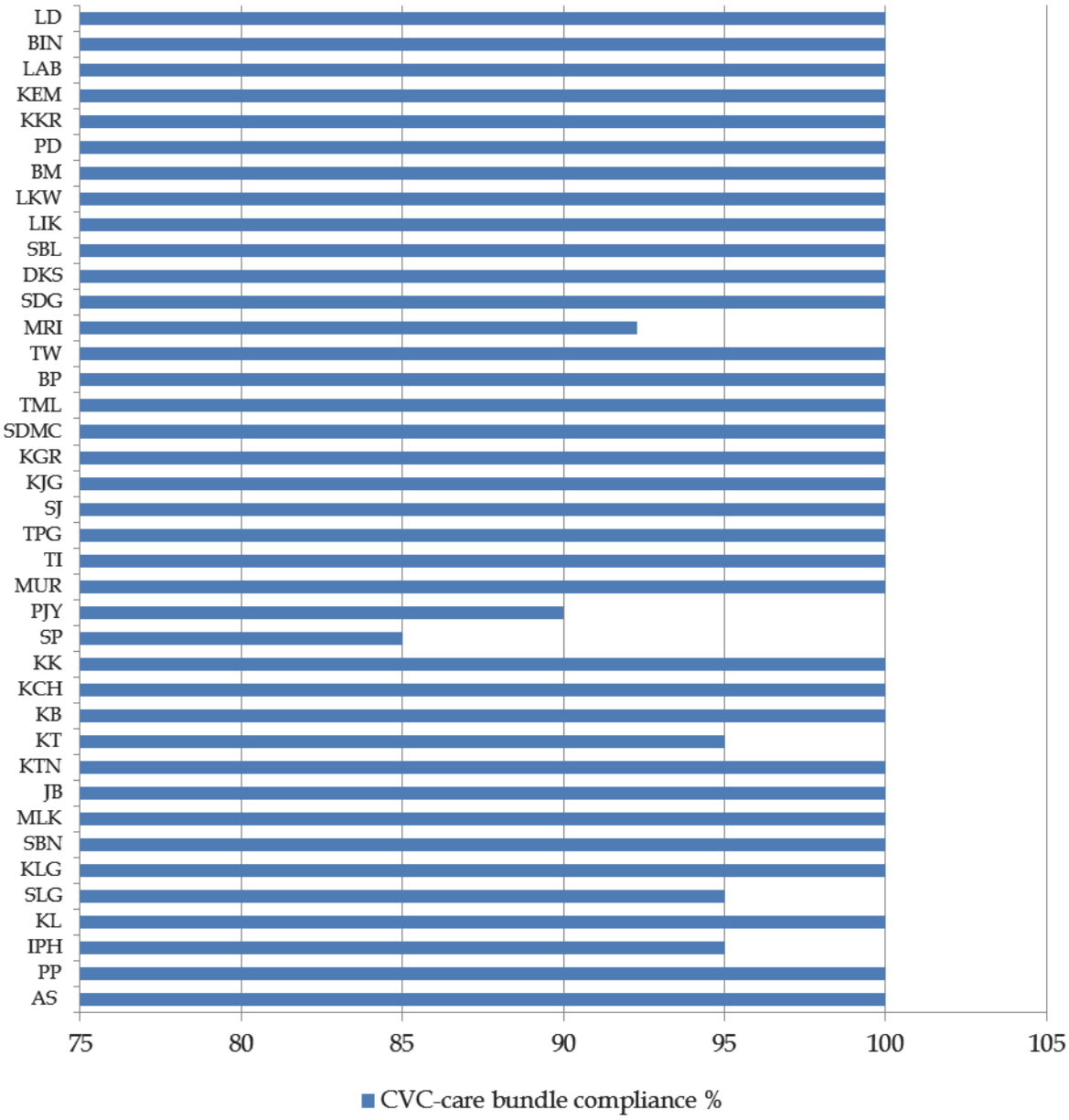
Hospital	CVC care bundle compliance %	CVC- BSI per 1000 catheter-day
AS	100	0
PP	100	5.08
IPH	95	0
KL	100	0.78
SLG	95	0
KLG	100	0
SBN	100	0
MLK	100	0
JB	100	3.74
KTN	100	0
KT	95	0
KB	100	0
KCH	100	0
KK	100	0
SP	85	0
PJY	90	0
MUR	100	0
TI	100	0
TPG	100	0
SJ	100	0
KJG	100	0
KGR	100	0
SDMC	100	0

