HOW ARE OUR ICUS COMPARING TO OTHER COUNTRIES

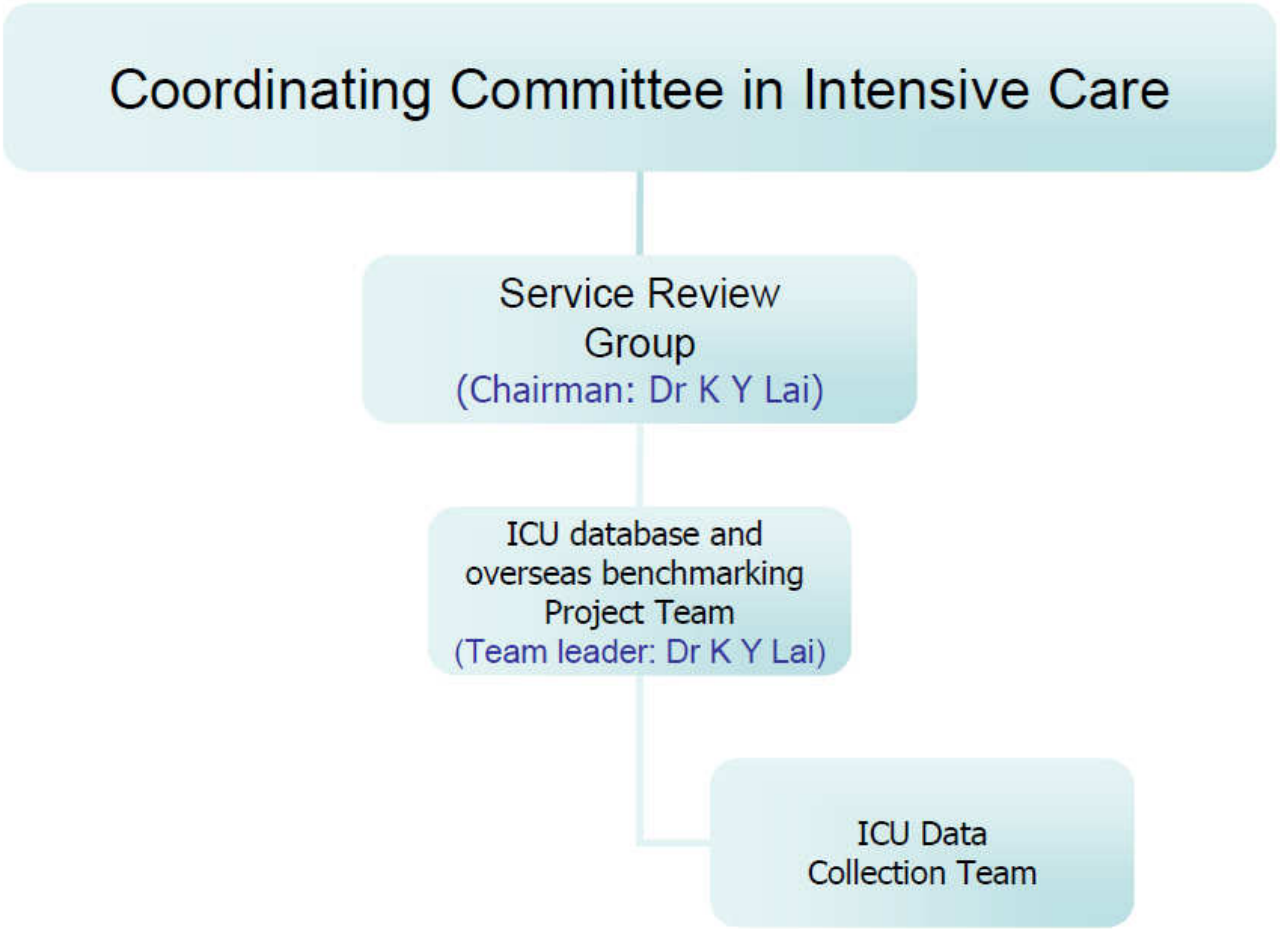
ICU scoring system

- Measure ICU performance
- Guide quality improvement activities

ICU Database and Overseas Benchmarking Project

- Benchmarking of performance of 14 ICUs within HA
- Analyse data of > 12000 admission per year
- APACHE standard report since 2006
- External consultancy by ICNARC in 2010

