Efficient blood testing in endourology

A transfusion dashboard initiative to minimize unnecessary type and screen tests

Ghizlane Moussaoui[1], Emma Piennar[2], Matthew S. Lee[3], Jacqueline D. Trudeau[4], Connor M. Forbes[1,5,6]

[1]Department of Urologic Sciences, University of British Columbia, Vancouver, BC, Canada; [2]Vancouver Coastal Health, Vancouver General Hospital, Vancouver, BC, Canada; [3]Department of Urology, Ohio State University, Columbus, OH, United States; [4]Department of Anesthesiology, Pharmacology and Therapeutics, University of British Columbia, Vancouver, BC, Canada; [5]The Vancouver Prostate Centre, Vancouver, BC, Canada; [6]The Vancouver Stone Centre, Vancouver, BC, Canada

Cite as: Moussaoui G, Piennar E, Lee MS, et al Efficient blood testing in endourology: A transfusion dashboard initiative to minimize unnecessary type and screen tests. *Can Urol Assoc J* 2026;20(4):101-6. http://dx.doi.org/10.5489/cuaj.9451

Published online December 15, 2025

See related commentary on page 107

ABSTRACT

INTRODUCTION: Type and screen testing (T&S) is routinely performed preoperatively for many endoscopic procedures, despite low transfusion rates. While important, T&S can be costly, unnecessary, and burdensome for patients to obtain in a short timeframe due to expiry. We aimed to assess and reduce unnecessary T&S in a safe and collaborative manner through a transfusion dashboard. We assessed the effect of reduced testing on patient safety, cost, and the environment.

METHODS: This quality improvement study used the transfusion dashboard, a web-based, institutional platform tracking blood transfusion trends. During the observation phase (2016–2019), procedure-specific preoperative T&S recommendations were developed. Following implementation of these recommendations in 2020, the incidence of T&S, perioperative transfusion rates, and rescue transfusion rates were assessed pre- and post-intervention using the Chi-squared test. Cost and environmental savings were also evaluated.

RESULTS: From 2016–2023, outcomes were tracked for 4375 pre-initiative and 2488 post-initiative patients who underwent endoscopic procedures. We found a statistically significant decrease in T&S following initiative implementation for transurethral resection of the prostate (TURP), percutaneous nephrolithotomy (PCNL), holmium enucleation of the prostate (HoLEP), and transurethral resection of bladder tumor (TURBT) by as much as 51.2%. There was no change in uncrossed or overall blood transfusions. Since the implementation of the initiative, $45 362.81 in testing materials were saved, and an associated reduction of 697 kg CO_2 was observed.

CONCLUSIONS: Institutional- and procedure-specific testing guidelines decreased unnecessary tests, leading to improved resource stewardship, reduced cost, improved patient experience, and environmental savings. Initial modest cost savings and care improvements may be amplified safely in larger organizations and across more procedures.

INTRODUCTION

Preoperative type and screen testing (T&S) is a common practice in surgical settings; however, many patients, particularly those undergoing low-risk or minimally invasive procedures, do not require blood transfusions during the perioperative period. In endourology specifically, transfusion rates have been reported to range from 2–7% for transurethral resection of the prostate (TURP).[1,2] Similarly, transfusion rates following transurethral resection of bladder tumor (TURBT) have been reported as 0.5–2%.[3] Post-holmium enucleation of the prostate (HoLEP) transfusion rates are generally <4%, while for percutaneous nephrolithotomy (PCNL), they range from 5–17%.[4,5] This represents an opportunity for improving patient care by reducing phlebotomy and overall cost to the system if T&S can be omitted safely.

