Transitioning to Office-based Transperineal Prostate Biopsy—A Case Study From a Regional New Zealand Hospital in Economic and Environmental Sustainability

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OBJECTIVE To explore the effects of the transition to office-based transperineal prostate biopsy (TPPB) on the interconnected domains of profit, planet, and people. Sustainability, encompassing environmental, social, and economic dimensions, is increasingly significant in health care. Urology, as a surgical specialty, presents unique opportunities to implement sustainable practices. This article outlines a case study detailing the transition of TPPB from the operating theater to an office-based setting.

METHODS This study utilized a multi-phase approach, integrating retrospective and prospective data analyses. Changes in clinical workflows, financial savings, environmental impacts, and accessibility to care were assessed. Life cycle analysis evaluated carbon emissions associated with TPPB, while clinical outcomes, including infection rates and procedural efficiency, were monitored. Patient satisfaction and equity in health care access were explored through geographic accessibility studies and procedural adaptations.

RESULTS Transitioning TPPB to an office-based setting resulted in:

1. Profit: Annual cost reductions of $302,000 NZD, increased procedural capacity, and elimination of hospital admissions due to transrectal ultrasound-guided-related sepsis.
2. Planet: Reduction in greenhouse gas emissions to 70 kgCO2e per biopsy, with significant contributions from reusable equipment packs and virtual consultations.
3. People: Enhanced patient comfort through fewer biopsy cores, reduced health care worker burden, and improved access for Māori populations via proposed mobile biopsy units.

CONCLUSION This case study underscores the potential for sustainable innovations in urology to achieve cost-effective, environmentally responsible, and socially equitable health care delivery. It serves as a model for integrating sustainability into clinical practice, reinforcing the need for data-driven decision-making and collaborative leadership in the medical field. UROLOGY 203: 53–59, 2025.

Sustainability, a concept long established in the business world, has gained increasing prominence in health care over the past decade. Despite its widespread use, the term often feels nebulous and overused within clinical contexts, leaving many health care practitioners uncertain about its practical applications. Sustainability in business is grounded in 3 primary domains: environmental responsibility, social impact, and economic viability.[1] Environmental responsibility focuses on reducing ecological footprints. Social impact, on the other hand, prioritizes diversity, equity, ethical practices, and community engagement. Economic viability ensures long-term profitability by investing in innovative technologies, managing risks effectively, and aligning financial goals with broader environmental and social objectives.[2] The principles of sustainability, often summarized as the "triple bottom line," underscore the interconnectedness of people, planet, and profits.[3] This

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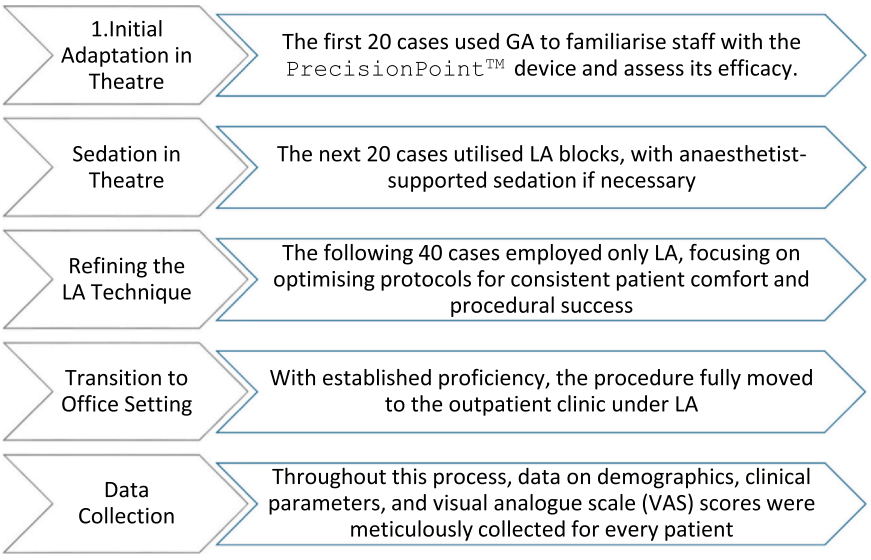

Figure 1. Phased introduction of transperineal prostate biopsy using the PrecisionPoint. GA, general anesthesia; LA, local anesthesia.

holistic approach aligns with the United Nations' definition of sustainable development, which emphasizes meeting the needs of the present without compromising future generations' ability to meet their own needs.

