UniWee

Evaluation report

Mylon, I., Maddock, F., Mairead M., Garner, J., Thomas, S.

Contents

1. Acknowledgements

The authors would like to thank all individuals and organisations who contributed to the development of the current report and interactive tool:

- Edel Fritchley; Gloucestershire Hospitals NHS Foundation Trust
- Savneet Lochab; Great Western Hospitals NHS Foundation Trust
- Paula Emmerson; South Western Ambulance Service NHS Foundation Trust
- Christopher Lund; Great Western Hospitals NHS Foundation Trust

2. Introduction

2.1. Context

Bedpans are the accepted device to support females who need to void their bladder in hospital environments (Rodriguez, 2016). Being manoeuvred onto a bedpan can be painful if the patient is injured, for example due to a hip fracture, and requires several staff to help move the patient (Gattinger et al., 2013). Beyond the physical discomfort, the dependence on staff and the exposure involved in using a bedpan can compromise a patient's sense of dignity. Reluctance to use bedpans due to discomfort and dependency on staff to support bladder voiding can lead to patients avoiding fluid intake to prevent their bladder from filling, resulting in dehydration and risk of kidney infections (Ellis et al., 2018; Gattinger et al., 2013).

Some patients with female genitalia will be catheterised to reduce the need to move the patient and reduce pain to the patient. Catheterisation can lead to urinary tract infections (UTIs) and incontinence (Farrington et al., 2016; Thomas et al., 2021), which can increase the length of a hospital stay (Mitchell et al., 2016). Further, 38% of patients with catheter-associated UTIs (CAUTIs) have sepsis, highlighting the severity of such infections (Barchitta et al., 2021). Incontinence pads can also be used, which can cause dermatitis and UTIs (Payne, 2015).

Men can usually void their bladder into a pulp urinal bottle without movement or staff assistance, in contrast to women, who often experience greater discomfort and loss of dignity due to the lack of equivalent provisions. Finding ways to allow women to comfortably void their bladder without pain and to minimise dependency on staff assistance is essential. An appropriate device should seek to reduce pain and improve privacy and dignity for these patients and may decrease hospital stay length.

2.2. UniWee

UniWee is a urine-collecting bottle made from disposable pulp designed for patients without male genitalia. This device allows these patients to void their bladder directly into a UniWee when lying or sitting in bed by themselves or with help. The UniWee can be disposed of by maceration (which involves breaking down the material into a watery slurry that can be discharged into the sewer system) or by composting. Booth et al. (2025) concluded that the UniWee provides patients with female anatomy with the same advantage as the male urinal bottle as this allows the patient to void their bladder without repositioning. Further, the UniWee was concluded to be acceptable to patients and staff and would have value in most clinical settings.

2.3. Purpose of the report

The current evaluation was funded by Health Innovation West of England as part of the Office of Life Sciences commission to provide real-world validation of health and care innovations. The current report provides the findings and key recommendations from the evaluation conducted by Unity Insights into the financial and environmental impact of the UniWee on the NHS using the neck of femur fracture pathway as an example of potential use at an average NHS hospital in England. The patient journey considered in the current report was from patient home to surgery; post surgery management was not included following findings from the pathway mapping exercise conducted.

3. Methodology

3.1. Evaluation approach

The purpose of this evaluation was to assess the value and carbon footprint of the UniWee through a cost-benefit analysis and high-level carbon impact analysis. To facilitate this, desktop research (Appendix A: Desktop research methodology) and a pathway mapping exercise (Appendix B: Pathway mapping findings) was also completed to identify how bladder voiding in female patients is supported through their journey in the neck of femur fracture pathway from home to surgery.

Evaluation questions

The evaluation questions were as follows:

1. What is the economic value of the UniWee?

2. Does the UniWee lead to a reduction in $kgCO_2e$ emissions in the neck of femur fracture pathway?

3.2. Cost-benefit analysis

General approach

The evaluation produced an ex-ante (forecasted) appraisal of the prospective impact of the UniWee, which was estimated using the best available evidence. The appraisal was assessed in line with *The Green Book* (HM Treasury, 2022a) methodology. The HM Treasury guidance is applied throughout the public sector to ensure consistent estimation of costs and benefits in cost-benefit appraisals. In recent years, the framework has been supplemented by several departmental or sectorial '*external supplementary guidance*' documents (HM Treasury, 2022a). The modelling presented within this document estimates one-year outcomes of the deployment of the UniWee within the NHS.

Scenario

There are 65,152 neck of femur patients across all 113 hospitals in England in 2025/26; of which an estimated 75% were female. The cost-benefit analysis examined one scenario: the impact of the UniWee in an average NHS hospital in England within the neck of femur pathway in 2025/26. An average hospital has 426 neck of femur patients (65,152 / 113 = 426), of which 320 (75%) are female.

Benefit and cost streams

To realise economic outcomes, benefit and cost streams must be monetised. Outcomes can be categorised as either direct (NHS-related outcomes), indirect (to other public sector organisations), or social outcomes (wider UK society). There may be additional benefits and costs that were not explored as part of the current evaluation (for example, a reduction in costs related to the treatment of pressure ulcer from delayed bladder voiding), nevertheless, these unmodelled components are unlikely to impact the overall result of the model. 'Appendix C: Health economic modelling methodology continued' provides more detailed calculations and source references according to each benefit and cost stream.

Benefit streams

The benefit streams were as follows:

- **Benefit stream 1:** A reduction in staff time in the neck of femur fracture pathway from paramedics arriving at the patient's home to the patient going in for surgery due to using the UniWee
  - This is a non-cash-releasing benefit.
  - For ease of calculation, this benefit stream was divided into three sub-streams:

        - **Benefit stream 1a:** A reduction in staff time at the patient's home due to using the UniWee
        - **Benefit stream 1b:** A reduction in staff time when waiting to enter hospital in the ambulance due to using the UniWee
        - **Benefit stream 1c:** A reduction in staff time due to using the UniWee in hospital before surgery
- **Benefit stream 2:** A reduction in the costs related to catheters due to use of the UniWee.
    - This is a cash-releasing benefit.
- **Benefit stream 3:** A reduction in the costs related to incontinence pads due to use of the UniWee.
    - This is a cash-releasing benefit.
- **Benefit stream 4:** A reduction in the costs related to bedpans due to use of the UniWee.
    - This is a cash-releasing benefit.
- **Benefit stream 5:** A reduction in the costs related to UTI treatments due to fewer catheterisations.
    - This is a cash-releasing benefit.
- **Benefit stream 6:** A reduction in the costs related to treatment of an acute kidney injury (AKI) from delayed toileting when sitting in an ambulance.
    - This is a cash-releasing benefit.

Cost streams

The cost streams were as follows:

- **Cost stream 1:** UniWee device cost and disposal.
    - This cost stream includes the cost of purchasing the device, alongside the cost required to dispose of the device via maceration.
- **Cost stream 2:** Implementation costs.
    - This cost stream includes staff training costs and information leaflet costs. The interactive tool created alongside the current document also considered storage and maceration facility installation costs.

Modelling assumptions

The following assumptions were made within the cost-benefit analysis:

- Figures identified in the pathway mapping exercise, estimations, and literature correctly represented an average NHS hospital in England.

- The hospital only used the following methods when a female patient needed to void their bladder in the neck of femur fracture pathway: catheter, disposable bedpan, incontinence pad, and a UniWee.
- No patients who used a UniWee developed an AKI.
- The unit cost of the UniWee device remained constant for 2025/26.
- The hospital had a maceration facility.
- The hospital had appropriate storage to store UniWee items.

Limitations

- The analysis relies on expert anecdotal evidence, estimations, and available literature so may not be accurate. An appropriate optimism bias correction has been applied accordingly to mitigate this and ensure prudency.
- The risk of developing an AKI is assumed to be the midpoint of 2% to 5% in hospitalised patients and therefore does not specifically relate to delayed toileting.
- It is assumed that UniWee will contribute to the reduction in incidence of UTIs, however this is based on expert judgement.
- Use of other health and social care system services was not included in the modelling.
- Outputs are based on figures in financial year 2025/26, and so future years will need to be re-modelled.
- The cost-benefit analysis tool provides a single answer based on the input information, which may mask uncertainty and level of precision.

3.3. High-level carbon impact analysis

A carbon impact analysis estimates how much greenhouse gas emissions are associated with a product, service, or change (in this case, UniWee within a single NHS hospital in England). The goal for the current analysis was to understand whether UniWee increases or decreases emissions overall.

Understanding where emissions arise is split into three scopes:

- **Scope 1:** Direct CO_2 emissions (for example, building, transport, and production-related activities).
- **Scope 2:** Indirect CO_2 emissions from generation of heat or electricity.
- **Scope 3:** Indirect CO_2 emissions caused by business activities of another organisation (for example, the emissions caused by the production or extraction of purchased raw materials).

Organisations are directly responsible for emissions in scope 1 and 2. Scope 3 involves shared responsibility across the value chain. The current analysis explores emissions related to scopes 1 and 2.