TML	100	1.35
KP	-	-
SMJ	90.9	-
BP	100	0
TW	100	0
MRI	92.3	0
KLM	100	-
SDG	100	0
SB	65	-
DKS	100	0
SI	81.25	-
SBL	100	0.83
AMP	-	-
LIK	100	0
UMMC	-	-
LKW	100	0
BM	100	0
SLR	-	-
PD	100	0
KKR	100	0
SGT	-	-
TM	-	-
KEM	100	0
KLP	-	-
LAB	100	0
KEN	100	-
BIN	100	0
LD	100	0
	97.6	

The mean compliance rate to CVC care bundle from October to December 2012 was 97.6%.

The actual incidence of CVC-BSI could not be obtained from this study in view of the high possibility of underdiagnosis in many units. The predominant microorganisms isolated from these infections were also not studied.

Fig 27 : CVC care bundle compliance rate, by MOH hospitals Oct - Dec 2012



SUMMARY

1. The total number of ICU beds in the 49 MOH participating centres was 589, with a median bed occupancy of 86.2%.

2. The number of cases analysed for year 2012 was 33,892, an increase of 13.8% over the previous year.

3. The percentage of patients denied admission due to the unavailability of ICU beds had declined from 48.3% to 32.0% 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 6.4% of all ICU admissions.

6. The average lengths of ICU and hospital stay were 4.8 and 15.5 days respectively.

7. In MOH hospitals, 65.1% of admissions were non-operative patients, an increase of 10% in the last five years.

8. Direct admission to MOH ICUs from the emergency department had increased more than two-fold from 13% in 2007 to 27.9% in 2012.

9. Inter-hospital ICU admissions decreased from 5.6% to 4.5% in the last five years.

10. 63.5% of admissions had single or no organ failure within 24 hours of ICU admission.

11. In MOH ICUs, cardiovascular failure (40%) was the most common organ failure during the first 24 hours of ICU admission, followed by respiratory (28%), neurological (17%), renal (10%), haematological (4%) 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 54.4%, 23.1% and 39.0% respectively.

13. During the first 24 hours of ICU admission, 20.3%, 9.0% and 13.6% of patients had severe sepsis, acute respiratory distress syndrome and acute kidney injury respectively.

14. The average SAPS II score was 37.3, 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 2012.

16. 77% of patients in MOH hospitals and 82% of patients in UMMC received invasive ventilation with an average duration of 4.5 days while 6.4% of ICU admissions in the private hospital were mechanically ventilated with average duration of 2.5 days.

17. The percentage of patients who received non-invasive ventilation increased from 12.1% in 2008 to 20.7% in 2012.

18. In MOH hospitals, 15% of ICU admissions had renal replacement therapy, with intermittent haemodialysis being the most common modality of therapy.

19. Among patients who were invasively ventilated, 11.7% had tracheostomy performed, with the median time from initiation of ventilation to tracheostomy being 6.9 days.

20. The decisions to withdraw or withhold therapy was made in 37% of patients who died in ICU,.

21. The incidence of VAP had decreased by more than half from 13.5 to 7.2 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 88.3% in 2008 to 97.5% in 2012.

24. The unplanned extubation rate was 0.3 per 100 intubated days in 2012.

25. The mean incidence of pressure ulcers was 6.8 per 1000 ICU days.

26. The crude in-ICU and in-hospital mortality rates were 21.2% and 29.5% respectively.

27. The mean standardised mortality ratio was 0.74 (95% CI 0.53 – 1.03).

28. 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 6.4% in 2011 to 5.6% in 2012.

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