Urologists' contributions to sustainability efforts can be divided into three key actions: utilizing innovation, collecting and analyzing data, and driving change. This article seeks to demonstrate that even simple and cost-effective innovations can initiate meaningful transformation. By systematically gathering data, evaluating outcomes, and presenting evidence to policymakers, we can advocate for improvements that span the critical domains of profit, the planet, and people.

n 2021, we undertook a transformative shift in prostate cancer diagnostics in our unit, transitioning from transrectal ultrasound-guided (TRUS) biopsies in an office-based setting and transperineal prostate biopsies (TPPB) in the operating theater to solely TPPB in an office-based setting. This initiative was driven by a commitment to improving patient outcomes, minimizing infection risks, and aligning with contemporary guidelines advocating TPPB as the preferred method due to its superior safety and diagnostic precision.[4]

Before this transition, our department's workflow regarding prostate cancer screening involved multiparametric magnetic resonance imaging (MRI) of the prostate for all at-risk patients. Those with targetable lesions underwent template and targeted TPPB under general anesthesia in theater using a grid-stepper system, while patients without lesions received TRUS biopsies under local anesthesia (LA) in the clinic. Although functional, this workflow was resource-intensive and posed significant infection risks related to the transrectal approach.[5] The introduction of the PrecisionPoint device with its coaxial needle design replaced the bulky grid-stepper system, thereby reducing the surface area of the perineum requiring anesthesia. A phased approach over 6 months ensured a smooth transition to this new workflow (Fig. 1). Over time, we have refined the outpatient TPPB workflow to its current streamlined steps (Fig. 2), simplifying the procedure and enhancing patient comfort.[6]

Beginning at this transition period, an in-office TPPB database has been maintained containing patient characteristics, disease parameters, histological and radiological results, and patient satisfaction outcomes. This has allowed numerous retrospective studies that explore the intricate intersections of the planet, people, and

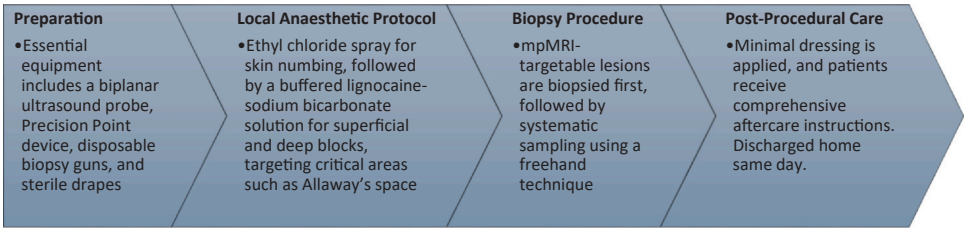

Figure 2. Refined TPPB workflow using the PrecisionPoint system. mpMRI, multiparametric magnetic resonance imaging; TPPB, transperineal prostate biopsy.

profit. We additionally undertook a series of prospective studies leveraging the same dataset. This dynamic repository has allowed us to examine critical issues at various stages in the clinical and operational timeline, offering invaluable insights that aid in optimizing patient outcomes, enhancing resource efficiency, and embracing sustainability in urology. We examine the effects this transition to office-based TPPB has had on the 3 principles of sustainability: profit, planet, and people.

PROFIT

Prostate biopsies are indispensable for diagnosing prostate cancer, yet they carry significant direct and indirect costs. The historical gold standard of TRUS prostate biopsy is associated with substantial costs due to the higher risk of complications resulting from the transrectal route, with the annual cost burden of managing post-biopsy infections in the United States being estimated at $623 million.[7] The costs of treating complications such as urinary retention, rectal bleeding, and persistent hematuria add further to the financial burden. TPPB using LA offers a cost-effective alternative by significantly reducing procedural costs and also the incidence of infections, often removing the need for prophylactic antibiotics.[8] Indirect costs are often underestimated but significantly impact patients and health care systems. For patients, indirect costs include time off work, lost productivity, and transportation expenses for multiple visits. Health care systems also bear indirect costs, including increased antimicrobial resistance stemming from overuse of prophylactic antibiotics in TRUS biopsies.[9]

Case Study A—Transitioning to Outpatient Clinic TPPB: Saving Money, Theater Space, and Lives

The transition from theater-based TPPB to an office-based setting exemplifies the significant benefits of innovation driven by data collection and analysis. This initiative has resulted in substantial cost savings, enhanced resource efficiency, and improved patient outcomes. As Peter Drucker aptly stated, "That which is measured improves,"[10] underscoring the critical role of robust data collection in fostering meaningful health care advancements.