Approach

The analysis utilised literature sources, estimations gained from the pathway mapping exercise, and assumptions to suggest the potential carbon impact of the UniWee. All emissions are expressed in $kgCO_2e$ (kilograms of carbon dioxide equivalent) and were calculated as follows (Equation 1):

$$Emissions\ (kgCO_2e) = Activity\ data\ \times Emission\ factor$$

Equation 1: The equation of emissions ($kgCo_2e$).

Streams

The high-level carbon impact analysis examines the carbon impact in four streams:

- **Stream 1:** A reduction in the number of catheters used by females in the neck of femur fracture pathway due to the use of the UniWee, leading to a reduction in $kgCO_2e$.
- **Stream 2:** A reduction in the number of bedpans used by females in the neck of femur fracture pathway due to use of the UniWee, leading to a reduction in $kgCO_2e$.
- **Stream 3:** A reduction in the number of incontinence pads used by females in the neck of femur fracture pathway due to use of the UniWee, leading to a reduction in $kgCO_2e$.
- **Stream 4:** Usage of the UniWee ($kgCO_2e$ associated with the use of UniWee products).

Modelling assumptions

The following assumptions were made within the high-level carbon impact analysis:

- Figures identified in the pathway mapping exercise, estimations, and literature correctly represented the average NHS hospital in England.
- The hospital only used the following methods when a female patient needed to void their bladder in the neck of femur fracture pathway: catheter, disposable bedpan, incontinence pad, and a UniWee.
- The hospital had a maceration facility.

Limitations

- The analysis relied on anecdotal evidence and literature so may not be accurate. An appropriate optimism bias correction has been applied accordingly to mitigate this and ensure prudency.

- Only scopes 1 and 2 were examined in the current evaluation. This means that indirect CO_2 emissions caused by business activities of another organisation was not examined, hence findings may not be an accurate representation of the entire carbon impact of the UniWee.

3.4. Authors

Contributions:

- Fay Maddock led on the project, designed and developed the model and wrote the report
- Ian Mylon quality assured the model and provided guidance on use of the green book
- Sian Thomas initiated the project, provided clinical leadership, convened the expert contributors, and signed off the expert assumptions
- Jennifer Garner provided project manager support
- Mairead Murphy commissioned the evaluation on behalf of HIWE

All authors provided input into and reviewed the final versions of the model and the report.

4. Results

4.1. What is the economic value of the UniWee?

The modelled benefits, costs, net benefit, and benefit-cost ratio (BCR) of the cost-benefit analysis were estimated over one year and presented in Table 1. There was a net benefit of £26,167 and a BCR of 19.4. This suggests that for every £1 invested, £19.40 of value was returned. These findings demonstrate substantial cost savings and efficiency improvements, highlighting the importance of optimising staff time through efficient methods to help a patient void their bladder.

The high BCR of 19.4 is strongly driven by the relatively low implementation costs of £1,350 in comparison to the relatively high non-cash releasing benefits. In particular there is a £21,502 reduction in staff time due to using the UniWee in hospital due to surgery. This is attributable to halving the number of staff needed to void a patient's bladder prior to surgery when using the UniWee compared to rolling the patient onto a bedpan. The figures contributing towards these costs and benefits in the model were based on assumptions, expert judgement, and literature sources, meaning that the exact BCR may differ. Nonetheless, assumptions were derived through a clear and auditable process, agreed them with clinicians with relevant experience, and built in an optimism bias factor. It is suggested that use of the UniWee is capable of delivering a relatively high BCR, although each hospital should consider whether these benefits will be realised in each setting before implementing the UniWee. This is discussed further in Section 5.

Table 1: Monetised benefits from health economic modelling.

Benefit and cost stream	Value (2025/26)
Benefits in an 'average' hospital with 426 neck of femur patients per year	
Benefit stream 1a: A reduction in staff time at the patient's home due to using the UniWee	£167
Benefit stream 1b: A reduction in staff time when waiting to enter hospital in the ambulance due to using the UniWee	£50
Benefit stream 1c: A reduction in staff time due to using the UniWee in hospital before surgery	£21,502
Benefit stream 2: A reduction in the costs related to catheters due to using the UniWee	£21
Benefit stream 3: A reduction in the costs related to incontinence pads due to using the UniWee	£431
Benefit stream 4: A reduction in the costs related to bedpans due to using the UniWee	£257
Benefit stream 5: A reduction in the costs related to UTI treatments due to fewer catheterisations	£2,942
Benefit stream 6: A reduction in the costs related to treatment of acute kidney injury from delayed toileting when sitting in an ambulance	£795
Total benefits	**£26,167**
Costs	
Cost stream 1: UniWee device cost and disposal	£1,141
Cost stream 2: Implementation costs	£209
Total costs	**£1,350**

Benefit and cost stream	Value (2025/26)
Results	
Net benefit	**£24,817**
Benefit-cost ratio	**19.4**
Average saving per patient	**£82**

**The figures above have been rounded to the nearest pound for ease of reading and as such, totals may not sum.*

Among the various benefit streams examined, benefit stream 1c (a reduction in staff time due to using the UniWee in hospital before surgery) yielded the greatest benefit out of all benefit streams (£21,502). This was attributed to the longer patient stays in this phase of care, resulting in a greater quantity of bladder voiding episodes. Moreover, hospital bladder voiding episodes required more staff and greater staff time to assist patients with bedpans or incontinence pads, amplifying the benefit observed with the adoption of the UniWee, which streamlined the process and reduced staff time burden.

In comparison, benefit stream 2 (a reduction in the costs related to catheters due to using the UniWee) generated the smallest benefit (£21). This outcome was expected, given the low proportion of patients who will have a catheter inserted.

Future models should account for the potential costs of installing storage and maceration facilities within hospitals. While these additional expenses would likely lower the BCR, the extent of the reduction will depend on existing infrastructure. In some hospitals, adequate storage and maceration capacity may already be in place, meaning the UniWee could be implemented with little or no additional facility cost.

4.2. Does the UniWee lead to a reduction in kgCO_2e in the neck of femur fracture pathway?

The carbon saving from the high-level carbon impact analysis was estimated over one year and presented in Table 2. Over one year (2025/26), the high-level carbon impact analysis estimated a total carbon saving of 473.37kgCO_2e, equivalent to the annual carbon absorption of approximately 18 trees. Most of this reduction was attributed to stream 3 (a reduction in the number of incontinence pads due to UniWee), which resulted in a saving of 518.40kgCO_2e. It should be noted that the figures contributing towards the model were heavily based on assumptions, expert judgement, and literature sources, meaning that the exact carbon saving may differ.

Table 2: Carbon saving ($kgCO_2e$) identified from high-level carbon impact analysis.

Stream	Value (2025/26)
Stream 1: A reduction in the number of catheters used by females in the neck of femur fracture pathway due to the use of the UniWee, leading to a reduction in $kgCO_2e$ emissions	14.44$kgCO_2e$
Stream 2: A reduction in the number of bedpans used by females in the neck of femur fracture pathway due to use of the UniWee, leading to a reduction in $kgCO_2e$ emissions	262.87$kgCO_2e$
Stream 3: A reduction in the number of incontinence pads used by females in the neck of femur fracture pathway due to use of the UniWee, leading to a reduction in $kgCO_2e$ emissions	518.40$kgCO_2e$
Stream 4: Usage of the UniWee ($kgCO_2e$ associated with the use of UniWee products)	322.34$kgCO_2e$
Results	
Total carbon saving	473.37$kgCO_2e$
Reduction in trees required to absorb $kgCO_2e$	18 trees

**The figures above have been rounded to the nearest decimal place for ease of reading and as such, totals may not sum.*

These findings demonstrate that implementation of the UniWee within the neck of femur fracture pathway delivers notable reductions in carbon emissions, evidenced by a notable total carbon saving of 473.37$kgCO_2e$ and a decreased requirement for the equivalent of 18 trees to offset these emissions. Findings reflect the likelihood of more sustainable practice in the neck of femur fracture pathway through use of the UniWee, compared to equipment that must be disposed of via yellow bags such as incontinence pads and catheters. The substantial decrease in the use of incontinence pads in particular yields environmental benefits, suggesting that usage of the UniWee can indeed result in ecological improvements. While these results are promising, they are fundamentally underpinned by estimates rather than direct measurement; increasing the accuracy of figures would yield a model with greater accuracy of outputs.

5. Recommendations

5.1. Collect real-world data on the UniWee, including the impact on patients

The cost-benefit analysis and high-level carbon impact analysis used figures primarily from pathway mapping exercises and estimations. Obtaining real-world figures would increase the accuracy of the model. For example, a time-and-motion study could be completed to identify the time taken for staff to assist patients with different method of bladder voiding (catheter, incontinence pad, bedpan, and the UniWee). Updating estimations with sources from literature, should they become available, could increase the accuracy of the model (through greater figure accuracy and a lower optimism bias) if real-world data is unable to be collected.