Previous studies have reported on the use of maximum surgical blood ordering schedule (MSBOS) or data acquired from an anesthesia information management system to provide guidelines for preoperative T&S ordering.[6,7] Omitting T&S for procedures where <5% of patients receive blood transfusion, the median blood loss is <50 cc, and where there is no risk for major bleeding, has been reported to be safe and effective at reducing unnecessary blood testing.[6]

Despite this evidence, T&S has been traditionally routinely performed at many institutions, including ours, prior to endourologic procedures. T&S remains valid for a finite period, which at our institution is 72

KEY MESSAGES

- Implementation of a transfusion dashboard led to a significant reduction in unnecessary preoperative type and screen (T&S) testing for routine endourologic procedures.
- This quality improvement initiative was performed safely and did not increase perioperative or rescue transfusion rates.
- Reduced T&S testing resulted in cost savings of over $45 000 and an associated reduction in CO_2 emissions, highlighting environmental benefits.
- The study provides a roadmap for safely reducing unnecessary T&S testing and decrease healthcare costs through data-driven recommendations and clinician education.

hours;[8] however, depending on institutional policies and patient-related factors (pregnancy, transfusion received, etc.), T&S may be valid for 72 hours or up to 60 days.[9] Preoperative bloodwork often involves patients traveling to testing centers in the days prior to their surgery. This leads to environmental waste from the trip itself, but also the machinery and material waste required for test processing. If not performed in advance, T&S performed the day of surgery can lead to operative delays, which can be detrimental to the healthcare system.

We aimed to reduce potentially unnecessary T&S by using a transfusion dashboard. This quality improvement initiative assessed the frequency of T&S and the associated transfusion rates across various endourologic procedures performed at two University of British Columbia/Vancouver Coastal Health hospitals. The data gathered were then analyzed to create recommendations to reduce unnecessary testing and to identify opportunities for cost savings and reduce environmental impact. We hypothesized that reducing unnecessary preoperative T&S could be done safely and lead to cost and environmental savings.

METHODS

Study design

The transfusion dashboard (TD) is a web-based platform developed at our institution. It centralizes and tracks blood transfusion data for both elective and urgent/emergent procedures performed at Vancouver General Hospital and at the University of British Columbia Hospital. The data collected includes rates of preoperative T&S and T&S obtained after the start of surgery. It also tracks the units of blood transfused intraoperatively, on postoperative day (POD) 0, and between POD 1–3. The TD also captures rescue transfusions, which are defined as the administration of uncrossed blood to patients in emergency settings when a valid type and screen (T&S) was not available. Procedures are grouped based on billing codes.

The TD allows data to be aggregated based on year, site, surgical service, clinical grouping (procedure billing codes), and case type (elective vs. urgent/emergent). Procedures with fewer than five cases/year and those performed on the same patient within 48 hours were excluded from the dashboard to preserve anonymity. Patient-specific data and demographics are not available or stored on the TD.

Our study focused on four endourologic procedures TURP, HoLEP, TURBT, and percutaneous nephrolithotomy (PCNL). Only elective procedures were included, excluding all urgent/emergent procedures.

This quality improvement initiative was comprised of two phases: an observational phase conducted from 2016–2019, followed by an implementation phase that began in 2020. During the observational phase, data were gathered on blood transfusion trends. This allowed the development of procedure-specific preoperative T&S recommendations, as well as guidelines for preoperative referral to our institutional blood management program.

During the implementation phase, the recommendations for the endourologic procedures included were disseminated to the surgeons responsible for ordering preoperative T&S. Dissemination of the new ordering guidelines was undertaken by author JDT through two sessions with the urologists at our institution. Infographics were also distributed to the urologists' offices. Additionally, one of our clinical nurses reached out to medical office assistants to provide further assistance as needed.

Between 2020 and 2023, data on preoperative T&S, perioperative, and rescue blood transfusion rates were gathered. A lifecycle assessment was performed for cost and environmental savings. The carbon footprint of T&S was calculated based on consumable production, transport to the site of use, test processing, and waste processing. Analysis included all aspects involved in the testing, from the materials needed for the blood draw

to the carbon emissions associated with the machinery used to process the blood samples.