Previously, TPPB were performed exclusively in the operating room under general anesthesia at a cost of $4200 NZD per patient. Typically, 9 TPPB were conducted per theater list, requiring 1 full theater day monthly with the annual expenditure for 108 cases reached $453,000 NZD. By transitioning these procedures to an office-based clinic under LA, the cost per biopsy dropped to $1400 NZD. Maintaining the same case volume in the outpatient clinic reduced annual costs to $151,000 NZD, achieving a realized savings of $302,000 NZD annually. The efficiency gains were evident over a 12-month period (April 2022-2023), during which the number of biopsies performed doubled to 208 cases. Despite this increase, the total expenditure amounted to only $291,000 NZD, reflecting a cost saving of $162,000 NZD compared to the traditional operating rooms (ORs) approach. These results highlight the cost-effectiveness of transitioning TPPB to an office-based setting.

Data from the year preceding the transition (March 2021-2022) revealed 8 hospital admissions for sepsis associated with TRUS biopsies, incurring a total cost of $60,228 NZD, or $7528 NZD per patient. The adoption of TPPB has eliminated these TRUS-related complications, leading to zero post-TPPB sepsis–related admissions and associated costs. This transition not only improved patient safety but also supported antimicrobial stewardship by reducing the need for antibiotics. The shift to office-based TPPBs has freed approximately 12 full-day theater lists annually, equating to a 10% increase in elective theater capacity, further enhancing efficiency and patient care. Moreover, reducing reliance on theater infrastructure for prostate biopsies aligns with value-based care principles, aiming to achieve the best outcomes at the lowest cost.[7]

PLANET

Environmental sustainability data play an increasingly pivotal role in decision-making across modern industries, with the discourse surrounding sustainable health care growing and emphasizing the need for efficient, long-lasting, and productive systems.[11,12] However, sustainable practices within the health care sector remain underdeveloped compared to other sectors.[13] Over the past decade, the health care sector is responsible for approximately 4.4% of global greenhouse gas (GHG) emissions, with even higher contributions observed in developed nations. Moreover, health care emissions in the United States increased by 6% between 2010 and 2018, reflecting an alarming upward trend.[14-16] ORs, often referred to as the "engine rooms" of hospitals, are notable contributors to GHG emissions. They disproportionately contribute to this footprint due to energy-intensive activities, such as heating, cooling, sterilization, reliance on single-use items, and the use of advanced technologies.[17] Research indicates that ORs require 3-6 times the resources of other hospital areas, with the energy consumption of a single theater suite in the UK equivalent to that of 2000 average households.[15] These findings underscore the urgency for a paradigm shift toward more sustainable and resource-efficient surgical practices as the global burden of surgical disease is expected to increase significantly, with an estimated 143 million additional surgical procedures needed annually by 2030 to address critical health needs.[18]

Case Study B—Carbon Footprint of Transperineal Prostate Biopsy in an Office Setting

We looked again at office-based TPPB to perform a prospective study with a focus on helping the planet, to evaluate

the environmental impact of TPPB procedures performed. Recognizing the urgency of mitigating climate change, we applied life cycle analysis methods to assess emissions associated with 38 consecutive TPPBs. The analysis examined emissions from electricity consumption, procurement of equipment and supplies, travel by staff and patients, waste disposal, and sterilization of linen. The results were compelling: a single TPPB generates 70 kgCO2e, comparable to driving 280 km or taking a 70-minute flight in economy class.[19] Procurement, particularly of disposable equipment, was the largest contributor (76%), followed by travel-related emissions (23%). Electricity use, waste disposal, and linen sterilization cumulatively contributed less than 1.5% of the emissions footprint.

The insights derived from our robust database allowed us to identify clear targets for intervention. For instance, transitioning to reusable alternatives in equipment packs could substantially reduce procurement emissions. As procurement accounts for the majority of emissions, even small changes in pack design could yield significant reductions. Similarly, the establishment of outreach biopsy clinics would address the emissions associated with patient travel. Our data showed that 20% of patients traveled over 200 km for a biopsy, highlighting the environmental and logistical burden of centralized care. Modeling indicates that redirecting patients to their nearest hospital could reduce travel emissions by up to 16% per case. Furthermore, virtual consultations for pre- and post-biopsy care, where feasible, could decrease travel-related emissions and improve patient convenience.[20,21]

The study also highlighted the environmental benefits of adopting evidence-based practices to reduce unnecessary biopsies. European Association of Urology guidelines recommend using multiparametric MRI to guide prostate biopsies, thereby avoiding low-value interventions and minimizing emissions from overdiagnosis and overtreatment.[22] By integrating these recommendations into routine care, emissions can be further reduced while maintaining high standards of patient care.

