

Trends in Utilization of Microaxial Flow Pump and Intra-aortic balloon pump in the United States, United Kingdom, and Canada

Dennis T. Ko, MD, MSc,^{1,2} Sharon Ayayo, MSc,^{3,4} Amitava Banerjee, MBBCh, DPhil,^{5,6} Christina Fu, PhD,⁷ Olivia Haldenby, MSc,¹ Mamas A. Mamas, BM BCh, MA, DPhil, FRCP,⁸ Mohamed O. Mohamed, PhD,^{5,6} Feng Qiu, MSc,¹ Peter Cram, MD,^{*1,10,11} Bruce E. Landon, MD^{*7,12}

* Equal contribution

Author Affiliations:

1. ICES (formerly Institute for Clinical Evaluative Sciences), Toronto, Ontario, Canada
2. Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada
3. Cardiff University, Cardiff, Wales, United Kingdom
4. University of Manchester, Manchester, England, United Kingdom
5. Institute of Health Informatics, University College London, London, United Kingdom
6. Barts Health National Health Service Trust, London, United Kingdom
7. Harvard Medical School, Boston, Massachusetts, United States
8. Keele Cardiovascular Research Group, Keele University, Stoke-on-Trent, United Kingdom
9. Barts Health National Health Service Trust, London, United Kingdom
10. University of Maryland School of Medicine, Baltimore, Maryland, United States
11. Baltimore VA Medical Center
12. Beth Israel Deaconess Medical Center, Boston, Massachusetts, United States

Corresponding Author Information:

Dennis T. Ko, MD, MSc
V106, 2075 Bayview Ave,
Toronto, Ontario, Canada, M4N 3M5

INTRODUCTION (132 words)

Rising healthcare spending is threatening the sustainability of health systems in many high-income countries.¹ While health technology assessment (HTA) is used in the United Kingdom (UK) and Canada to guide payment decisions for new technologies, the United States (US) typically funds newly approved technologies without HTA.² Microaxial flow pumps (MAFP) (e.g., Impella), and intra-aortic balloon pumps (IABP) are relatively costly cardiac devices frequently used to provide hemodynamic support in complex percutaneous coronary interventions (PCI) and patients with myocardial infarction (MI) with cardiogenic shock.³ Despite their widespread use in the US and some other countries, data on their effectiveness remain limited.^{4,5} Our objective was to evaluate the adoption and de-adoption of MAFP and IABP in patients undergoing PCI in the US, UK, and Canada to understand how utilization patterns varied across countries.

METHODS (102 words)

We conducted a retrospective cross-sectional cohort study using clinical and administrative data for patients aged ≥ 65 years, who underwent PCI between January 1, 2012, and December 31, 2021. MAFP or IABP use was identified using administrative codes in the US or pre-specified data fields in the UK and Canada. Utilization rates for each procedure were calculated annually in each country, standardized per 10,000 PCI procedures performed per year. Linear regression models were used to evaluate significant temporal changes in procedure utilization. Additional information on the data sources and study conduct is provided in the **eMethods**.

RESULTS (171 words)

The cohort included 52,637 MAFP in the US, 264 in the UK, and 112 in Canada. Median age was 75 years, and 30% were female. MAFP use in the US increased from 60/10,000 PCI in 2012 to 443/10,000 in 2021 —a 7-fold increase. In contrast, utilization remained low in the UK and Canada (Figure 1), with 2021 rates of 9.2 and 7.3 per 10,000 PCI, respectively. Among MAFP recipients, 17.5% had a primary diagnosis of ST-segment elevation MI with cardiogenic shock in the US, compared to 9.1% in the UK, and 17.9% in Canada.

For IABP, the utilization rate was 328/10,000 PCI in the US in 2012 and 356/10,000 PCI in 2021 ($p=0.66$ for trend) (Figure 2). In contrast, IABP utilization decreased significantly in the UK and Canada. In the UK, IABP utilization was 206/10,000 PCI in 2012 and declined to 66/10,000 in 2021 (68% reduction, $p < 0.001$). In Canada, the rate decreased from 261/10,000 in 2012 to 185/10,000 in 2021, (29% reduction, $p = 0.002$).