Statistical analysis

Preoperative T&S rates pre and post implementation of TD recommendations were compared using the Chi-squared test. Overall perioperative blood transfusion rates were also compared using the Chi-squared test. Cost and environmental savings were analyzed through a lifecycle assessment of a single test and subsequently extrapolated to the number of tests saved. Environmental savings were then converted into kilograms of CO_2 equivalents. The cost analysis included the materials and process costs of the test itself. Statistical analysis was performed using SPSS-v.25 (IBM Corp., Armonk, NY, U.S.). A p-value <0.05 was the threshold for statistical significance.

RESULTS

With appropriate institutional internal review board review, the observational phase took place between 2016 and 2019. A total of 4393 pre-initiative patients were included, consisting of 1302 TURPs, 462 HoLEPs, 1409 TURBTs, and 1220 PCNLs. The post-initiative group included 2488 patients: 640 TURPs, 561 HoLEPs, 784 TURBTs, and 503 PCNLs (Table 1).

Based on the data gathered during this phase, preoperative T&S was recommended for TURP and HoLEP if the baseline hemoglobin was <100 g/L or if the prostate size was >80 cm^3. This was found to be consistent with recommendations from other trials published in the literature.[3] T&S was recommended in all patients undergoing PCNL (unchanged from pre-TD) and not recommended for any patients undergoing TURBT.

Referral to our institutions' preoperative blood management program was recommended for patients undergoing a TURP, HoLEP, or PCNL and with a baseline hemoglobin of <115 g/L (recommendations summarized in Table 2). The implementation phase occurred between 2020 and 2023 and included 3206 patients for all four procedures. T&S rates before the implementation of the testing recommendations ranged from 8.6% for TURBT to 95.6% for PCNL (Table 3). During the implementation phase, T&S decreased to 4.1% for TURBT, 83.6% for PCNL, and to 70.2% for HoLEP (p<0.001 for all three procedures) (Table 3). The largest testing rate difference was seen for TURP, with T&S rates of 92.7% pre-TD and 41.5% post-implementation, a 51.2% reduction in T&S (p<0.001) (Table 3).

Table 1. Number of patients included in the study, by procedure and time period

Procedure	Pre-intervention (n)	Post-intervention (n)
TURP	1302	640
HoLEP	462	561
TURBT	1409	784
PCNL	1220	503
Total	4393	2488

HoLEP: holmium e-nucleation of the prostate; PCNL: percutaneous nephrolithotomy; TURBT: transurethral resection of bladder tumor; TURP: transurethral resection of the prostate.

Table 2. Summary of preoperative type and screen-testing recommendations

Procedure groups	Recommended preop T&S	Referral to preoperative blood management program
TURP	If >80 cc or Hgb <100 g/L	Hgb <115 g/L
HoLEP	If >80 cc or Hgb <100 g/L	Hgb <115 g/L
TURBT	No	No
PCNL	Yes	Hgb <115 g/L

Hgb: hemoglobin; HoLEP: holmium e-nucleation of the prostate; PCNL: percutaneous nephrolithotomy; T&S: type and screen testing; TURBT: transurethral resection of bladder tumor; TURP: transurethral resection of the prostate.

Table 3. Pre- and post-transfusion dashboard initiative type and screen-testing rates

Procedure groups (n=6881)	Preop T&S rates (%)			
	Pre	Post	Δ (%)	p
TURP	92.7 (n=1207)	41.5 (n=266)	51.2	<0.001
HoLEP	94.2(n=435)	70.2 (n=394)	24	<0.001
TURBT	8.6 (n=121)	4.1 (n=32)	4.5	<0.001
PCNL	95.6 (n=1166)	83.6 (n=420)	12	<0.001

Hgb: hemoglobin; HoLEP: holmium e-nucleation of the prostate; PCNL: percutaneous nephrolithotomy; T&S: type and screen testing; TURBT: transurethral resection of bladder tumor; TURP: transurethral resection of the prostate.

