

Redesigning and Delivering Excellent Care for Emergency Surgery and Trauma Patients

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Background/Aim

- Khoo Teck Puat Hospital (KTPH) was the first restructured hospital in Singapore to introduce the Emergency Surgery and Trauma (ESAT) service in November 2014 to handle emergency surgical conditions and trauma patients.
- Aims of the ESAT service:
 - Consultant-led management** of patients
 - Separation of **emergency and elective workflows**
 - Efficient deployment** of department manpower
 - Better patient outcomes with **decreased time to intervention**
 - Increased **presence of senior staff** during major operations.
- ESAT subsequently evolved from a **single-consultant (SC) led service** into a **rotating weekly consultant (WC) service** in January 2017 to ensure sustainability.

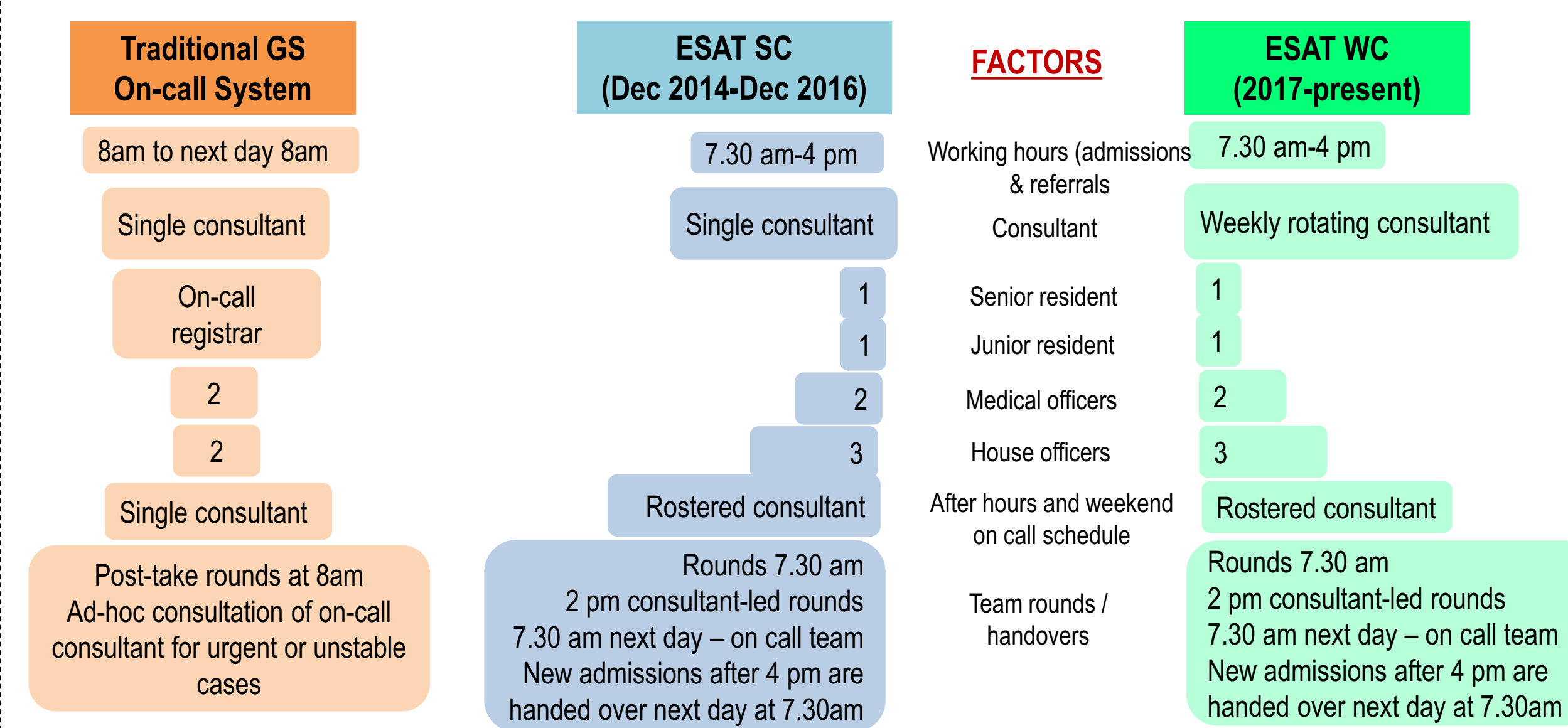


Figure 1. Comparison of team structures between traditional model, ESAT SC and ESAT WC

Methodology

- Retrospective review was performed for all emergency surgical admissions and trauma admissions from 2014 to 2020.
- Outcomes of Pre-ESAT and ESAT were compared for overall impact and subgroup analysis was performed in specific domains with significant improvement.
- Efficiency outcomes** measured:
 - Priority (P) status of the operation, time of first review by GS in emergency department (ED), presence of consultant in OT, surgery performed within or out of office hours.
- Clinical outcomes** measured:
 - Length of stay (LOS), hospital bill, 30-day re-admission rate, surgical complications Clavien grade III-V, mortality rate.
- Data from the National Trauma Registry (NTR) was used in review of the **Case Fatality Rate (CFR) 2012-2018** to compare trauma mortality rates before and after introduction of the ESAT service.

Strategy for Change / Intervention

The ESAT service is also an active driving force for the development of integrated and transdisciplinary best practice models:

