Budget Impact Analysis of Implementing an Autotransfusion System in Cardiovascular Surgery at a Hospital Level in Saudi Arabia

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OBJECTIVES

- Donated blood is a critical resource in the management of cardiovascular surgery [1,2] . Evidence suggests a negative correlation between allogeneic blood transfusion (ABT) and patient health outcomes [3,4].
- It is therefore important to consider blood conservation strategies [5], such as an autotransfusion system (ATS) where a patient's salvaged blood is re-transfused using specialised equipment to reduce or avoid ABT and the associated risks/costs [6,7].
- This research was undertaken to estimate the budget impact (BI) of instituting ATS to augment the use and dependency on ABT during cardiovascular surgery in the Kingdom of Saudi Arabia (KSA).

METHODOLOGY

- A BI model that only assumes perioperative transfusion was developed in MS Excel® to compare three scenarios:
  - Conventional ABT (control) – where blood from volunteer donors is transferred to another person [8],
  - Using ATS solely – where a patient's own blood is removed and later transferred back [8],
  - Using ATS and ABT – where a patient receives their own blood and extra ABT as required.
- A hospital buyer perspective was taken based on one ATS machine linked to the annual surgeries (*Fig 1*).

Figure 1: The Xtra® Autotransfusion System (ATS) machine [9]

- BI was considered as the relevant direct healthcare costs incurred: blood acquisition, hospitalisation/clinical staff, follow-up, and reoperations/complications, as shown in Table 1 (exemplar).

Table 1: Direct health care costs associated with a single cardiac surgery procedure related to an external blood procurement scenario (total cost of usership per patient)

Direct Healthcare Costs								
Standard of care			ATS without transfusion			ATS with transfusion		
Cardiac surgery								
Fixed costs	Model Default	User Input	Fixed costs	Model Default	User Input	Fixed costs	Model Default	User Input
Selection/harvesting	-		Average total cost of transfusing autologous RBC	2 407		Average total cost of transfusing autologous RBC	2 407	
Maintenance costs	-		Pre-admission of autologous blood	615		Pre-admission of autologous blood	615	
Inventory	-					Cost of transfusing allogeneic RBC	1 718	
HLA typing	450							
Average total cost of transfusing allogeneic RBC	5 250							
Variable costs	Model Default	User Input	Variable costs	Model Default	User Input	Variable costs	Model Default	User Input
Cost of hospitalisation and clinical staff	144 802		Cost of hospitalisation and clinical staff	135 342		Cost of hospitalisation and clinical staff	126 342	
Theater	54 529		Theater	54 326		Theater	54 326	
ICU	50 732		ICU	50 454		ICU	50 454	
General ward	39 546		General ward	20 583		General ward	20 583	
Follow up care	61 058		Follow up care	61 058		Follow up care	61 058	
Complications	23 142		Complications	-		Complications	4 023	
Reoperations	4 611		Reoperations	2 306		Reoperations	2 306	
Total cost of usership	238 718	-	Total cost of usership	191 728	-	Total cost of usership	197 661	-

- Direct costs were calculated using micro costing and where split between fixed costs and variable costs. Acquisition cost of ATS machine was excluded from BIA.

- For a hospital that owns an in-house blood bank, fixed costs associated with ABT included the following:
  - Cost of selecting/harvesting the blood
  - Maintenance costs
  - Inventory costs, and
  - HLA typing cost.
- For a hospital that procures blood externally, fixed costs associated with ABT included the following:
  - Average cost of procuring allogenic RBCs from an external source, and
  - HLA typing cost.
- For ATS, the fixed costs included the following:
  - Average total cost of transfusing autologous RBCs, which included - cost of collection and autotransfusion of autologous blood, cost of filtration and re-transfusion of autologous blood, and cost of additional disposables.
  - Pre-admission of autologous blood from patients, and
  - Cost of transfusing allogeneic RBC (ONLY for ATS with transfusion) – the cost of transfusing allogeneic RBCs is dependent on whether the hospital has a blood bank or procures blood externally.
- Variable costs are independent of whether the hospital owns a blood bank or not, and included the following:
  - Cost of hospitalisation and clinical stuff – this is the sum of costs associated with clinical costs and length of stay in theater, ICU ward, and general ward.
  - Follow up care costs – these are the costs associated with the direct post-operative care.
  - Complications costs – this is the sum of costs associated with treating the probability of the following complications: transmission of infections, acute haemolytic transfusion reactions, transfusion-related acute lung/renal injury and nosocomial infections.
  - Reoperations costs – this is the cost associated with a probability of a reoperation.

RESULTS

- In the control group, the cost of performing a single case equated to 237,864 (*Fig. 2*) Saudi Riyal (SAR) for a hospital with in-house blood bank and SAR 238,718 (*Fig. 3)* for a hospital that procures externally.

	Scenario 1	Scenario 2	Scenario 3	Incremental Budget Impact Results	
	Standard of care	ATS without transfusion	ATS with transfusion	(Scenario 1-Scenario 2)	(Scenario 1-Scenario 3)
Cardiac surgery	237 864	191 728	197 405	46 136	40 459

Figure 2: Cost of performing a single case of cardiac surgery for a hospital with an in-house blood bank

	Scenario 1	Scenario 2	Scenario 3	Incremental Budget Impact Results	
	Standard of care	ATS without transfusion	ATS with transfusion	(Scenario 1-Scenario 2)	(Scenario 1-Scenario 3)
Cardiac surgery	238 718	191 728	197 661	46 990	41 057

Figure 3: Cost of performing a single case of cardiac surgery for a hospital that procures blood externally

- Compared to this, when using ATS solely, the cost became SAR 191,72 (80.6% vs control) and ATS with ABT SAR 197,405 (83.0% vs control) for a hospital with in-house blood bank and SAR 197,661 (82.8% vs control) for a hospital that procures externally (Fig. 4).

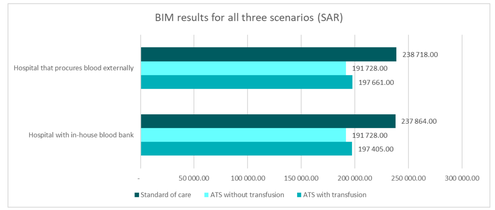

Figure 4: BIM results for ABT, ATS, and ATS with ABT

- Results are driven by a substantial reduction in the need for ABT, shorter length of stay and fewer reoperations/complications associated with ATS (*Fig. 5*).

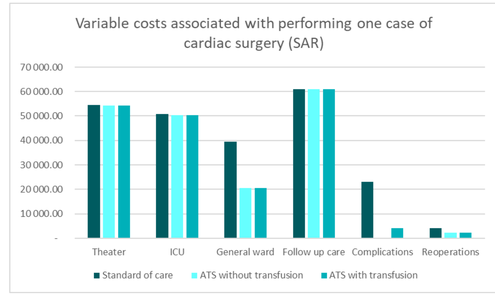

Figure 5: Variable costs associated with performing a single cardiac surgery procedure

- ATS is associated with capital expenditure (excluded from BIA) and the cost of disposables (included in BIA) used.

CONCLUSION

- Data indicates that the implementation of ATS can be cost saving compared to conventional ABT in KSA.
- In this era of patient blood management, where multimodal methods of reducing dependence on ABT are commonplace, ATS appears to be an affordable technology that reduces costs and is associated with better patient outcomes compared to ABT.

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ACKNOWLEDGEMENTS

- To Prof S. Gunaydin for the peer review of content provided on patient blood management strategies, technological developments, and supporting evidence.

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