5.2. Identify costs related to storage and maceration facilities

The current model assumed that hospitals have adequate storage space and maceration facilities as most hospitals use disposable male urinal bottles. If the UniWee requires new or specialised storage equipment or dedicated maceration capabilities, these infrastructure needs must be incorporated into the cost-benefit analysis to provide an accurate estimate of implementation costs.

To minimise upfront expenses, initial trials of the UniWee should be conducted in hospitals that already possess suitable storage and maceration facilities. This approach allows for a more cost-effective rollout by avoiding additional capital investments during early adoption phases. Any plans for broader deployment should carefully assess and budget for potential infrastructure upgrades as needed.

5.3. Explore other benefits of the UniWee

While the current health economic model and high-level carbon impact analysis highlight the primary benefits of the UniWee, further value may be uncovered through additional analysis. For example, although treatment costs related to CAUTIs are already included in the model, it is recommended to account for downstream complications such as sepsis, which carries significant clinical and financial burden. Exploring the use of the UniWee in other clinical areas and environments may also reveal further benefits, which could strengthen the overall economic case further.

5.4. Compare the UniWee to similar devices

The UniWee could be compared to similar devices through:

- Collecting data to support a comparative cost-benefit analysis, to understand staff time savings and treatment cost savings due to both methods
- Conducting a time-and-motion study to quantify staff time savings required for both the UniWee and similar devices. This would inform assumptions within the cost-benefit analysis. If this is not feasible, distribute surveys to clinical staff to estimate the time savings yielded. Staff surveys could also be utilised to estimate the proportion of current product use, UniWee use, and similar devices use to identify the proportion of methods replaced by the UniWee and similar devices. This would factor into the cost-benefit analysis and carbon impact analysis.
- Gathering carbon impact data for current bladder voiding methods, UniWee, and similar devices to allow comparison.

This would allow decision-makers to assess the relative advantages of the UniWee and make evidence-based decisions regarding broader implementation. Any further analysis should be proportionate to the overall cost of the UniWee. The net costs of using a UniWee for all eligible female patients in the neck of femur fracture pathway in an average-sized hospital are just over £1,000 per year. Therefore, if a more accurate time-and-motion study showed a lower BCR, this would be a small amount to pay for improved equity, patient choice, and dignity.

6. Conclusion

This desktop exercise has shown that the UniWee indicates meaningful potential to improve operational efficiencies, reduce costs, and improve environmental sustainability within the average NHS hospital neck of femur fracture pathway for patients with female genitalia. It may also improve patient outcomes and experience and reduce health inequalities. By undertaking comparative analyses with similar devices and integrating broader clinical, economic, and carbon impact data, decision-makers will be equipped to make informed, evidence-driven choices regarding adoption. Furthermore, incorporating the perspectives of staff and patients is essential for ensuring successful implementation and ongoing optimisation. Collectively, these efforts will not only strengthen the economic case for the UniWee but facilitate its effective integration within diverse clinical environments, supporting enhanced patient care and responsible resource use.

7. References

Barchitta, M., Maugeri, A., Favara, G., Riela, P. M., La Mastra, C., La Rosa, M. C., San Lio, R. M., Gallo, G., Mura, I., Agodi, A., Brusaferro, M., Fenaroli, S., Sicoli, E., Montagna, M. T., Squeri, R., Di Bartolo, R. M., Tribastoni, S., Mattaliano, A. R., Bellocchi, P., … Farruggia, P. (2021). Cluster analysis identifies patients at risk of catheter-associated urinary tract infections in intensive care units: Findings from the SPIN-UTI Network. *Journal of Hospital Infection*, *107*, 57–63. https://doi.org/10.1016/j.jhin.2020.09.030

Booth, S., Ellis, P., Lyttle, M. D., Lochab, S., Pegrum, J., & Thomas, S. (2025). Disposable female urinal bottle (the UniWee) improves patient experience for immobile women with lower limb fractures. *Emergency Medicine Journal*. https://doi.org/10.1136/emermed-2024-214181

Centre for Sustainable Healthcare & South Warwickshire University NHS Foundation Trust. (2023). *2023 Impact Report South Warwickshire University NHS Foundation Trust*. https://blmkhealthandcarepartnership.org/publications/sustainability/sustainable-health-care-system/case-studies/national/physio-referrals-from-care-homes-south-warwickshire-impact-report-1/?layout=file

Chenitz, K. B., & Lane-Fall, M. B. (2012). Decreased Urine Output and Acute Kidney Injury in the Postanesthesia Care Unit. *Anesthesiology Clinics*, *30*(3), 513–526. https://doi.org/10.1016/j.anclin.2012.07.004

Ellis, R., Del Vecchio, S., Kalma, B., Ng, K., Morais, C., Francis, R., Gobe, G., Ferris, R., & Wood, S. (2018). *Association between preoperative hydration status and acute kidney injury in patients managed surgically for kidney tumours*. https://link.springer.com/article/10.1007/s11255-018-1901-2

Farrington, N., Hill, T., Fader, M., & Richardson, A. (2016). *Supporting women with toileting in palliative care: Use of the female urinal for bladder management | International Journal of Palliative Nursing*. https://www.magonlinelibrary.com/doi/abs/10.12968/ijpn.2016.22.11.524

Gattinger, H., Werner, B., & Saxer, S. (2013). Patient experience with bedpans in acute care: A cross-sectional study. *Journal of Clinical Nursing*, *22*(15–16), 2216–2224. https://doi.org/10.1111/jocn.12203

Geene, K. (2023). *Comparative Life Cycle Assessment of absorbent underpads*. https://fse.studenttheses.ub.rug.nl/30718/7/Deelbare%20versie.pdf

HM Treasury. (2022a). *The Green Book*. GOV.UK. https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent/the-green-book-2020

HM Treasury. (2022b). *The Green Book: Central Government Guidance on Appraisal and Evaluation* ([Updated edition]). HM Treasury.

HM Treasury, Public Service Transformation Network, & New Economy. (2014). *Supporting public service transformation: Cost benefit analysis guidance for local partnerships*. https://www.greatermanchester-ca.gov.uk/media/1583/cba_guidance_020414_1312_final.pdf

Jambulingam, R., Campion, A., Howard, J., & Tokala, D. P. (2023). Do Patients With Neck of Femur Fractures (NOFF) Experience Long Pre-Hospital Delays in the United Kingdom? *Cureus*, *15*(9), e45729. https://doi.org/10.7759/cureus.45729

John, J. B., Collins, M., Eames, S., O'Flynn, K., Briggs, T. W. R., Gray, W. K., & McGrath, J. S. (2025). The carbon footprint of the perioperative transurethral resection of bladder tumour pathway. *BJU International*, *135*(1), 78–87. https://doi.org/10.1111/bju.16477

John, J., Collins, M., O'Flynn, K., Briggs, T., Gray, W., & McGrath, J. (2024). Carbon footprint of hospital laundry: A life-cycle assessment. *BMJ Open*, *14*(2), e080838. https://doi.org/10.1136/bmjopen-2023-080838

Jones, K. C., Weatherly, H., Birch, S., Castelli, A., Chalkley, M., Dargan, A., Findlay, D., Gao, M., Hinde, S., Markham, S., Smith, D., & Teo, H. (2025, April 8). *Unit Costs of Health and Social Care 2024 Manual* [Reports and Papers]. Personal Social Services Research Unit (University of Kent) & Centre for Health Economics (University of York). https://doi.org/10.22024/UniKent/01.02.109563

Kamdar, A., Yahya, A., & Thangaraj, L. (2009). Retrospective observational study of the incidence of short-term indwelling urinary catheters in elderly patients with neck of femur fractures. *Geriatrics & Gerontology International*, *9*(2), 131–134. https://doi.org/10.1111/j.1447-0594.2008.00490.x

MacDonald, M. (2002). *Review of Large Public Procurement in the UK*. 140.