- Optimal Care Index (OCI) for acute cholecystitis:** Joint implementation with Corporate Office and Operations Department to quantify value delivered to patients through holistic outcomes measurement.
- Emergency Laparotomy Pathway (ELAP):** Integrated transdisciplinary team approach for patients undergoing major abdominal surgery, including Geriatrics, Emergency Department, Anaesthesia, nurses, and community team.
- Critical Haemorrhage to Operating Room Protocol (CHOP)** for the multidisciplinary trauma team to enhance timely intervention for severe polytrauma victims.
- KTPH Interprofessional Trauma Training workshop (SAFE-KIT)** for cross-disciplinary education and trauma activation simulation training

Results / Impact

Table 1. Overall key clinical outcomes

Clinical outcomes measured	Pre-ESAT (N = 1248)	ESAT (N = 1279)	P
Case time (min) from booking to OT			
P1 (n=48)	47 (34)	46 (36)	0.95
P2 (n=369)	98 (66)	67 (42)	0.001
P3 (n=688)	225 (305)	79 (133)	<0.001
Time to GS review (min) (n=1603)	81 (91)	71 (81)	0.02
Consultant in OT (%) (n=280)	86	96	<0.01
Operations in office hours (%) (n=1141)			
Day (07:30-16:00)	40	43	0.3
After hours (16:00-07:30)	60	56	
Hospital bill size (USD)			
Appendectomy	\$2690 (5240)	\$2331 (4909)	0.07
Cholecystectomy	\$2990 (1840)	\$2746 (1223)	0.14
Cholecystectomy	\$3862 (2917)	\$3189 (1759)	0.24
Incision and drainage	\$839 (771)	\$917 (1360)	0.46
ICU length of stay (d) (n=85)	8.3 (13)	4.7 (4.8)	0.09
Overall length of stay (d)	4.5 (9)	3.5 (4.5)	<0.01
Appendectomy	2.6 (2)	2.0 (1.5)	0.003
Cholecystectomy	4.9 (3.6)	3.7 (1.4)	0.09
Incision and drainage	1.7 (2)	1.7 (1.6)	0.87
Re-admission rate (%)	5	7	1
Post-operative complications (%)			
Clavien III-V	0.9	0.4	0.14
Mortality	2.4 (1.9%)	11 (0.9)	0.03

Data are number (%), mean (SD). ED: Emergency department, GS: General surgery, OT: operating theatre, USD: US dollars, ICU: Intensive Care Unit, d: Day.

