

## 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.<sup>1-3</sup>
- Anemia, including iron deficiency anemia (IDA) and iron deficiency without anemia, in most medical, surgical and obstetric populations, is under-recognized and under-reported by health authorities and clinicians.<sup>1-2</sup>
- These conditions are associated with a significant increased in morbidity, mortality, use of intensive care units (ICU) and longer hospital length of stay for health care systems.<sup>3-5</sup>
- In elective surgeries, preoperative anemia rates can reach up to 75%.<sup>6</sup>

## OBJECTIVES

- The aim of the study is to quantify the potential health economic benefits of implementing preoperative anemia management, the first pillar of Patient Blood Management (PBM), in the Romanian healthcare system.

## METHODS

- Hospital claims database with cases discharged from 515 Romanian hospitals reporting to National Health Insurance House (NHIH) between 1st January 2019 and 31st December 2019 was reviewed retrospectively.
- Hip and knee arthroplasty (HKA) cases were used as proxy for major non-cardiac interventions. Similarly, coronary artery bypass grafting (CABG) cases were used as proxy for major cardiac surgery interventions and were identified via RO-DRG codes.
- Non- elective surgeries and patients < 18 years of age were excluded.
- Preoperative iron deficiency anemia treatment was made with intravenous (IV) ferric carboxymaltose (FCM) (two 500 mg vials before surgery).
- A decision tree health economic model from an already published study from Turkey <sup>7</sup> was adapted and populated with local cost and epidemiologic data. We estimated cost effectiveness and budget impact of implementing treatment with FCM as a preoperative anemia measure (first pillar of PBM) in a Romanian hospital setting (**Figure 1**).
- Data on endpoints and probabilities for non-cardiac and cardiac surgeries were obtained from the results of the Kleinerüschkamp et al. study <sup>8</sup> (**Table 1**).
- The health economic model simulated two potential scenarios:
  - (1) all elective surgeries with IDA received ferric carboxymaltose treatment;
  - (2) half of elective surgeries with IDA received treatment, which is closer to the real-life practice
- 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. Based on expert opinion preoperative anemia rate in both cardiac and non-cardiac cases is 30% and iron deficiency anemia rate from total anemia cases is 90% in Romania. Finally, 50% of patients with IDA would receive FCM treatment.
- In 2019, there were 1,258 CABG surgeries and 13,383 hip and knee arthroplasties in Romanian hospitals.

## 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 overall net cost savings related to avoided post-surgical adverse events following non-cardiac and cardiac surgeries in Romania in 2019 were €1,488,909 and €11,966 respectively in scenario 1 (**Table 3**) and €358,394 and €5,385 respectively in scenario 2.
- Total net cost savings were €1,500,875 in scenario 1 and €363,779 in scenario 2.