Figure 1 demonstrates that T&S rates continued to decrease during the implementation period, with the greatest reductions seen in 2023. Table 4 highlights the pre- and post-implementation transfusions rates for TURPs, HoLEPs, TURBTs, and PCNLs intraoperatively,

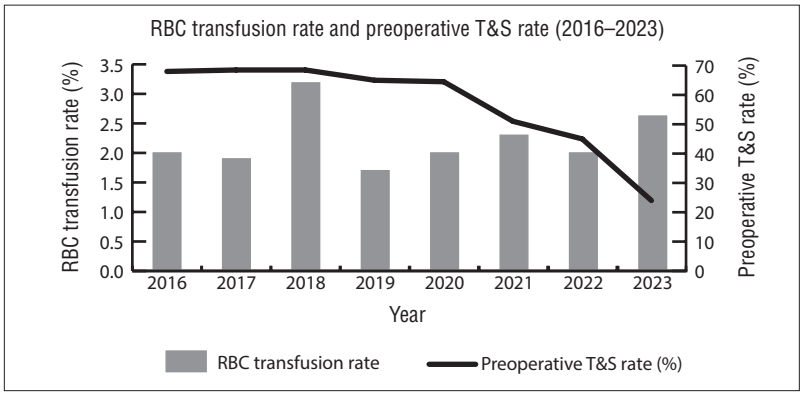

Figure 1. Summary of type and screen testing (T&S) and transfusion rates across all procedures. RBC: red blood cell.

on POD 0, and on POD 1–3. None of the patients included received a rescue transfusion, which refers to uncrossed blood in the absence of valid T&S. No statistically significant differences were found in the overall transfusion rates for any of the four groups pre- and post-intervention.

Cost analysis was performed to determine the monetary savings associated with implementation of T&S recommendations. Between 2020 and 2023, a total of $45 362.81 was saved over a total of 3206 procedures. The largest savings were noted for TURP and TURBT, where $12 905.16 and $24 615.88 was saved, respectively. Environmental savings analysis found an overall reduction of 697 kgCO_2 over the course of three years. The largest savings were seen for TURP and TURBT (Table 5).

DISCUSSION

Although historic blood transfusion rates for transurethral prostate surgery were reported to be as high as 20%, contemporary data report transfusion rates consistently in the range of 2–4% or less.[10,11] This improvement is likely due to advancements in surgical technique and technology; however, many institutions provide preoperative blood testing guidelines based on the 1979 MSBOS, where preoperative T&S testing is recommended for transurethral prostate surgery and over 60 other elective procedures.[11]

While many institutions have adopted the initial MSBOS recommendations across various surgical procedures, most have not adapted their recommendations to the changing landscape of modern surgery.[12] Indeed, minimally invasive and endoscopic surgeries are generally associated with a reduced risk of perioperative blood transfusions, suggesting that preoperative T&S may be unnecessary in select patients and procedures; however, reducing unnecessary testing should not come at the expense of patient safety. In this paper, we provide a roadmap for the safe rollout of a T&S reduction program.

Our quality improvement study highlights that with clear and data-driven T&S recommendations, unnecessary preoperative bloodwork can be eliminated in endourologic surgery. Our results demonstrated that even with significant reductions in testing, for example, as high as 51.2% in the TURP group, no statistically significant increase in overall perioperative transfusion rates was identified, as might be expected, suggesting the preoperative T&S were not necessary. This finding was consistent across all four procedures in our study.

Most importantly, the rate of rescue blood transfusions remained 0% in all cases post-implementation. This signifies that reducing unnecessary testing can be done safely, as even in situations where patients required a transfusion, there was sufficient time to obtain a T&S.