Maloney, B., McKerlie, T., Nasir, M., Murphy, C., Moi, M., Mudalige, P., Naser, N. E., & Duane, B. (2022). The environmental footprint of single-use versus reusable cloths for clinical surface decontamination: A life cycle approach. *Journal of Hospital Infection*, *130*, 7–19. https://doi.org/10.1016/j.jhin.2022.09.006

Mangram, A., Moeser, P., Corneille, M. G., Prokuski, L. J., Zhou, N., Sohn, J., Chaliki, S., Oguntodu, O. F., & Dzandu, J. K. (2014). Geriatric trauma hip fractures: Is there a difference in outcomes based on fracture patterns? *World Journal of Emergency Surgery*, *9*(1), 59. https://doi.org/10.1186/1749-7922-9-59

Mistry, H., Abdelaziz, T. S., & Thomas, M. (2018). A Prospective Micro-costing Pilot Study of the Health Economic Costs of Acute Kidney Injury. *Kidney International Reports*, *3*(6), 1285–1293. https://doi.org/10.1016/j.ekir.2018.06.006

Mitchell, B. G., Ferguson, J. K., Anderson, M., Sear, J., & Barnett, A. (2016). Length of stay and mortality associated with healthcare-associated urinary tract infections: A multi-state model. *Journal of Hospital Infection*, *93*(1), 92–99. https://doi.org/10.1016/j.jhin.2016.01.012

Mott MacDonald. (2002). *Review of Large Public Procurement in the UK*. HM Treasury. https://www.parliament.vic.gov.au/images/stories/committees/paec/2010-11_Budget_Estimates/Extra_bits/Mott_McDonald_Flyvberg_Blake_Dawson_Waldron_studies.pdf

National Institute for Health and Care Excellence. (2023, October 18). *Tools and resources | Stroke rehabilitation in adults | Guidance | NICE*. NICE. https://www.nice.org.uk/guidance/ng236/resources

Office for Budget Responsibility. (2022). *Inflation*. Office for Budget Responsibility. https://obr.uk/forecasts-in-depth/the-economy-forecast/inflation/

Payne, D. (2015). *Incontinence associated dermatitis: Reducing the risk*. https://www.magonlinelibrary.com/doi/abs/10.12968/nrec.2015.17.3.144

PSSRU. (2021). *Unit Costs of Health and Social Care 2021 | PSSRU*. https://www.pssru.ac.uk/project-pages/unit-costs/unit-costs-of-health-and-social-care-2021/

Rizan, C., Lillywhite, R., Reed, M., & Bhutta, M. F. (2022). Minimising carbon and financial costs of steam sterilisation and packaging of reusable surgical instruments. *British Journal of Surgery*, *109*(2), 200–210. https://doi.org/10.1093/bjs/znab406

Rodriguez, A. (2016). Patient’s Ease of Use, Comfort, and Satisfaction with the Female Urinal. *All Publications*. https://scholarlycommons.baptisthealth.net/se-all-publications/2680

Royal College of Physicians. (2024). *The National Hip Fracture Database*. https://www.nhfd.co.uk/2024report

Smith, D. R. M., Pouwels, K. B., Hopkins, S., Naylor, N. R., Smieszek, T., & Robotham, J. V. (2019). Epidemiology and health-economic burden of urinary-catheter-associated infection in English NHS hospitals: A probabilistic modelling study. *Journal of Hospital Infection*, *103*(1), 44–54. https://doi.org/10.1016/j.jhin.2019.04.010

Thomas, S., Harris, N., Dobransky, J., Grammatopoulos, G., Gartke, K., Liew, A., & Papp, S. (2021). Urinary catheter use in patients with hip fracture: Are current guidelines appropriate? A retrospective review. *Canadian Journal of Surgery*, *64*(6), E630–E635. https://doi.org/10.1503/cjs.014620

Wyman, J. F., Cain, C. H., Epperson, C. N., Fitzgerald, C. M., Gahagan, S., Newman, D. K., Rudser, K., Smith, A. L., & Vaughan, C. P. (2022). Urination Frequency Ranges in Healthy Women. *Nursing Research*, *71*(5), 341–352. https://doi.org/10.1097/NNR.0000000000000595

8. Appendices

8.1. Appendix A: Desktop research methodology

Desktop research underpinned the cost-benefit analysis and high-level carbon impact analysis calculations. Research involved systematic collection and review of existing data and literature from reliable secondary sources. All sources were assessed for credibility and relevance, ensuring that the research provided a robust foundation for the cost-benefit analysis and carbon impact analysis. Source formats collated included:

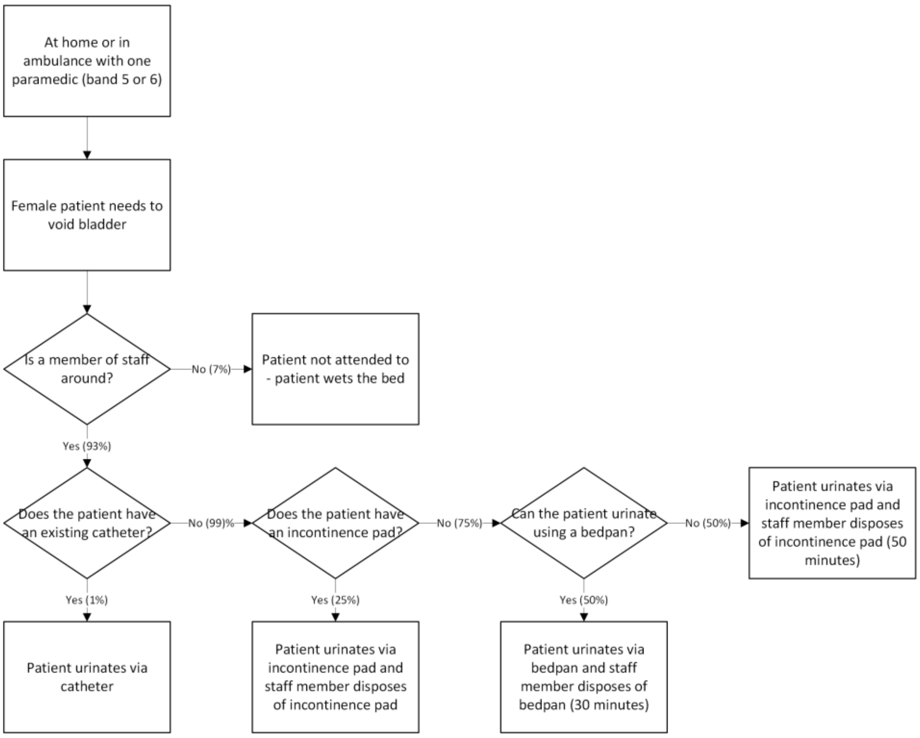
- Academic journals
- NHS reports
- Government publications
- Online databases

For the cost-benefit analysis, desktop research focused on gathering data on NHS budget allocations, healthcare expenditure, and efficiency metrics. This provided the basis for comparing the costs and benefits associated with the UniWee. In parallel, carbon impact analysis data was collected from sources detailing the NHS's environmental footprint, including energy use, waste management practices, and carbon emissions data. This supported the carbon impact analysis by estimating the impact of the UniWee on carbon emissions.

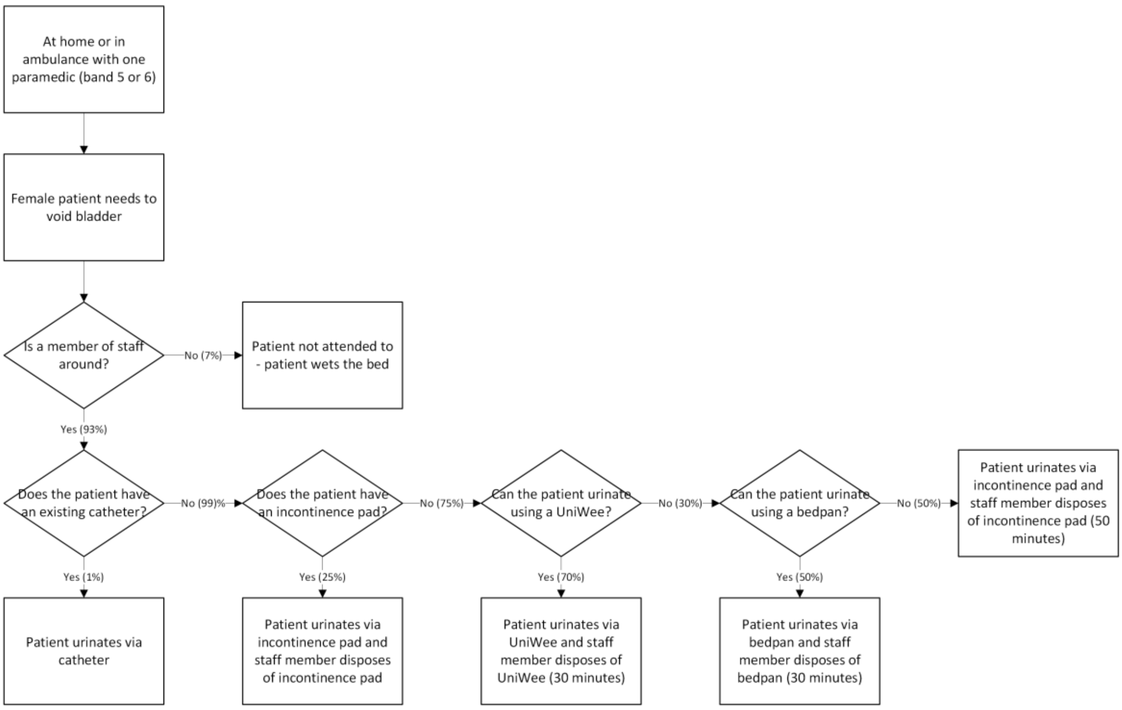
8.2. Appendix B: Pathway mapping findings