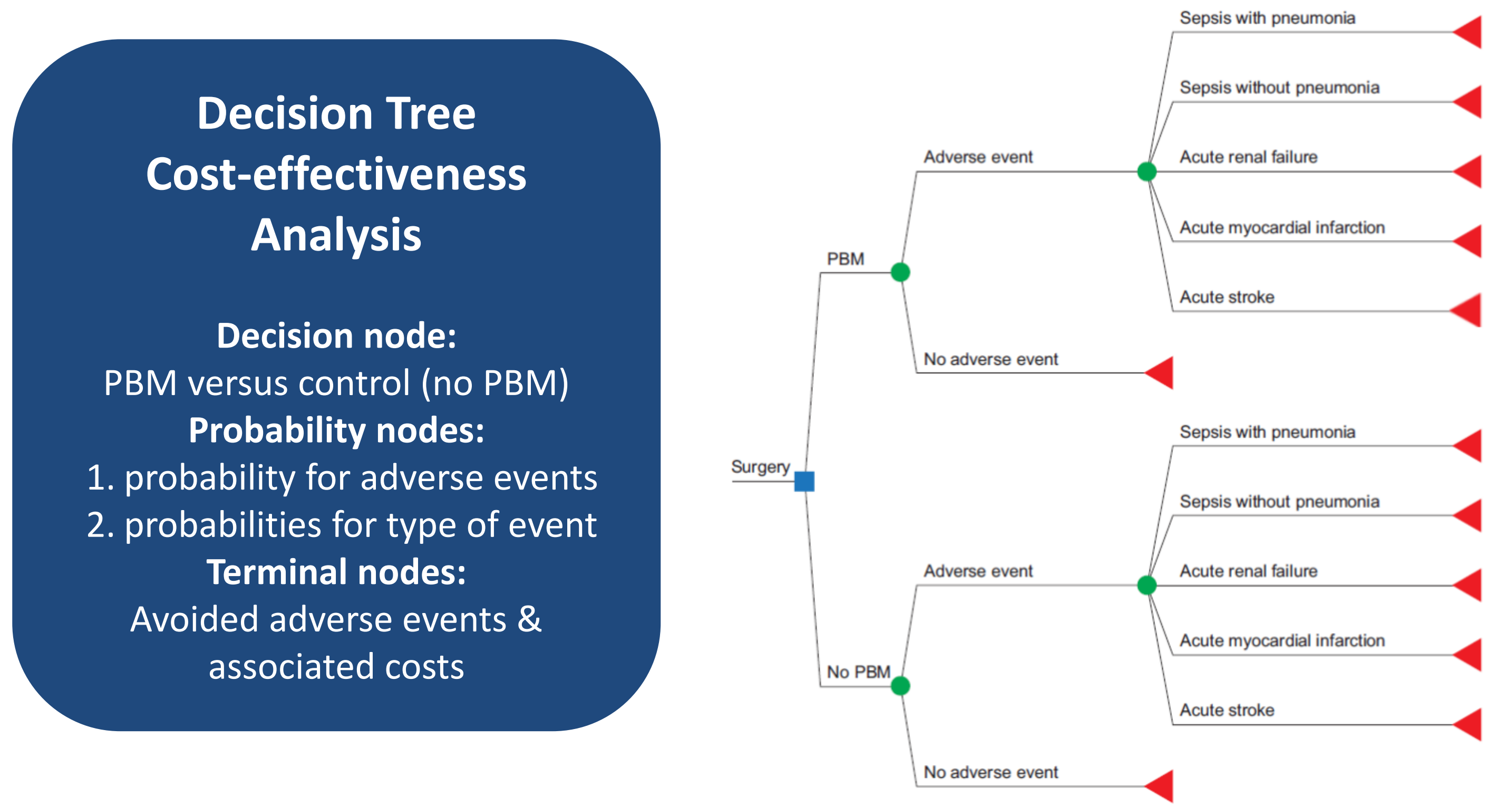
## CONCLUSIONS

- 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 Romania.
- Scenario analysis showed that the potential savings are higher if FCM treatment is applied to all iron deficiency anemia cases.

