Cost-Effectiveness and Budget Impact Analyses of Implementing the First Pillar of Patient Blood Management with Intravenous (IV) Ferric Carboxymaltose (FCM) on the Turkish Healthcare System

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INTRODUCTION

- Patient blood management (PBM) is a patient-centered, evidence-based multidisciplinary approach that aims to optimize hemoglobin concentration, maintain hemostasis and minimize blood loss in patients undergoing surgery.¹⁻³
- The available evidence indicates that anemia, bleeding and exposure to allogeneic products are risk factors for morbidity and mortality in elective surgery.⁴⁻⁸
- These risk factors account for an economic burden on healthcare systems through prolonged length of stay in hospital (LOS), re-hospitalizations and increased risk of adverse events and complications.
- The Ministry of Health (MoH) of Turkey embarked on a project titled 'Technical Assistance for Improving Blood Transfusion Management in Turkey' in March 2019 with assistance from the European Union.⁹

OBJECTIVES

 The aims of this study is: (1) to explore the cost-effectiveness of comprehensive anemia management, first pillar of PBM, in non-cardiac and cardiac surgery from the Turkish Social Security Institution (SSI) perspective; (2) to explore the budget impact of PBM for coronary artery bypass grafting and hip & knee arthroplasty to the SSI.

METHODS

- A decision tree model with probabilities of adverse events was developed to assess the cost-effectiveness of PBM versus no PBM in non-cardiac (hip & knee arthroplasties – H&K) and cardiac surgeries (coronary artery bypass grafting –CABG) with a simulated cohort of 10,000 patients in Turkey (Figure 1).
- The endpoints of the study were postoperative adverse events avoided for a hospitalization period of up to 30 days (sepsis with or without pneumonia, acute renal failure, acute myocardial infarction and acute stroke). The implementation of the first pillar of PBM (i.e. preoperative anemia measure) was compared with placebo.
- Preoperative anemia treatment was made with intravenous (IV) ferric carboxymaltose (FCM) (two 500 mg per 10 mL vials before surgery).
- Data on endpoints and probabilities for non-cardiac and cardiac surgeries were obtained from the results of the Kleinerüschkamp et al. study,⁸ and given as incremental cost per avoided postoperative complication.
- The budget impact analysis was based on the costs of treating postoperative adverse events and the cost of receiving PBM. Figure 2 shows the epidemiological and costing data used in the analysis.
- In 2017, there were 12,237 CABG surgeries and 77,780 hip and knee arthroplasties in Turkish MoH hospitals. According to Ünal et al (2020)^{10,} 33% of these would have preoperative anemia (4038 patients undergoing CABG and 25,667 patients with H&K arthroplasty). Based on Drabinski et al (2021)¹¹, 50% of the patients with preoperative anemia would have iron deficiency anemia (IDA) (2019 patients undergoing CABG and 12,834 patients with H&K arthroplasty). Finally, on the basis of expert opinion, 50% of patients with IDA would receive 1000 mg of IV FCM treatment (1010 patients undergoing CABG and 6417 patients with H&K arthroplasty).
- Sensitivity analysis for both CEA and BIM were conducted to check the robustness of results.

RESULTS

- PBM was found to dominate the control arm in both non-cardiac and cardiac surgeries and provided better outcomes with lower costs (Table 2). With the implementation of PBM, the incremental cost was -12,122 TRY for non-cardiac surgery and -11,449 TRY for cardiac surgery.
- The overall net cost savings related to avoided post-surgical adverse events following hip and knee arthroplasty in Turkey in 2017, were 70,729,809 TRY (€3,844,011) (Table 3).
 For CABG surgeries were 35,979,085 TRY (€1,955,385).

CONCLUSIONS

In our study, the implementation of PBM was associated with a decreased rate of adverse events in both cardiac and non-cardiac surgical patients. PBM should be advocated as a cost-effective and cost-saving option in major surgeries in Turkey. The SSI can play a leading role by promoting, regulating and implementing policy for the inclusion of PBM in hospital-based process improvement initiatives with the goal of improving patient safety and clinical outcomes.



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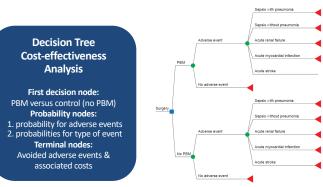


Table 1. Postoperative adverse events and probabilities for non-cardiac & cardiac surgeries

/表\	Control arm			PBM arm			Total avoided
	n	%	Probability	n	%	Probability	adverse events n
Sepsis with pneumonia	1108	25.14	0.2514	156	3.54	0.0354	952
Sepsis without pneumonia	824	18.69	0.1869	416	9.44	0.0944	408
Acute renal failure	402	9.12	0.0912	198	4.49	0.0449	204
Acute MI	596	13.52	0.1352	450	10.21	0.1021	146
Acute stroke	158	3.58	0.0358	100	2.27	0.0227	58
Total adverse events		3088			1320		1768

UN R	Control arm			PBM arm			Total avoided
(Å)	n	%	Probability	n	%	Probability	adverse events n
Sepsis with pneumonia	648	25.89	0.2590	265	10.59	0.1059	383
Sepsis without pneumonia	482	19.26	0.1926	197	7.87	0.0787	285
Acute renal failure	250	9.99	0.0999	94	3.76	0.0376	156
Acute MI	303	12.11	0.1211	7	0.28	0.0028	296
Acute stroke	190	7.59	0.0759	66	2.64	0.0264	124
Total adverse events	1873			629			1244

Figure 2. Budget Impact Analysis: epidemiological & costing data in Turkey

Dudget Impect	11 3	Hip & knee Arthroplasty	CABG
Budget Impact	Surgeries	77,780	12,237
Analysis	Patients with preoperative anemia	25,667	4038
 33% of patients with 	Patients with IDA	12,834	2019
preoperative anemia ¹	Treated with FCM	6417	1010
 50% of patients with preoperative anemia have IDA³ 	Postoperative Adve	Cost (TRY)	
• 50% of patients with IDA treated	Sepsis with pneu	16,349.93	
with FCM	Sepsis without pne	13,622.70	
WILLITCIVI	Sepsis Michourphi	carrierina	
• 1000 mg IV FCM (two vials) per	Acute renal fai		465,226.83
			465,226.83 35.975,10

Table 2. Cost-Effectiveness results of implementing PBM versus no PBM in Turkey

Type of Surgery	Comparators	Cost (TRY)	Incremental cost (TRY)	Avoided adverse events	Incremental avoided adverse events	ICER
Non-cardiac	PBM	13,285	-12,122	1768	1768	PBM
surgery	Control	25,407	=12,122	0	1708	dominates
Cardiac	PBM	7,417	11 440	1244	1244	PBM
surgery	Control	18,866	-11,449	0	1244	dominates

Table 3. Estimation of potential net cost-savings of implementing PBM in Turkey

/春/	Adverse events		Cost of treati events	Difference		
!!	Control	PBM	Control	PBM	(TRY)	
Sepsis with pneumonia	711	100	11,624,318	1,636,926	9,987,391	
Sepsis without pneumonia	529	267	7,201,916	3,637,015	3,564,901	
Acute renal failure	258	127	120,025,886	59,108,758	60,917,128	
Acute MI	382	289	13,758,103	10,387,831	3,370,272	
Acute stroke	101	64	10,426,814	6,598,535	3,828,279	
Total	1982	847	163,037,036	81,369,065	81,369,065	
Total cost of PBM						
Total net cost saving to the SSI (TRY)						
Total net cost saving to the SSI (€) ^c						

Figure 1. Decision tree model comparing PBM versus no PBM implementation

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