Governance Structure



ICU Audit

- **UK**: Intensive Care and National Audit and Research Centre (ICNARC)
- **Scotland**: Scottish Intensive Care Society Audit Group (SICSAG)
- **Australia and New Zealand**: Centre for Outcome and Resource Evaluation (CORE)
- **USA** : Joint Commission
- **Malaysia**: Malaysian Registry of Intensive Care

ICNARC

- Audit and analysis of the performance of > 200 critical care units across England, Wales and Northern Ireland
- Annual admission > 65,000
- Produce annual report since 1996

SICSAG

- Audit and analysis of the performance of 25 ICU/ combined units in Scotland
- Annual admission > 10,000
- Produce annual report since 1998

CORE

- Audit and analysis of the performance of > 150 ICU/ HDU in Australian and New Zealand
- Annual admission > 130,000
- Produce annual report since 1992

USA

- Joint Commission of USA
  - Performance measures developed in 2002
    - ICU 5 ICU LOS (Risk adjusted)
    - ICU 6 Hospital mortality
  - Suspended implementation of data collection for the ICU measure set in 2005

USA

- Philips Healthcare remote ICU programme
  - Use APACHE IV system
  - 390 ICUs in USA
  - 300,000 admission /year
  - 6.7% of total ICU population

- ICU scoring systems are used in only 10-15% of US ICU patients

Malaysia

- Audit and analysis of the performance of 36 MOH ICU and 1 private ICU in 2011
- Number of admission > 29,000
- Produce annual report since 2004

Performance Benchmarking

- Ratio of number of **deaths** observed to the number of deaths predicted (SMR)
- Actual to predicted ratio of **LOS**

Mortality Rate

	HK (2011)	Scotland (2011)	Australia / New Zealand (2010)	Malaysia (2011)
ICU mortality rate	11.9%	15.2%	6.6%	21.2%
Hospital Mortality rate	18.9%	21.8%	10.2%	29.5%
APACHE II SMR	0.55	~0.79		
APACHE III-j SMR	~0.72		0.75	
mean APACHE IV SMR	0.77			
SAP II SMR				0.77

Length of ICU Stay

	HK (2011)	Scotland (2011)	Australia / New Zealand (2010)	Malaysia (2011)
Median	1.96		1.8	
Mean	4.25	4.6		4.7

Difficulties for International Benchmarking

- Use of different scoring systems
- Pitfalls of mortality rate / SMR
- Pitfalls of LOS

Use of Different Scoring Systems

Risk adjusted Hospital Mortality Rate

- **ICNARC**: INCARC model and APACHE III-j model
- **SICSAG**: APACHE II mode
- **CORE**: APACHE III-J model
- **Cerner**: APACHE IV model
- **Malaysia**: SAP II

Calibration

- These new models are not superior to the originals but simply modified the model to better fit their own population

- The current practice of calibrating scoring systems in each region
  - Prevent comparison of outcomes across different countries
  - Hinder identification of superior care processes as no universal tool

Pitfalls of SMR

Pitfalls of SMR

- Reflects many aspects of ICU care
  - Use of best practices
  - Accurate diagnosis
  - Effective and timely therapies
- Adoption of simple SMR reporting for benchmarking is problematic
  - Differences in population composition
  - Lacks information about performance of different acuity subpopulations

Pitfalls of SMR

- Contribution of high risk patients to the SMR
  - An ICU with better than average outcomes in its low-risk population can have an aggregate SMR > 1 if outcome are below average in the high-risk group, even though the high-risk group represents a smaller percentage of the total ICU population

Comparison of Aggregate SMRs in Two Hypothetical ICUs With Similar Performance Within Risk Groups But Different Severity Distribution