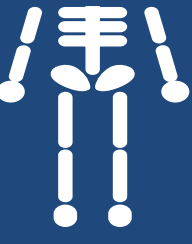
**REFERENCES.** 1. Kassebaum NJ, Jasrasaria R, Naghavi M, Wulf SK, Johns N, Lozano R et al. A systematic analysis of global anemia burden from 1990 to 2010. *Blood*. 2014;123:615-24. doi:10.1182/blood-2013-06-508325. 2. Munoz M, Gomez-Ramirez S, Kozak-Langenecker S, Shander A, Richards T, Pavia J et al. Fit to fly: overcoming barriers to preoperative haemoglobin optimization in surgical patients. *Br J Anaesth*. 2015;115:15-24. doi: 10.1093/bja/aeu165. 3. Fowler AJ, Ahmad T, Philli NK, Allard S, Gillies MA, Pearce RM. Meta-analysis of the association between preoperative anaemia and mortality after surgery. *Br J Surg*. 2015;102:1314-24. doi: 10.1002/bjs.9861. 25. 4. Klein AA, Collier TJ, Brar MS, Evans C, Hallward G, Fletcher SN et al. The incidence and importance of anaemia in patients undergoing cardiac surgery in the UK - the first Association of Cardiothoracic Anaesthetists national audit. *Anaesthesia*. 2016;71:627-35. doi:10.1111/anae.13423. 5. Nissensohn AR, Wade S, Goodnough T, Knight K, Dubois RW. Economic burden of anemia in an insured population. *J Manag Care Pharm*. 2005;11:565-74. doi: 10.18553/jmcp.2005.11.7.565. 6. Gómez-Ramírez S, Jerićić C, Muñoz M. Perioperative anemia: Prevalence, consequences and pathophysiology. *Transfusion and Apheresis Science*. 2019;58(4):369-74. ISSN 1473-0502. https://doi.org/10.1016/j.transci.2019.06.011. 7. Tatar M, Alkay N, Yildirim Güçlü Ç, Bernede O, Erdemli B, Günaydin S. Cost-Effectiveness and Budget Impact of Comprehensive Anemia Management, The First Pillar of Patient Blood Management, on the Turkish Healthcare System. *Clinicoecon Outcomes Res*. 2022 May 30;14:415-426. doi: 10.2147/CEOR.S360944. PMID: 35669886; PMCID: PMC9166278. 8. Kleinerüschkamp A, Meybohm P, Straub N, Zacharowski K, Choirapokayil S. A model-based cost-effectiveness analysis of Patient Blood Management. *Blood Transfus*. 2019 Jan;17(1):16-26. doi: 10.2450/2018.0213-17. Epub 2018 Feb 16. PMID: 29517965; PMCID: PMC6343592.


**DISCLOSURES.** This study was supported by CSL Vifor

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



**Table 1.** Postoperative adverse events and probabilities for non-cardiac & cardiac surgeries (**Scenario 1**)

	Control arm			PBM arm			Total avoided adverse events n
	n	%	Probability	n	%	Probability	
Sepsis with pneumonia	1,108	25.14	0.2514	156	3.54	0.0354	952
Sepsis w/o 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	3,088			1,320			1,768

	Control arm			PBM arm			Total avoided adverse events n
	n	%	Probability	n	%	Probability	
Sepsis with pneumonia	648	25.89	0.2590	265	10.59	0.1059	383
Sepsis w/o 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	1,873			629			1,244

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

### Budget Impact Analysis

- 30% of patients with preoperative anemia
- 90% of patients with preoperative anemia have IDA
- 100% or 50% of patients with IDA treated with FCM
- 500 mg IV FCM (two vials) per patient

	Hip & knee Arthroplasty	CABG
Surgical interventions	13,383	1,258
Patients with preoperative anemia	4,015	377
Patients with IDA	3,613	340
Treated with FCM	1,807	170

Postoperative Adverse Event	Cost (€)
Sepsis with pneumonia	2,896.14
Sepsis without pneumonia	1,590.86
Acute renal failure	1,594.43
Acute MI	1,216.99
Acute stroke	1,067.43

**Table 2.** Cost-Effectiveness results of implementing PBM versus no PBM in Romania (**scenario 1**)

Type of Surgery	Comparators	Cost (€)	Savings when PBM applied (€)	Incremental avoided adverse events	ICER
Non-cardiac surgery	PBM	836,664	-1,594,217	710	PBM dominates
	Control	2,430,881			
Cardiac surgery	PBM	49,426	-86,957	47	PBM dominates
	Control	136,383			

**Table 3.** Estimation of potential net cost-savings of implementing PBM in Romania (**Only non-cardiac surgeries, scenario 1**)

Nono-cardiac	Adverse events		Cost of treating adverse events (€)		Difference (€)
	Control	PBM	Control	PBM	
Sepsis with pneumonia	445	63	1,288,321	181,420	1,106,901
Sepsis without pneumonia	331	167	526,221	265,745	260,476
Acute renal failure	161	79	257,377	126,750	130,627
Acute MI	239	181	291,203	219,868	71,335
Acute stroke	63	40	67,758	42,880	24,878
Total	1,240	530	2,430,881	863,664	1,594,217
Total cost of PBM					105,308
Total net cost saving to the health system, HKA (€)					1,488,909