Home to waiting to enter hospital

Current pathway

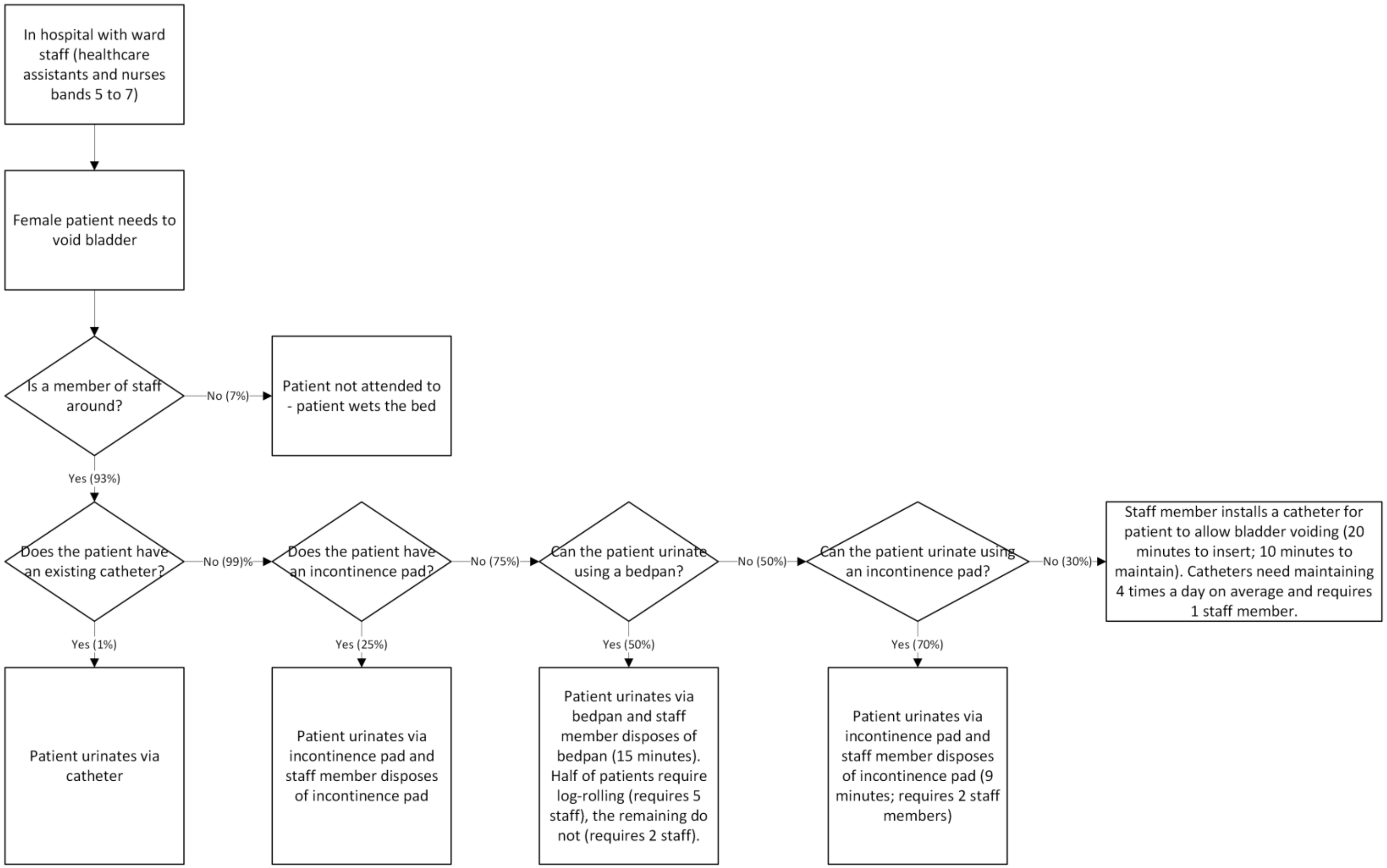


Pathway with UniWee

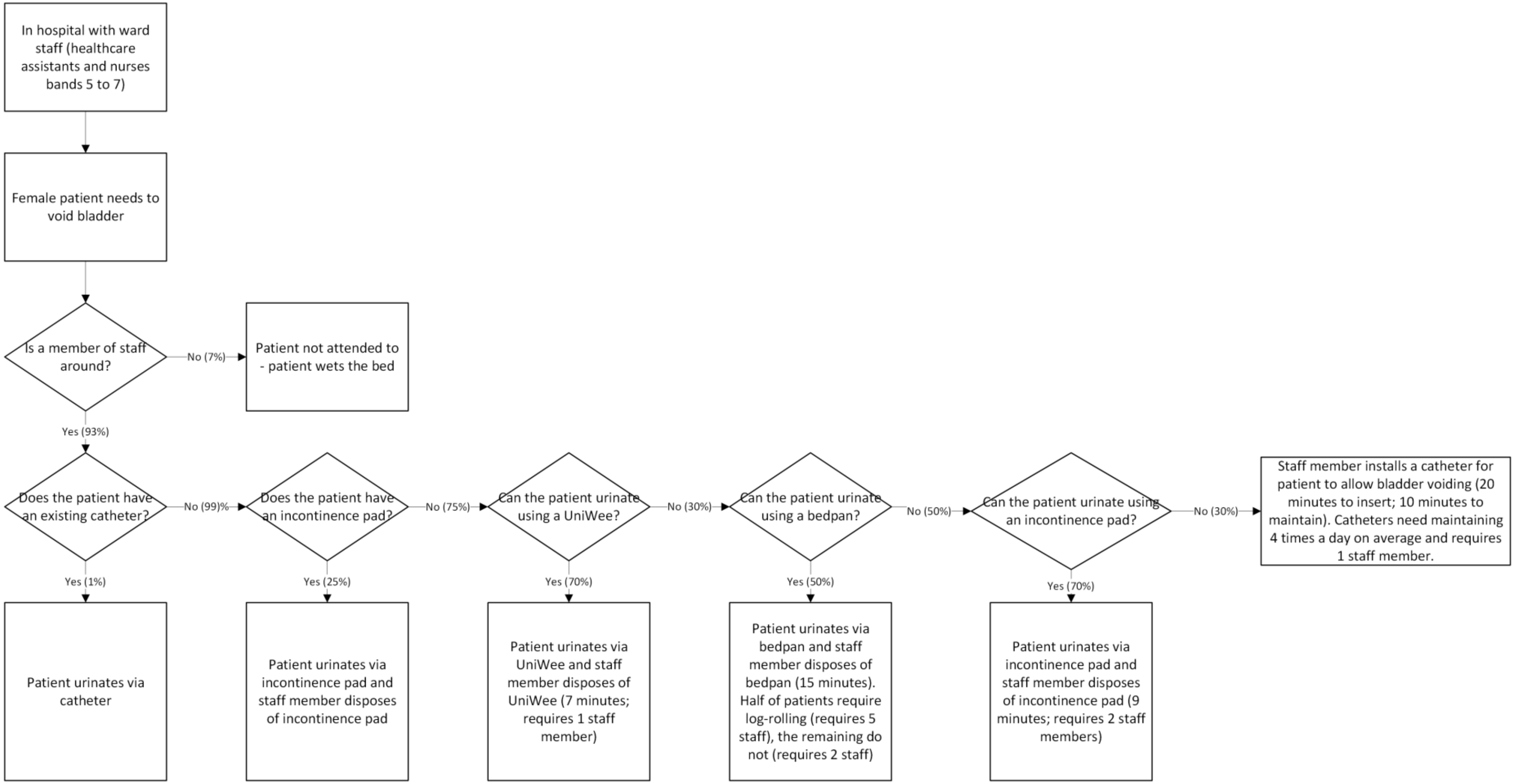


In hospital

Current pathway



Pathway with UniWee



8.3. Appendix C: Health economic modelling methodology continued

Cost-benefit analysis methodology

A cost-benefit analysis (CBA) aims to determine whether the economic value of an intervention can justify the service's costs by comparing the cost of two or more alternatives and reviewing the return on investment (ROI) based on a static model of the world. Savings are estimated from the perspective of society in the UK, in other words, including social benefits (for example, quality-adjusted life years gained) as well as cost savings to the healthcare system. It is not possible to include all costs and benefits within the appraisal. Despite this, the programme's effects should be considered and outcomes that are most likely to determine the difference between alternative options should be included within the appraisal. The net benefit (Equation 2) and benefit cost ratio (BCR; Equation 3) are economic summary measures that can be derived from such an appraisal and consist of the following formulae:

$$Net\ benefit = Total\ benefits - Total\ costs$$

Equation 2: The equation for net benefit, used within the health economic modelling.

$$Benefit\ cost\ ratio = \frac{Present\ value\ benefits}{Present\ value\ costs}$$

Equation 3: The equation for benefit cost ratio, used within the health economic modelling.

Net benefit is an estimate of the total value gained or lost by the programme in '*present value*' terms. That is, the benefits minus the costs in each year are estimated, and the resulting net cash flow in each year is transformed into present value using Equation 2 above. This gives an overall estimate of the value of the intervention when taking into account time preference (in other words, benefits and costs today are worth more than equal benefits and costs in the future).