Case Study C—Assessing the Clinical Utility of Routine Pre-biopsy Urine Cultures in Transperineal Prostate Biopsy Patients to Reduce Resources Utilized

Routine pre-biopsy urine cultures have traditionally been performed to identify asymptomatic bacteriuria in patients undergoing TPPB, with an aim to pre-emptively treat potential infections and minimize the risk of post-biopsy complications. However, the necessity and cost-effectiveness of this approach have increasingly come under scrutiny. We conducted a retrospective study evaluating 411 patients undergoing TPPB from January 2022-January 2024. The study found that routine pre-biopsy urine cultures did not significantly affect post-biopsy infection outcomes in asymptomatic patients. Of the 411 patients, the incidence of clinical urinary tract infections (UTIs) was low at 3.4%, and urosepsis was exceedingly rare, occurring in just 0.2% of cases. Conversely, patients with abnormal pre-biopsy urine cultures demonstrated a significantly higher rate of clinical UTIs at 23.1%, underscoring that targeted intervention for this subgroup could be beneficial. These findings align with existing literature suggesting that routine pre-biopsy urine cultures may not be universally necessary for all patients, especially those without symptoms or other significant risk factors.[7,23]

Reducing unnecessary testing helps to improve resource utilization while also allowing redirection of resources, money, and workload to more important domains. In our unit, the current process involves sending a lab form to patients, often requiring them to drive significant distances to a lab. The results must then be followed up by our administrative personnel, who contact the patient, a task that may seem minor but, when multiplied across the 300 TPPBs performed in 2024, adds up significantly consuming precious minutes of our nurses' workdays. From a financial perspective, routine urine cultures represent a considerable cumulative cost. In New Zealand, the cost of a single urine culture is approximately $45. With 250 TPPBs performed annually at our hospital, omitting routine urine cultures in asymptomatic patients could save $11,250 per year. Additionally, eliminating unnecessary urine cultures could significantly reduce administrative workload, freeing up staff time currently dedicated to processing lab forms, coordinating test results, and arranging antibiotic prescriptions.[24]

These findings advocate for a more selective approach to pre-biopsy urine screening. Routine cultures could be reserved for patients presenting with symptoms of UTI, those with an indwelling urinary catheter, or other high-risk factors such as diabetes or immunosuppression. This targeted strategy would optimize resource allocation, reduce health care expenditures, and avoid unnecessary antibiotic use, which is crucial in an era of rising antibiotic resistance.[25]

PEOPLE

Sustainability efforts in health care extend beyond environmental and financial considerations, encompassing the critical pillar of social equity, often summarized as the "people" component in the sustainability framework. By addressing disparities in access to essential services such as TPPB, health care systems can improve outcomes for marginalized populations while advancing broader social goals. The "People" component also includes patient satisfaction with procedures without compromising clinical outcomes or patient safety, further increasing the sustainability of a procedure.

Case Study D—Geographic Accessibility to Prostate Biopsy

Our findings underscore significant inequities in geographic accessibility in regional New Zealand, particularly for indigenous Māori communities who face

disproportionately greater travel burdens. On analysis of data from the TPPB database, the mean travel distance for Māori patients traveling for TPPB is 58.1 km farther than their non-Māori counterparts ($P = .0001$). Reducing travel requirements would minimize the financial and logistical strain on patients and their families, many of whom may already experience socioeconomic disadvantages.[26] Our findings provide an evidence-based rationale to justify potential investment in a mobile biopsy service as a socially responsible and economically viable initiative.

To realize this vision, we propose leveraging our data to advocate for collaboration among key stakeholders, including Te Whatu Ora, non-governmental organizations, and private-sector businesses for a mobile biopsy unit. The utilization of a mobile unit could reduce the overall waiting time for biopsies, especially for patients in remote areas, thus improving the timeliness of cancer diagnosis and treatment. Studies have shown that timely intervention significantly enhances patient outcomes, particularly for conditions as time-sensitive as cancer.[27] For Te Whatu Ora, this model aligns with their mandate to deliver equitable health care services, addressing the needs of indigenous and rural populations. The mobile biopsy unit also aligns with broader sustainability objectives to lower the overall carbon footprint associated with prostate cancer diagnostics by reducing patient travel.[28]

Case Study E—Comparative Analysis of Targeted vs Systematic and Targeted Prostate Biopsy During Re-biopsy in Active Surveillance Patients

We also explored whether the biopsy process could be made shorter and less uncomfortable for our active surveillance patients by reducing the number of cores taken during a biopsy. Naturally, this also benefits the doctor and the health care system, enabling more biopsies to be performed if the procedure is quicker and more efficient. In a retrospective study, we compared the effectiveness of targeted biopsy (TB) vs a combination of systematic and targeted biopsy (STB) in detecting prostate cancer progression during re-biopsies for patients on active surveillance for low-risk prostate cancer. Using data from 47 active surveillance patients between January 2022 and December 2023, the study assessed the diagnostic yield of TB guided by multiparametric MRI against that of STB.