Example ICUs	Low-risk pts	Medium-risk pt	High-risk pt	All pts
ICU A				
Patients No.	600	300	100	1000
Predicted mortality rate, %	3	15	60	12.4
Actual death, No	9	45	90	144
Predicted death, No	18	45	60	123
SMR	0.50	1.0	1.50	1.17
ICU B				
Patients No.	400	300	300	1000
Predicted mortality rate, %	3	15	60	23.7
Actual death, No	6	45	270	321
Predicted death, No	12	45	180	237
SMR	0.50	1.0	1.50	1.35

Subgroup SMR Data Showing How Aggregate SMR Data Can Obscure Poor Low-Risk Population Performance

Example ICUs	Low-risk pts	Medium-risk pt	High-risk pt	All pts
ICU A				
Patients No.	400	300	200	900
Actual no of death	24	42	110	176
Predicted mortality rate, %	3.0	15.0	60.0	19.7
Actual death, %	6	14	55	19.6
Predicted death, No	12	45	120	1.17
SMR	2.00	0.93	0.92	0.99

- Cautions in using the data
  - Differences in the numbers of high- and low-risk patients can affect calculated SMR
  - Reflects the disproportionate impact of high-risk patients on SMR, and ICUs with fewer such patients will have this effect diluted

Pitfalls of SMR

- Use 10% and 50% APACHE III predicted hospital mortality cutoffs to differentiate low-, medium-, and high-risk populations
- In USA, large tertiary care hospital ICUs tend to have slightly fewer low-risk patients and more patients with very high mortality risk
- Wide disparity within ICUs in their performance in the different acuity groups

Impact of ICU structure and care process

- Lead-time bias
  - EDs triage to the ICU with less treatment and, thus, more abnormal vital signs, higher mortality predictions, and lower actual-to-predicted ratio
- Vasilevskis found a correlation between ICU transfers to other hospitals and observed SMR
  - Each 1% increase in transfers was associated with a 0.02 decrease in SMR

- Post ICU outcomes are affected by the quality of medical-surgical floor care
  - ?ICU mortality ratios rather than the use of hospital mortality ratios
- Proposed that 30 day post-discharge mortality might be a more suitable outcome than hospital mortality

Predicted Risk of Hospital Death

	HK (2011)	Scotland (2011)	Australia / New Zealand (2010)	Malaysia (2011)
mean APACHE II	31.2%		21.1%	
median APACHE II			12.9%	
mean APACHE III-j	24%		13.4%	
median APACHE III-j	11.3%		4.3%	
mean APACHE IV	23.3%			
SAP II				28.7%

Pitfalls of LOS

How to measure LOS?

- Median
  - the distribution is usually skewed to the left as a higher proportion of patients were discharged early
  - better reflection of the distribution as it reflects the LOS of majority of patients
- Mean
  - impact of ICU bed demand and resource implication
  - may be affected by the few patients with excessively long LOS

LOS is affected by

- Quality of ICU care
- End-of-life policies
- Discharge planning
- Downstream bed availability

Pitfalls of LOS

- Increasing severity of illness is linearly related to predicted mortality rate

- LOS demonstrates a more complex relationship
  - LOS increases linearly as predicted mortality rose
  - LOS was largely unrelated to acuity for nonsurvivors

Pitfalls of LOS

- The APACHE predicted LOS for high risk patients is a combination of the average survivors and non-survivors LOS
- It penalizes high-performing ICUs that have better than predicted high-risk patient mortality rates but poor performing ICUs that have excess mortality in this group benefit from it
- Actual-to-predicted LOS performance for low-, medium-, and high-risk patients separately

Pitfalls of LOS

- ICU and hospital discharge practice
  - Transfer patients to other hospitals or alternative care sites, such as long-term acute care units, will have shorter hospital stays and potentially decreased mortality rates
  - Transfer to other hospitals is more common in community hospitals

Other useful benchmarks

- Occupancy rate
- Admission rate of low risk monitoring
- Out of hour discharge
- Readmission rate

Occupancy rate

- Ideal occupancy rate
  - ICNARC: 70%
  - SIGSAG: 75%

- Occupancy rate > 80%
  - a reflection of local difficulties accommodating new admissions and forcing early discharges
  - associate with increased hospital mortality