The BCR measures the present value of benefits against the present value of costs. This ratio summarises the overall relationship between relative benefits and costs of the UniWee (for example, £X return for every £1 invested). A BCR greater than one indicates that the UniWee may deliver a positive NPV (for example, a BCR of two indicates that for every £1 spent, there is an expected £2 return). If the BCR is equal to one, then the present value of the benefits equals that of the costs. Where the BCR is less than one, the value of the costs will outweigh the benefits.

It is important to note that summary measures are not without limitations (for example, measures may not fully capture all potential impacts of the UniWee and alternative pathways).

Optimism bias

Optimism bias (OB) is defined as "*the tendency for a project's costs and duration to be underestimated and / or benefits to be overestimated*", as identified by historical UK government reviews on public sector procurement (Mott MacDonald, 2002). To account for such optimistic estimates, the health economic model applied OB correction factors in response to the level of uncertainty in the data or assumptions used within the model.

Unity Insights' approach is an adaptation of the model created by the Greater Manchester Combined Authority (GMCA) Research Team (HM Treasury et al., 2014). The GMCA model is featured in the supplementary guidance of *The Green Book* and offers a robust and prudent approach to economic analysis (HM Treasury, 2022b). The results outlined in this document include results in which an assumption-specific OB has been applied to each benefit stream. The optimism bias used uses the following matrix displayed in Figure 1.

			Data source									
		Confidence grade	Formal service delivery contract costs Figures derived from local stats / RCT trials		Practitioner monitored costs Figures based on national analysis in similar areas		Costs developed from ready reckoners Figures based on generic national analysis		Costs from similar interventions elsewhere Figures based on international analysis		Cost from uncorroborated expert judgement	
			1		2		3		4		5	
Age of data	< 2 Years	1	1.1	0%	2.1	10%	3.1	15%	4.1	25%	5.1	40%
	2 - 3 Years	2	1.2	5%	2.2	10%	3.2	15%	4.2	25%	5.2	45%
	3 - 5 Years	3	1.3	10%	2.3	15%	3.3	20%	4.3	30%	5.3	50%
	5 - 10 Years	4	1.4	15%	2.4	25%	3.4	30%	4.4	40%	5.4	55%
	> 10 Years	5	1.5	25%	2.5	30%	3.5	40%	4.5	50%	5.5	60%

Figure 1: Unity Insights' optimism bias confidence grades.

Adjusting for inflation

Ensuring that costs and benefits are adjusted for inflation removes the general effects of inflation and presents costs and benefits included within the appraisal in '*real'* base year prices, rather than in nominal prices (in other words, the first year of the intervention). Various rates were applied depending on data type, namely:

- CPI Inflation rate (Office for Budget Responsibility, 2022).
- The NHSCII Pay and Prices (PSSRU, 2021).

Benefit and cost streams

Benefit stream 1: A reduction in staff time in the neck of femur fracture pathway from paramedics arriving at the patient's home to the patient going in for surgery due to the UniWee

The calculation for benefit stream 1 was as follows (Figure 2):

- Benefit stream 1a was summed with benefit stream 1b and 1c.

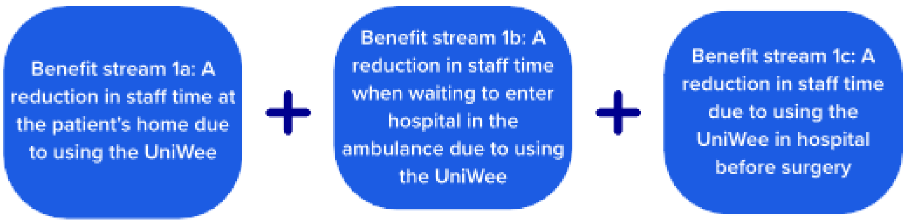


Figure 2: The calculation for benefit stream 1.

<u>Benefit stream 1a: A reduction in staff time at the patient's home due to using the UniWee</u>

The calculation for benefit stream 1a was as follows (Figure 3):

- Number of patients with female genitalia in the neck of femur pathway (320) was calculated as follows:
    - The number of patients in the neck of femur pathway was 426, taken from averaging the number of neck of femur fracture patients in each hospital across England (Royal College of Physicians, 2024).
    - This was multiplied by 75%, the proportion of patients with female genitalia in the neck of femur fracture pathway (Mangram et al., 2014).
- The proportion of patients who need to void their bladder at their home whilst the paramedic is with them (20%) was identified through the pathway mapping exercise.

- The proportion of incontinence pads replaced by the UniWee from home to hospital (24%) was identified through the pathway mapping exercise.
    - The proportion of female patients who need to void their bladder that had a staff member to help them (93%) was multiplied by the proportion who did not have an existing catheter (99%), the proportion who did not have an incontinence pad (75%), and the proportion who could not void their bladder using a bed pan (50%) = 34.5%.
    - This value was subtracted from the equivalent in the UniWee pathway (10.4%) to equal 24%.
        - The proportion of female patients who need to void their bladder that had a staff member present to help them (93%) was multiplied by the proportion who did not have an existing catheter (99%), the proportion who did not have an incontinence pad (75%), the proportion who could not void their bladder using a UniWee (30%), and the proportion who could not void their bladder using a bed pan (50%) = 10.4%.
- Staff time saving due to using the UniWee versus incontinence pads (0.33 hours) was identified through the pathway mapping exercise.
    - This was identified through multiplying the time taken to use an incontinence pad (50 minutes) by the number of staff required to insert an incontinence pad (1 staff member) and subtracting this from the time taken to use a UniWee (30 minutes) multiplied by the number of staff required to insert a UniWee (1 staff member). This was equal to 20 minutes, or 0.33 hours. All figures were identified through pathway mapping.
- The proportion of disposable bedpans replaced by UniWee from home to hospital (24%) was identified through the pathway mapping exercise.
    - The proportion of female patients who need to void their bladder that had a staff member present to help them (93%) was multiplied by the proportion who did not have an existing catheter (99%), the proportion who did not have an incontinence pad (75%), and the proportion who could void their bladder using a bed pan (50%) = 34.5%.
    - This value was subtracted from the equivalent in the UniWee pathway (10.4%) to equal 24%.
        - The proportion of female patients who need to void their bladder that had a staff member present to help them (93%) was multiplied by the proportion who did not have an existing catheter (99%), the proportion who did not have an incontinence pad (75%), the proportion who could not void their bladder using a UniWee (30%), and the proportion who could void their bladder using a bed pan (50%) = 10.4%.

- Staff time saving due to using the UniWee versus disposable bedpans (0.00 hours as they required the same amount of staff time) was identified through the pathway mapping exercise.
    - This was identified through multiplying the time taken to use a bedpan (30 minutes) by the number of staff required to insert a bedpan (1 staff member) and subtracting this from the time taken to use a UniWee (30 minutes) multiplied by the number of staff required to insert a UniWee (1 staff member). This was equal to 0.00 minutes, or 0.00 hours. All figures were identified through pathway mapping.
- Staff time cost per hour (£52) was calculated by multiplying the following figures together:
    - The number of staff tending to a patient at home (n = 1) was identified through the pathway mapping exercise.
    - This was multiplied by the unit cost based on staff bandings of the paramedic (either a band 5 or band 6 paramedic, as identified through pathway mapping), estimated to be £52 based on Jones et al. (2024).
    - Inflation was applied, bringing the staff time cost to £54 per hour.
- An optimism bias correction factor of 40% was applied to the calculation.

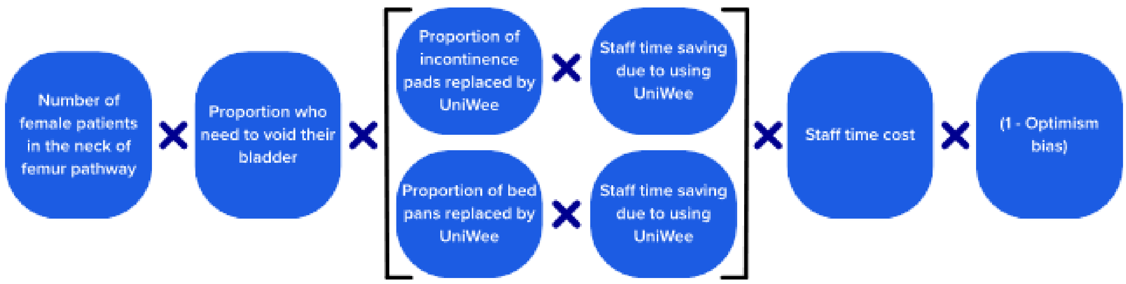


Figure 3: The calculation for benefit stream 1a.

Benefit stream 1b: A reduction in staff time when waiting to enter hospital in the ambulance due to using the UniWee

The calculation for benefit stream 1b was as follows (Figure 4):

- Number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- The proportion of patients who need to void their bladder in the ambulance on the way to the hospital (6%) was identified through the pathway mapping exercise.