Srivastava et al have previously reported on the safety of preoperative T&S guidelines tailored to patient

Table 4. Pre- and post-transfusion dashboard initiative transfusion rates

Procedure groups	Transfusion rates (%)								
	Pre-TD implementation				Post-TD implementation				
	Intraop (n)	POD 0 (n)	POD 1-3 (n)	Overall (n)	Intraop (n)	POD 0 (n)	POD 1-3 (n)	Overall (n)	p*
TURP (n=1942)	0.18 (n=2)	0.46 (n=6)	0.46 (n=6)	0.92 (n=12)	0.35 (n=2)	0.59 (n=4)	0.35 (n=2)	0.94 (n=6)	0.99
HoLEP (n=1023)	0	0.25 (n=1)	1.52 (n=7)	1.78 (n=8)	0.32 (n=2)	1.11 (n=6)	0.79 (n=4)	1.75 (n=10)	0.99
TURBT (n=2193)	0.26 (n=4)	0.43 (n=6)	0.6 (n=8)	0.86 (n=12)	0.1 (n=1)	0.49 (n=4)	0.88 (n=7)	1.27 (n=10)	0.46
PCNL (n=1723)	1.37 (n=17)	2.55 (n=31)	3.43 (n=41)	5.1 (n=62)	1.85 (n=9)	4.13 (n=21)	3.27 (n=16)	5.69 (n=29)	0.67

*Statistical analysis compares the overall transfusion rates for each procedure group. HoLEP: holmium e-nucleation of the prostate; PCNL: percutaneous nephrolithotomy; POD: postoperative day; TURBT: transurethral resection of bladder tumor; TURP: transurethral resection of the prostate.

Table 5. Cost and environmental savings across endourological procedures since institution of transfusion dashboard initiative (2020–2023 inclusively)

Procedure	Cost saving (SCAD)	Environmental saving ($kgCO_2$)
TURP	$12 905.16	198
HoLEP	$4855.66	75
TURBT	$24 ,615.88	378
PCNL	$2986.10	46
Overall	$45 362.81	697

HoLEP: holmium e-nucleation of the prostate; PCNL: percutaneous nephrolithotomy; POD: postoperative day; TURBT: transurethral resection of bladder tumor; TURP: transurethral resection of the prostate.

factors when undergoing a TURP.[2] Similar to our study, they found that in patients with larger prostates and lower baseline hemoglobin, preoperative T&S is warranted but can be safely omitted in patients with neither of these characteristics. In 2022, Finlay et al published the results of their quality improvement initiative, where they successfully reduced routine T&S in patients undergoing elective anatomic lung resections.[13] Similar to our study, they found no increase in transfusion rates post-intervention, and they reported no differences in postoperative complication rates.

Similar T&S reduction initiatives have also been performed for general surgery. In 2022, Fadel et al published a systematic review of 15 studies that assessed the necessity of preoperative blood typing in patients undergoing cholecystectomy and appendectomy. They found that among the 37.8% of patients who underwent preoperative T&S testing, only 2.1% required a transfusion (range 0–2.1%).[14] In 2022, Booth et al further demonstrated that in patients undergoing elective colectomy with a hematocrit >35%, the same-day transfusion risk was only 0.8%. Their study suggested that selective T&S based on hematocrit levels alone could reduce unnecessary testing in 81% of patients.[15]

During the study period, we noted a statistically significant decrease in preoperative T&S rates for PCNL, despite no changes being made to T&S guidelines prior to this procedure. We believe this is likely the result of a spillover effect from practice pattern changes of urologists ordering less preoperative bloodwork for the three other endourologic procedures. Our results also showed that patients undergoing PCNL did not have an increase in perioperative or rescue transfusions. While this was an unintended effect of the initiative, preoperative T&S rates were also safely decreased for PCNL, suggesting that guidelines to reduce preoperative testing before PCNL could be implemented in the future.