Discussion (200 words)

We examined trends in mechanical support use among older patients undergoing PCI from 2012-2021 when practice guidelines downgraded their support for IABP, and MAFP was emerging as a potential adjunctive treatment despite limited evidence of effectiveness.^{3,6} In our comparison across different health systems using nationally representative, patient-level data, several key insights emerged. First, MAFP adoption was substantially faster in the US, with over 40-fold higher utilization than in the UK and Canada in 2021. Second, IABP de-adoption patterns varied substantially: utilization declined by 68% in the UK and 29% in Canada but remained stable in the US. Finally, MAFP was not primarily adopted as a replacement therapy for IABP in the US but instead resulted in expanded use of mechanical support among patients undergoing elective PCI procedures. The superior hemodynamic support provided by MAFP compared to

IABP has generated significant enthusiasm but divergence in clinical guidelines across countries.³ Our findings underscore that healthcare financing structures and use of HTA may play a dominant role in shaping the adoption and de-adoption of cardiac technologies across countries, often outweighing clinical efficacy considerations alone.²

REFERENCES

1. Berwick DM, Hackbarth AD. Eliminating waste in US health care. *JAMA*. 2012;307(14):1513-1516. doi:10.1001/jama.2012.362
2. Williams MM, Smith NR, Uyl-de Groot CA, et al. Variations in the Medical Device Authorization and Reimbursement Landscape: A Case Study of 2 Cardiovascular Devices Across 4 Countries. *Circ Cardiovasc Qual Outcomes*. 2025:e011636. doi:10.1161/CIRCOUTCOMES.124.011636
3. Samsky MD, Morrow DA, Proudfoot AG, Hochman JS, Thiele H, Rao SV. Cardiogenic Shock After Acute Myocardial Infarction: A Review. *JAMA*. 2021;326(18):1840-1850. doi:10.1001/jama.2021.18323
4. Thiele H, Zeymer U, Neumann FJ, et al. Intraaortic balloon support for myocardial infarction with cardiogenic shock. *N Engl J Med*. 2012;367(14):1287-1296. doi:10.1056/NEJMoa1208410
5. Moller JE, Engstrom T, Jensen LO, et al. Microaxial Flow Pump or Standard Care in Infarct-Related Cardiogenic Shock. *N Engl J Med*. 2024;390(15):1382-1393. doi:10.1056/NEJMoa2312572
6. Ibanez B, James S, Agewall S, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). *Eur Heart J*. 2018;39(2):119-177. doi:10.1093/eurheartj/ehx393

Figure legends

Figure 1. Trends in utilization of microaxial flow pump (MAFP) in the United States, United Kingdom, and Canada

Rate of MAFP per 10,000 PCI procedures (y-axis) is plotted from 2012 to 2021 (x-axis) in the United States (blue dots); United Kingdom (orange dots), and Canada (green dots).

Figure 2. Trends in utilization of intra-aortic balloon pump in the United States, United Kingdom, and Canada

Rate of IABP per 10,000 PCI procedures (y-axis) is plotted from 2012 to 2021 (x-axis) in the United States (blue dots); United Kingdom (orange dots), and Canada (green dots).

Acknowledgements

This study was supported by ICES, which is funded by an annual grant from the Ontario Ministry of Health (MOH) and the Ministry of Long-Term Care (MLTC). This document used data adapted from the Statistics Canada Postal Code^{OM} Conversion File, which is based on data licensed from Canada Post Corporation, and/or data adapted from the Ontario Ministry of Health Postal Code Conversion File, which contains data copied under license from ©Canada Post Corporation and Statistics Canada. Parts of this material are based on data and/or information compiled and provided by: Ontario Ministry of Health and the Canadian Institute for Health Information. The analyses, conclusions, opinions and statements expressed herein are solely those of the authors and do not reflect those of the funding or data sources; no endorsement is intended or should be inferred.

Funding/Support

Funding for this study was supported by a grant from the US National Heart Lung and Blood Institute (1R01HL167887) and the National Institutes of Health (R01AG058878). Dr. Ko is supported by the Jack Tu Chair in Cardiovascular Research, University of Toronto/Sunnybrook Hospital. The funding source had no role in the study's design, conduct, or reporting.