- The proportion of incontinence pads replaced by the UniWee (24%) was calculated as in benefit stream 1a.
- Staff time saving due to using the UniWee versus incontinence pads (0.33 hours) was calculated as in benefit stream 1a.
- The proportion of disposable bedpans replaced by the UniWee (24%) was calculated as in benefit stream 1a.
- Staff time saving due to using the UniWee versus disposable bedpans (0.00 hours) was calculated as in benefit stream 1a.
- Staff time cost per hour (£54) was calculated as in benefit stream 1a.
- An optimism bias correction factor of 40% was applied to the calculation.

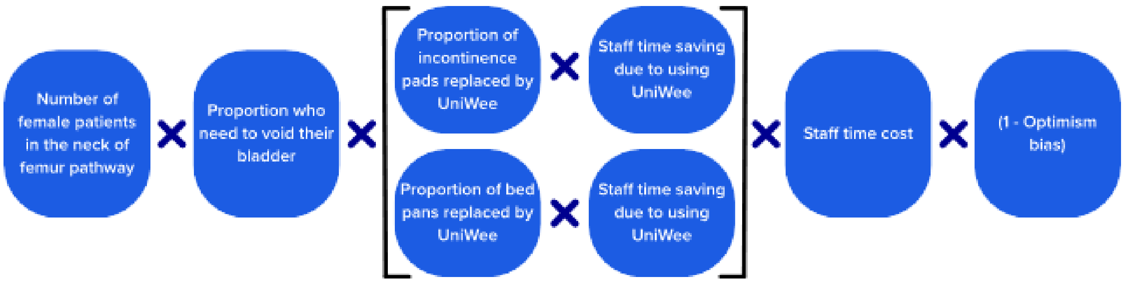


Figure 4: The calculation for benefit stream 1b.

Benefit stream 1c: A reduction in staff time due to using the UniWee in hospital before surgery

The calculation for benefit stream 1c was as follows (Figure 5):

- The number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- The proportion of catheters replaced by the UniWee (7%) was identified through the pathway mapping exercise.
    - The proportion of female patients who need to void their bladder that had a staff member present to help them (93%) was multiplied by the proportion who did not have an existing catheter (99%), the proportion who did not have an incontinence pad (75%), the proportion who could not void their bladder using a bed pan (50%), and the proportion who could have a catheter inserted (30%) = 10%.
    - This value was subtracted from the equivalent in the UniWee pathway to equal 7%.

                - The proportion of female patients who need to void their bladder that had a staff member to help them (93%) was multiplied by the proportion who did not have an existing catheter (99%), the proportion who did not have an incontinence pad (75%), the proportion who could not void their bladder using a UniWee (30%), the proportion who could not void their bladder using a bed pan (50%), and the proportion who could have a catheter inserted (30%) = 3%.

- The total increase in staff time due to using a UniWee over a catheter (-0.35 hours) was calculated by:
    - Multiplying the time taken to insert a catheter (20 minutes) by the number of staff required to insert a catheter (1) and the number of times a catheter needs inserting during the patient's hospital stay (1). This was equal to 20, which was summed with the following calculation:
        - Multiplying the time taken to maintain a catheter (10 minutes) by the number of staff required to maintain a catheter (1), the number of times a catheter needs maintaining per day (4 times), and the length of stay in hospital (1.375 days; Jambulingam et al., 2023). This was equal to 55 minutes, which was summed with the time taken to insert a catheter (20 minutes) to equal 75 minutes. This was subtracted by the following calculation:
            - Multiplying the time taken to insert and use a UniWee (7 minutes) by the number of staff required to help a patient insert and use a UniWee (1), the number of times a patient needs to void their bladder in hospital per day (10 times; Wyman et al., 2022), and the length of stay in hospital (1.375 days; Jambulingam et al., 2023). This was equal to 96.25 minutes, which was subtracted from 75 minutes to equal -21.25 minutes. This was divided by 60 minutes to identify the time reduction in hours (-0.35 hours).
- The proportion of incontinence pads replaced by the UniWee (17%) was identified through the pathway mapping exercise.
    - The proportion of female patients who need to void their bladder that had a staff member present to help them (93%) was multiplied by the proportion who did not have an existing catheter (99%), the proportion who did not have an incontinence pad (75%), the proportion who could not void their bladder using a bed pan (50%), and the proportion who could have an incontinence pad inserted (70%) = 24%.
    - This value was subtracted from the equivalent in the UniWee pathway to equal 17%
        - The proportion of female patients who need to void their bladder that had a staff member present to help them (93%) was multiplied by the proportion who did not have an existing catheter (99%), the proportion who did not have an incontinence pad (75%), the proportion who could not void their

bladder using a UniWee (30%), the proportion who could not void their bladder using a bed pan (50%), and the proportion who could have an incontinence pad inserted (70%) = 7%.

- The total reduction in staff time due to using a UniWee over an incontinence pad (2.25 hours) was calculated by:
    - Multiplying the time taken to insert and use an incontinence pad (9 minutes) by the number of staff required to help a patient insert and use an incontinence pad (1 staff member), the number of times a patient needs to void their bladder in hospital per day (10 times; Wyman et al., 2022), and the length of stay in hospital (1.375 days; Jambulingam et al., 2023). This was equal to 247.5 minutes and was subtracted by the total time taken to insert and use a UniWee across the patient's length of stay (96.25 minutes) as identified above and divided by 60 minutes to equal 2.52 hours.
- The proportion of disposable bedpans replaced by UniWee (24%) was identified through the pathway mapping exercise.
    - The proportion of female patients who need to void their bladder that had a staff member to help them (93%) was multiplied by the proportion who did not have an existing catheter (99%), the proportion who did not have an incontinence pad (75%), and the proportion who could void their bladder using a bed pan (50%) = 34.5%.
    - This value was subtracted from the equivalent in the UniWee pathway to equal 24%.
        - The proportion of female patients who need to void their bladder that had a staff member to help them (93%) was multiplied by the proportion who did not have an existing catheter (99%), the proportion who did not have an incontinence pad (75%), the proportion who could not void their bladder using a UniWee (30%), and the proportion who could void their bladder using a bed pan (50%) = 10%.
- The total reduction in staff time due to using a UniWee over a disposable bedpan (10.43 hours) was calculated by:
    - Multiplying the time taken to insert and use a disposable bedpan (15 minutes; identified through pathway mapping) by the number of times a patient needs to void their bladder in hospital per day (10 times; Wyman et al., 2022), the length of stay in hospital (1.375 days; Jambulingam et al., 2023). This was equal to 206.25 minutes and was multiplied by the following calculation:
        - Multiplying the proportion of patients who require log-rolling to use the bedpan (50%; as identified through pathway mapping), and the number of staff required to log-roll a patient (5 staff members). This was equal to 2.5 and was summed with the following calculation:

- Multiplying the proportion of patients who do not require log-rolling to use the bedpan (50%; as identified through pathway mapping), and the number of staff required for a patient to use a bedpan without log-rolling (2 staff). This was equal to 1, which was summed with 2.5 to equal 3.5. Multiplying this by 206.25 minutes equals 721.88 minutes and was subtracted by the total time taken to insert and use a UniWee across the patient's length of stay (96.25 minutes) as identified above and divided by 60 minutes to equal 10.43 hours.

- Staff time cost per hour (£37) was identified by:
  - Pathway mapping identified the breakdown of staff on the ward:
    - 4 healthcare assistants
    - 4 band 5 nurses
    - 1 band 6 ward sister
    - 1 band 7 ward manager
  - Staff unit cost per hour was identified through Jones et al. (2024) and National Institute for Health and Care Excellence (2023)
    - Band 2 to 3 healthcare assistant: £16 (National Institute for Health and Care Excellence, 2023)
    - Band 5 nurse: £45 (Jones et al., 2024)
    - Band 6 ward sister: £56 (Jones et al., 2024)
    - Band 7 ward manager: £67 (Jones et al., 2024)
  - Inflation was applied, bringing the staff time cost to £38 per hour.
- An optimism bias correction factor of 40% was applied to the calculation.

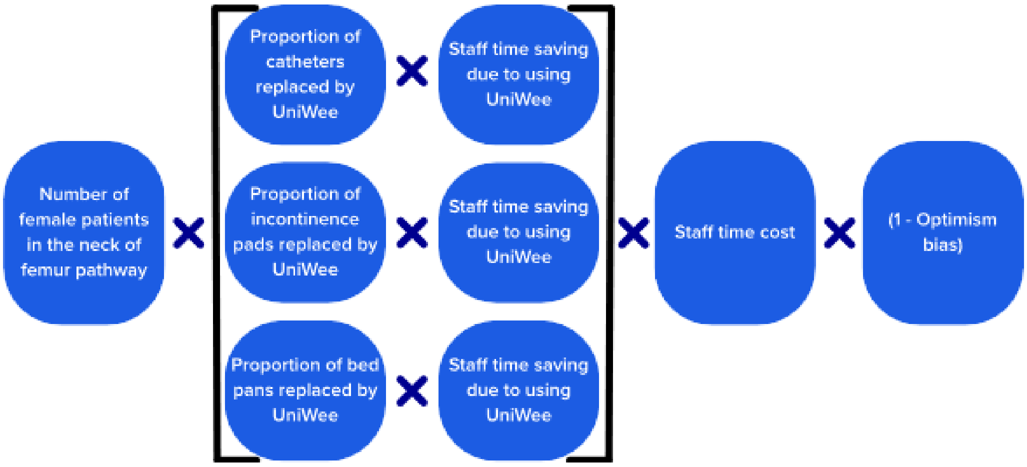


Figure 5: The calculation for benefit stream 1c.