Reducing unnecessary T&S testing over the course of three years resulted in a total cost savings of $45 362.81. Leung et al previously assessed the effect of reducing unnecessary preoperative tests in elective head and neck surgery cases. Similar to our results, their quality improvement initiative found that approximately 69% of preoperative tests were unnecessary, with estimated cost savings of £7823.08/year (approximately $13 718.71).[16]

While our cost savings may be modest, they are the result of reducing rates of only one test across four endourologic procedures at two institutions. These savings could be amplified should this initiative be implemented at a larger scale across multiple sites and surgical services, and for other types of unnecessary preoperative testing. Phoenix et al previously reported that approximately 31.3% of preoperative tests were unnecessary and associated with £11.2 million in healthcare spending across the U.K.[17]

Reducing unnecessary T&S was also associated with environmental savings. Over the course of three years, we estimate to have saved 697 $kgCO_2$ emissions. This is equivalent to CO_2 emissions from 769 pounds of coal burned or the emissions from charging 46 014 smartphones.[18] McAlister et al have previously reported that the carbon footprint of individual blood tests is small. This does not account for additional patient trips, time, or loss of productivity; however, blood tests represent the most commonly processed tests in laboratories and, therefore, reducing unnecessary ordering of these tests should have a significant impact on overall carbon footprint.[19]

A recent publication by Fan et al focusing on hematologic laboratory carbon emissions highlighted that while the carbon footprint for a single test is minimal, that of multiple, repetitive, and unnecessary tests represents a significant proportion of hematologic laboratory waste.[20] Clinicians and administrators must work together to establish sustainable strategies to reduce the already significant carbon footprint caused by our healthcare system. Our study demonstrates that even small, straightforward interventions can impact carbon emissions, without any detrimental effects on patient care or safety.

Limitations

This study is not without limitations.

First, the intervention relied primarily on clinician education, and long-term adherence to the recommen-

dations may vary and has not been formally assessed in this study. While we demonstrate a consistent decrease in T&S rates over the three-year implementation phase, we cannot definitively comment on the sustained adherence of clinicians and trainees beyond this period. Further studies could evaluate the impact of alternative strategies to promote adherence, such as integrating T&S recommendations directly into electronic medical record order sets.

Second, this study was conducted at two high-volume centers within a single health authority system, and the results may not be fully generalizable to other institutions.

Finally, the study period overlapped with the COVID-19 pandemic, which may have influenced hospital resource allocation and patient care pathways, potentially introducing confounding factors.

CONCLUSIONS

The transfusion dashboard quality improvement initiative effectively reduced unnecessary preoperative type and screen testing in endourologic procedures without increasing perioperative or rescue transfusion rates. The significant decrease in testing led to cost savings of over $45 000 and reduced CO^2 emissions by 697 kg over three years. These results demonstrate that targeted testing recommendations can enhance resource stewardship and reduce environmental impact and healthcare costs in our publicly funded system. Care improvements may be amplified safely in larger organizations and across more procedures and services.

COMPETING INTERESTS: Dr. Lee has been a consultant for Boston Scientific, and Richard Wolf Medical Instruments Corporation; and is a member of the Data Monitoring Committee for Butterfly. Dr. Forbes has received research support from Boston Scientific, Karl Storz, and Olympus (unrelated to this paper). The remaining authors have no competing personal or financial interests to disclose.

This paper has been peer-reviewed.