Occupancy Rate

HK (2010)	Scotland (2011)	Australia / New Zealand (2010)	Malaysia (2011)
81.1% (ICU)	74%	67.7%	88.6% (median)

Admission for Low Risk Monitoring

Evaluating the Performance of an Institution Using an ICU Benchmark

Afessa, et al, Mayo Clin Proc 2005; 80 (2)

Low risk monitoring admissions

- Patients not receiving life-support therapy and are at a low (<10%) risk for subsequently receiving life-supporting therapy

Admission rate for low risk monitoring

- Good performance
  - All ICU: < 20%
  - Medical ICU: < 12%
  - Medical- surgical ICU: < 17%
  - Surgical ICU: < 32%
- Poor performance
  - All ICU: > 68%
  - Medical ICU: > 61%
  - Medical- surgical ICU: > 76%
  - Surgical ICU: > 66%

Australia and New Zealand 2010

	Australia	New Zealand	Total
Proportion of patients with planned admission to ICU following elective surgery	38.2%	25.4%	37.3%

Most Common APACHE Admission Diagnoses in the 2008 eICU Program Database

Diagnosis	Number of patients (%)
Acute myocardial infarction	9.065 (5.1)
Respiratory- medical, not otherwise categorised	7.773 (4.4)
CABG alone	6.665 (3.8)
CHF	5.930 (3.4)
Unstable angina	4.650 (2.6)
Rhythm disturbance (atrial, supraventricular)	4.594 (2.6)
CVA /stroke	4.630 (2.6)
Cardiovascular- medical, not otherwise categorised	4.233 (2.4)
Diabetic ketoacidosis	3.478 (2.0)
Chest pain- unknown origin	3.453 (2.0)
Cardiac arrest (with or without respiratory arrest)	3.014 (1.7)
Bleeding, GI location, undefined	3.074 (1.7)
Pneumonia- bacterial	3.036 (1.7)

Most Common APACHE Admission Diagnoses in 2011 in HA ICU

Diagnosis	Number of patients (%)
Sepsis, pulmonary	606 (5.0)
Renal failure, acute	390 (3.2)
GI Perforation/Rupture, surgery for	363 (3.0)
Pneumonia, bacterial	351 (2.9)
Cancer-other GI tract, surgery for (i.e. hepatoma, gallbladder etc.)	327 (2.7)
Sepsis, GI	308 (2.6)
Congestive Heart Failure	301 (2.5)
Acid-base electrolyte disturbance	286 (2.4)
Cardiac arrest	261 (2.2)
Neoplasm-cranial, surgery (excluding transphenoidal)	251 (2.1)

Out-of-hour discharge and Readmission Rate

Readmission

- Early discharges from critical care are those that happen before the patient is deemed medically ready because of pressure on beds or staffing
- Readmission to critical care may be an indicator that discharge was too early
- They can be used as a marker of insufficient resources

	Australia	New Zealand	Total
Proportion discharged to ward after hours (18:00-6:59)	15.4%	12.1%	15.1%
Readmission Rate	5.1%	4.2%	5.0%

Scotland

- The mean readmission rate to ICU is 1.6%

Conclusion

- Evaluate low-, medium-, high-acuity subgroup performance independently and we can use these data to target quality issues and improve quality of care
- Avoid too frequent measurement of actual to predicted ratios because results from small numbers of patients can result in less reliable data and wide CIs
- Useful for internal quality monitoring

Internal quality improvement

- Inconsistencies between ICU and hospital mortality
  - Premature discharge, poor floor care
- Discordance between ICU and hospital LOS
  - Lack of floor beds
- Track performance over time
  - Continuously improving quality and rapidly detecting problems that might reflects gaps in care

Malaysia

	2007	2008	2009	2010	2011
ICU mortality %	22.3	19.9	21.2	20.9	21.2
Hospital mortality %	30.7	27.2	29.7	28.1	29.5
SMR	0.89	0.85	0.89	0.80	0.77

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THANK YOU