Table 2. Outcomes for cholecystitis

Factors	Pre-ESAT (N = 82 ^a)	ESAT (N = 172 ^a)	P
Clinical Outcomes			
Early laparoscopic cholecystectomy (ELC)	34 (41.5%)	145 (84.3%)	<0.001
Emergency re-admission within 30 days	8 (9.8%)	3 (1.7%)	0.003
Length of stay (days)			
DLC	4.55 ± 2.2	1.89 ± 1.6	0.001
ELC	5.03 ± 2.6	4.15 ± 2.9	
Conversion	9 (11.0%)	4 (2.3%)	0.003
Efficiency Outcomes			
Time to OT (min)	197 ± 98	180 ± 56	0.014
Timing of emergency surgery after office hours	14/48 (29.2%)	25/145 (17.2%)	0.075
Operative duration (min)	139 ± 53.4	121 ± 38.5	0.030
Consultant present	74 (90.2%)	172 (100%)	NA

^aPre-ESAT, N = 82 (delayed laparoscopic cholecystectomy N = 48, early laparoscopic cholecystectomy N = 34); ESAT, N = 172 (delayed laparoscopic cholecystectomy N = 27, early laparoscopic cholecystectomy N = 145)

The ESAT model has improved outcomes for patients with **acute GS** conditions:

- Time to GS review for acute admissions (71 mins vs 81 mins)
- Decreased time to intervention for P2 and P3 cases
- Increase in consultant presence for major emergency surgeries
- Decreased length of stay from 4.5 to 3.5 days.
- Decrease in mortality rate 1.9% to 0.9%.

Subgroup analysis of patients with **acute cholecystitis** showed:

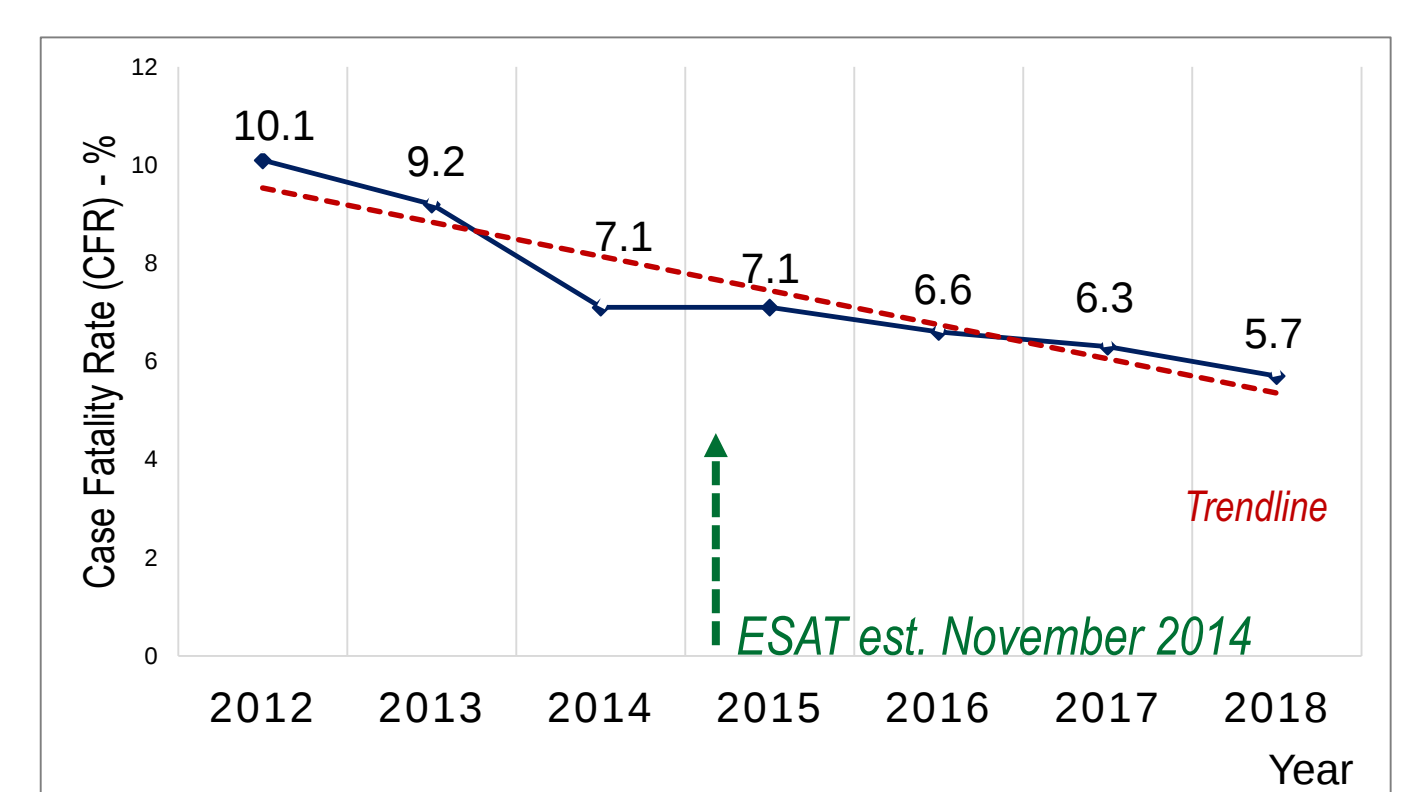
- Early cholecystectomy rates increased from 41.5% to 84.3%
- Time to intervention decreased from 197 to 180 minutes
- Operative duration decreased from 139 to 121 minutes
- Decreased conversion rate from 11.0% to 2.3%
- Decreased 30-day readmission rates from 9.8% to 1.7%