REFERENCES

1. Rassweiler J, Teber D, Kuntz R, et al. Complications of transurethral resection of the prostate (TURP)—incidence, management, and prevention. *Eur Urol* 2006;50:969-79; discussion 980. https://doi.org/10.1016/j.eururo.2005.12.042
2. Srivastava A, Singh B, Elhence P, et al. Is type and crossmatch really necessary for transurethral resection of prostate? A retrospective study from a tertiary care center in northern India. *Global J Transfusion Med* 2022;7:42-6. https://doi.org/10.4103/gjtm.gjtm_91_21
3. Smith H, Falconer R, Szczachor J, et al. Routine preoperative group and save for TURP and TURBT — need and cost effectiveness. *J Clin Urol* 2017;11:33-7. https://doi.org/10.1177/2051415817717908
4. Michel MS, Trojan L, Rassweiler JJ. Complications in percutaneous nephrolithotomy. *Eur Urol* 2007;51:899-906. https://doi.org/10.1016/j.eururo.2006.10.020.
5. Rosette J de la, Assimos D, Desai M, et al. The Clinical Research Office of the Endourological Society Percutaneous Nephrolithotomy Global Study: Indications, complications, and outcomes in 5803 patients. *J Endourol* 2011;25:11-7. https://doi.org/10.1089/end.2010.0424
6. Frank SM, Rothschild JA, Masear CG, et al. Optimizing preoperative blood ordering with AATA acquired from an anesthesia information management system. *Anesthesiology* 2013;118:1286-97. https://doi.org/10.1097/ALN.0b013e3182923da0
7. Woodrum CL, Wisniewski M, Triulzi DJ, et al. The effects of a data-driven maximum surgical blood ordering schedule on preoperative blood ordering practices. *Hematology* 2017;22:571-7. https://doi.org/10.1080/10245332.2017.1318336.
8. Pei Z, Szallasi A. Prevention of surgical delays by pre-admission type and screen in patients with scheduled surgical procedures: improved efficiency. *Blood Transfus* 2015;13:310-2. https://doi.org/10.2450/2014.0172-14
9. Basavarajegowda A, Shastry S. Pretransfusion testing. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing. http://www.ncbi.nlm.nih.gov/books/NBK585033/ (accessed November 10, 2024)
10. Wendt-Nordahl G, Bucher B, Häcker A, et al. Improvement in mortality and morbidity in transurethral resection of the prostate over 17 years in a single center. *J Endourol* 2007;21:1081-7. https://doi.org/10.1089/end.2006.0370
11. Friedman BA. An analysis of surgical blood use in United States hospitals with application to the maximum surgical blood order schedule. *Transfusion* 1979;19:268-78. https://doi.org/10.1046/j.1537-2995.1979.19379204208.x
12. White MJ, Hazard SW, Frank SM, et al. The evolution of perioperative transfusion testing and blood ordering. *Anesthesia & Analgesia* 2015;120:1196-203. https://doi.org/10.1213/ANE.0000000000000619
13. Finley DJ, Fay KA, Porter ED, et al. Reducing unnecessary type and screens prior to thoracic surgery: A quality improvement initiative. *J Surg Res* 2023;283:743-50. https://doi.org/10.1016/j.jss.2022.11.032
14. Fadel MG, Patel I, O'Leary L, et al. Requirement of preoperative blood typing for cholecystectomy and appendectomy: A systematic review. *Langenbecks Arch Surg* 2022;407:2205-16. https://doi.org/10.1007/s00423-022-02600-x
15. Booth AT, Allen S, Simianu VV, et al. Selective type & screen for elective colectomy based on a transfusion risk score may generate substantial cost savings. *Surg Endosc* 2002;36:8817-24. https://doi.org/10.1007/s00464-022-09307-6
16. Leung BC, Nazeer S, Smith M, et al. Reducing unnecessary preoperative testing in elective ENT surgery: clinical and financial implications. *J Perioper Pract* 2015;25:225-9. https://doi.org/10.1177/175045891502501103
17. Phoenix GK, Elliott T, Chan JK, et al. Preoperative blood tests in elective general surgery: Cost and clinical implications. *J Perioper Pract* 2012;22:282-8. https://doi.org/10.1177/175045891202200902
18. United States Environmental Protection Agency. Greenhouse gas equivalencies calculator. Available at: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator (accessed December 8, 2025)
19. McAlister S, Barratt AL, Bell KJ, et al. The carbon footprint of pathology testing. *Med J Aust* 2020;212:377-82. https://doi.org/10.5694/mja2.50583
20. Fan BE, Tan JG, Favaloro EJ. Reducing our carbon footprint in the haematology laboratory: A shared responsibility. *Int J Lab Hematol* 2023;45:778-80. https://doi.org/10.1111/ijlh.14060

CORRESPONDENCE: Dr. Connor M. Forbes, Department of Urologic Sciences, University of British Columbia, Vancouver, BC, Canada; connor.forbes@vch.ca