The results demonstrated that TB identified prostate cancer in 91.4% of cases compared to 48.9% for systematic biopsies. When focusing on clinically significant prostate cancer (csPCa), TB showed a detection rate of 46.8%, while STB yielded 19.1%. The study found that cancer reclassification, leading to curative treatment, occurred in 51% of patients post-biopsy. However, systematic biopsies revealed higher International Society of Urological Pathology (ISUP) grades than TB in only 8.5% of cases, with 4.2% of cancers missed by TB but detected by STB. Importantly, in just 1 patient (2.1%), management would have differed had systematic biopsy results been excluded. These findings suggest that TB alone may suffice in re-biopsy protocols for active surveillance (AS) patients, potentially reducing the number of biopsy cores, procedure time, patient discomfort, and risk of complications. These outcomes challenge the current standard of systematic biopsies in re-biopsy protocols, highlighting the need for larger, multicenter studies to validate these results and inform global guidelines.

Case Study F—Advancing Prostate Cancer Screening With Machine Learning

Our TPPB database now encompasses over 700 patients and continues to expand by approximately 300 cases annually. With this growing repository, we are committed to continuous analysis and reanalysis, pooling data with other global centers to drive innovation in prostate cancer screening. Harnessing advanced technologies such as machine learning and artificial intelligence, we aim to create models that enhance diagnostic precision, improve patient outcomes, and ultimately make prostate cancer screening more accessible and effective for people.

In a collaborative effort spanning New Zealand, Australia, and Switzerland, researchers developed a machine-learning–based predictive model to detect csPCa. The study included 1272 patients who underwent prostate biopsy, incorporating clinical parameters such as age, body mass index, prostate-specific antigen (PSA) levels, prostate volume, PSA density, and Prostate Imaging - Reporting and Data System (PI-RADS) scores. Among the models tested, the LightGBM model outperformed the others with a receiver operating characteristic area under the curve of 0.851 in the test set and 0.818 in external validation.[29] The most critical predictors were PI-RADS, PSA density, previous biopsy history, age, and body mass index. This model demonstrated superior calibration and clinical utility compared to individual predictors, suggesting its potential to streamline biopsy decision-making. Notably, an online risk calculator, developed alongside the predictive model, offers clinicians a practical tool to improve patient stratification and reduce unnecessary biopsies.

Conclusion

Throughout this case study, we have demonstrated how a seemingly small adjustment—transitioning prostate biopsies to an office-based setting—can ripple outward, driving meaningful enhancements in the interconnected domains of people, planet, and profit. When coupled with diligent data management, these changes yield not only immediate benefits but also a treasure trove of insights for ongoing improvement in sustainability. The shift to office-based TPPB has led to reduced expenditure, reduced GHG, improved AS patient satisfaction, and increased sustainability in prostate cancer diagnosis. This transition and subsequent

analysis of the data have also led to avenues for future improvements in delivering care, reducing inequity, and improving patient stratification and selection.

In medicine, institutions are often steeped in tradition, which makes them notoriously resistant to change. This inertia stems from factors such as hierarchical structures, the prioritization of immediate clinical demands over long-term innovation, and a culture that often emphasizes caution. Breaking through this resistance requires individuals who are willing to lead change from within.[30] For health care to advance, clinicians must adopt a dual mindset, blending the meticulous care of medical practice with the strategic foresight of business leaders. Doctors, once seen primarily as guardians of health, must now also become architects of systems that prioritize efficiency, equity, and sustainability. This shift necessitates not only embracing change but mastering the tools that drive it: data collection, analysis, and application.

Ethical Declaration

Not required.

Disclosures

The authors declare that they have no relevant financial interests.

CRediT Authorship Contribution Statement

Keu Maoate: Data curation, Investigation, Validation, Writing – review & editing. **Flavio Vasconcelos Ordones:** Data curation, Investigation, Methodology, Project administration, Resources, Supervision. **Lodewikus Petrus Vermeulen:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft. **Charlton Martin:** Project administration, Validation, Writing – original draft, Writing – review & editing. **Ali Hooshyari:** Data curation, Formal analysis, Investigation, Methodology, Resources, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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