Table 3: Tier 1 and 2 Trauma Volume and Case Fatality Rates (CFR) 2015 – 2018

Year	Tier 1 ISS ≥ 25			Tier 1 ISS 16 – 24			Tier 2 ISS 9 – 15			Tier 1 and Tier 2		
	No. of cases	No. of deaths	CFR (%)	No. of cases	No. of deaths	CFR (%)	No. of cases	No. of deaths	CFR (%)	No. of cases	No. of deaths	CFR (%)
2015	42	13	31.0	169	6	3.6	677	13	1.9	888	32	3.6
2016	34	8	23.5	163	7	4.3	849	15	1.8	1046	30	2.9
2017	45	5	11.1	186	6	3.2	856	12	1.4	1087	23	2.1
2018	51	8	15.7	167	2	1.2	844	9	1.1	1062	19	1.8

NB: Excluding Head Injuries With AIS ≥5 and Dead On Arrival (DOA)

Figure 2. Overall trauma CFR for Tier 1 pts



- KTPH receives *second highest volume of Tier 1 trauma patients* in Singapore (NTR data)
- Mortality rate for Tier 1 trauma consistently below national average and lowest among other restructured hospitals in 2018.
- Dedicated ESAT team for management of polytrauma within the multidisciplinary framework.

Subgroup analysis of **ELAP patients** showed:

- Decrease in Clavien III major complications from 19.1% to 10.7%.
- Average length of stay decreased from 15.5 to 11.9 days.
- Average bill size decreased from SGD \$32,128 to \$25,286.
- Consultant presence in operating theatre increased from 92% to 100%.

Conclusions

- ESAT service has reshaped the traditional model of care for emergency surgery and trauma in KTPH.
- The redesigned care model has enabled more effective resource allocation with significant holistic improvements in clinical, efficiency, productivity and value outcomes without increasing manpower requirements.
- Implementation of novel tools like the OCI will align ESAT with strategic directives of looking beyond health to value.