Disclosures/Conflicts of Interest

The authors have no disclosures or conflicts of interest to report.

Figure 1. Trends in utilization of microaxial flow pump (MAFP) in the United States, United Kingdom, and Canada

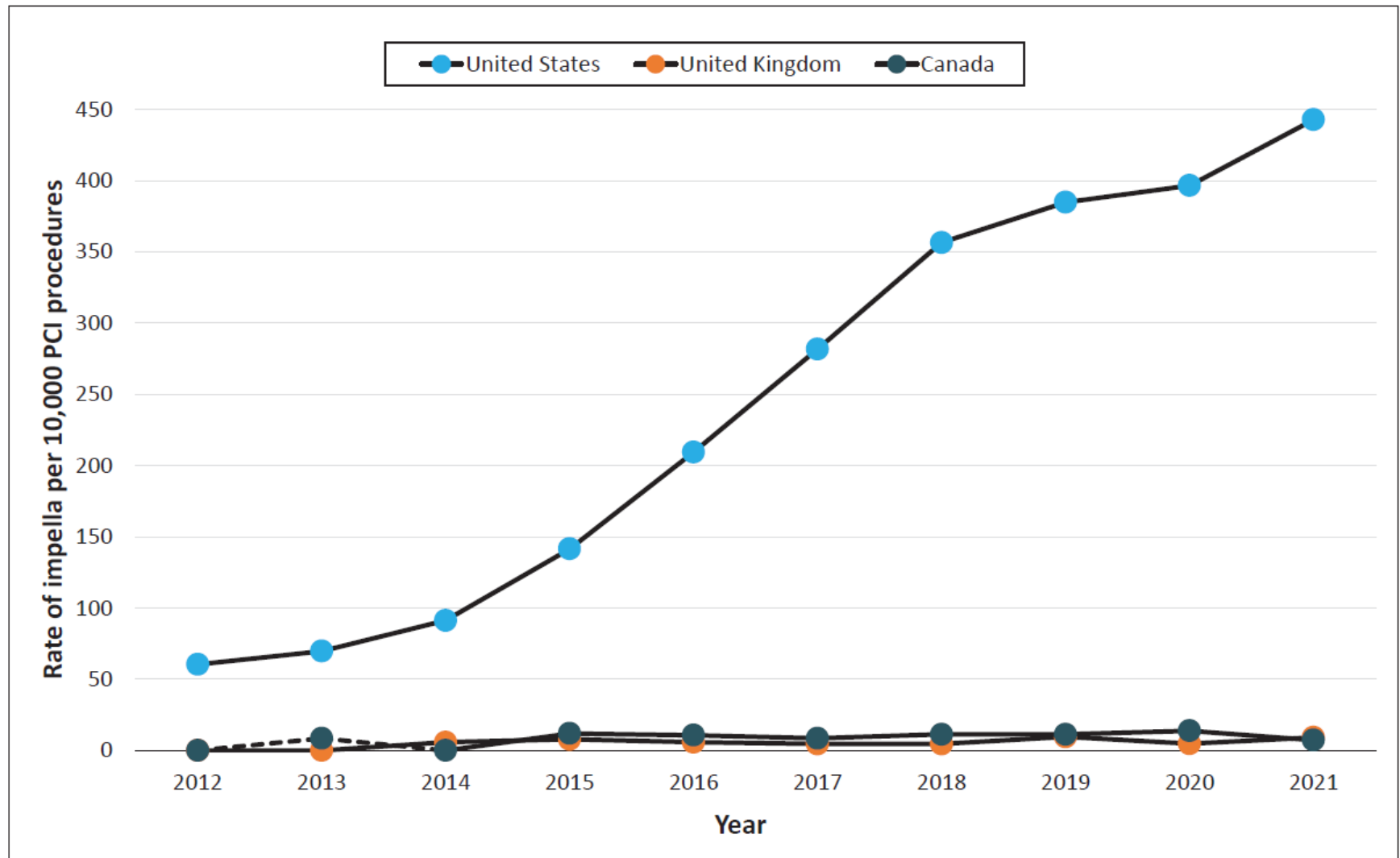


Figure 2. Trends in utilization of intra-aortic balloon pump in the United States, United Kingdom, and Canada