Benefit stream 2: A reduction in the costs related to catheters due to use of the UniWee

The calculation for benefit stream 2 was as follows (Figure 6):

- The number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- The proportion of catheters replaced by UniWee (7%) was calculated as in benefit stream 1c.
- The number of times a catheter needs maintaining during a patient's hospital stay (5 times) was identified by:
    - Multiplying the number of times a catheter needs tending to per day (4; taken from pathway mapping) by length of stay (1.375 days; Jambulingam et al., 2023) and subtracting this by the number of times a catheter needs inserting during the patient's stay (1).
- Cost of inserting a catheter including consumables and disposal costs was estimated at £5.46 using the following method:
    - Pathway mapping discussions identified the consumables required to insert a catheter included:
        - Catheter (disposed of via yellow disposal bag)
        - Gel (disposed of via yellow disposal bag)
        - Cleaning solution (disposed of via yellow disposal bag)
        - Syringe (disposed of via yellow disposal bag)

        - Apron (disposed of via yellow disposal bag)
        - Two pairs of gloves (disposed of via yellow disposal bag)
        - Antimicrobial wipes (disposed of via yellow disposal bag)
        - Plastic bag for catheter (disposed of via yellow disposal bag)
        - 400ml urine meter (disposed of via yellow disposal bag)
    - Conversations with a hospital trust identified the unit cost of a catheter pack, containing the above consumables, as £1.05. The only item not within the catheter pack was the 400ml urine meter, which cost £4.21.
    - Catheter insertion disposal cost was assumed to be £0.20. This figure was based on estimating the size of yellow disposal bags and how many of each item could fit in a yellow disposal bag and dividing this by an estimation of the cost to dispose of the yellow bag. It should be noted that this figure is hypothetical and was not identified by a subject matter expert.
- Cost of maintaining a catheter including consumables and disposal costs was estimated at £0.29 using the following method:
    - Pathway mapping discussions identified the consumables required to maintain a catheter included:
        - One apron (£0.02; disposed of via yellow disposal bag)
        - One pair of gloves (£0.03; disposed of via yellow disposal bag)
        - One disposable male pulp urine bottle (£0.15; disposed of via maceration)
    - Conversations with a hospital trust identified the unit cost of the above items, summing to equal £0.20.
    - Catheter maintenance disposal cost was assumed to be £0.09. This figure was based on estimating the size of yellow disposal bags and how many of each item that was disposed of using this method could fit in a yellow disposal bag and dividing this by an estimation of the cost to dispose of the yellow bag. It should be noted that this figure is hypothetical and was not identified by a subject matter expert. The disposable male pulp urinal bottle was disposed of via maceration, where one cycle costed £0.15 and could dispose of two urinal bottles, resulting in a cost of £0.08 per bottle.
- An optimism bias correction factor of 40% was applied to the calculation.

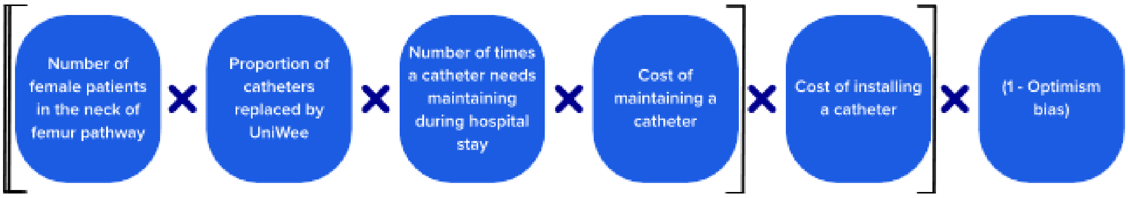


Figure 6: The calculation for benefit stream 2.

Benefit stream 3: A reduction in the costs related to incontinence pads due to use of the UniWee

The calculation for benefit stream 3 was as follows (Figure 7):

- The number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- The number of incontinence pads used per patient from home to hospital (0.26) was identified by summing the proportion of patients who needed to void their bladder at home (0.20) and in the ambulance (0.06).
- The number of incontinence pads used per patient in hospital (13.75) was identified by multiplying the number of times a patient voids their bladder in hospital (10 times; Wyman et al., 2022) by the length of stay in the neck of femur fracture pathway (1.375 days; Jambulingam et al., 2023).
- The proportion of incontinence pads replaced by UniWee from home to hospital (24%) was calculated as in benefit stream 1a.
- The proportion of incontinence pads replaced by UniWee in hospital (17%) was calculated as in benefit stream 1c.
- The total cost of an incontinence pad and consumables, including disposal was estimated at £0.94 using the following method:
  - Conversations with a hospital trust identified the following costs of items required (£0.80):
    - Incontinence pad: £0.34 (disposed of via yellow disposal bag)
    - Gloves: £0.03 for one pair (disposed of via yellow disposal bag)
    - Antimicrobial wipes (3 are used for one incontinence pad): £0.0028 for one wipe (disposed of via yellow disposal bag)
    - Clean sheet (washing bedding): £0.42 (not disposed of)
  - Incontinence pad and consumables disposal cost was assumed to be £0.14. This figure was based on estimating the size of yellow disposal bags and how many of each item could fit in a yellow disposal bag and dividing this by an estimation of the

cost to dispose of the yellow bag. It should be noted that this figure is hypothetical and was not identified by a subject matter expert.

- An optimism bias correction factor of 40% was applied to the calculation.

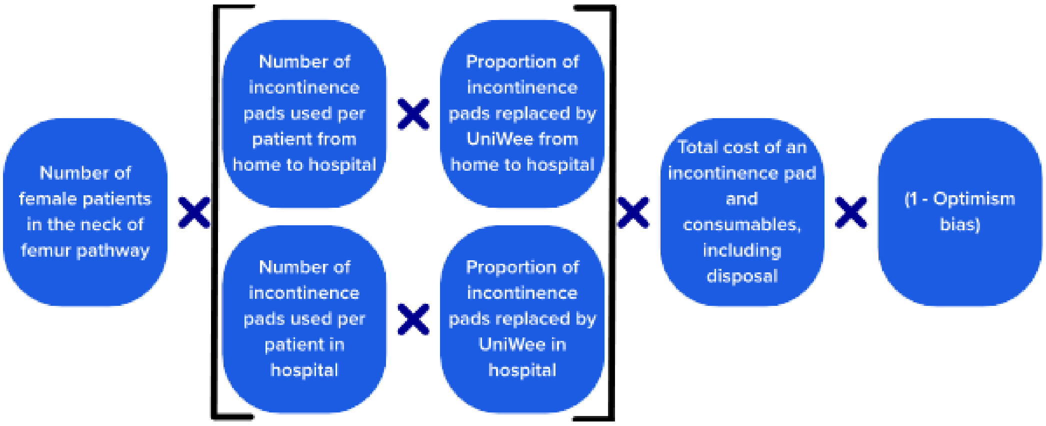


Figure 7: The calculation for benefit stream 3.

Benefit stream 4: A reduction in the costs related to bedpans due to use of the UniWee

The calculation for benefit stream 4 was as follows (Figure 8):

- The number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- The number of disposable bedpans used per patient from home to hospital (0.26) was identified by summing the proportion of patients who needed to void their bladder at home (0.2) and in the ambulance (0.06).
- The number of disposable bedpans used per patient in hospital (13.75) was identified by multiplying the number of times a patient voids their bladder in hospital (10 times; Wyman et al., 2022) by the length of stay in the neck of femur fracture pathway (1.375 days; Jambulingam et al., 2023).
- The proportion of disposable bedpans replaced by UniWee from home to hospital (24%) was calculated as in benefit stream 1a.
- The proportion of disposable bedpans replaced by UniWee in hospital (24%) was calculated as in benefit stream 1c.
- The total cost of a disposable bedpan and consumables, including disposal was estimated at £0.40 using the following method:

- Conversations with a hospital trust identified the following costs of items required (£0.40):
    - Slipper pan: £0.00 (as this item was reusable and already purchased by the hospital)
    - Bedpan liner: £0.12 (disposed of via maceration)
    - Incontinence sheet: £0.09 (disposed of via yellow disposal bag)
    - Gloves (two pairs required; £0.06): £0.03 for one pair (disposed of via yellow disposal bag)
    - Antimicrobial wipes (one wipe required): £0.0028 for one wipe (disposed of via yellow disposal bag)
- Disposable bedpan and consumables disposal cost was assumed to be £0.50. This figure was based on estimating the size of yellow disposal bags and how many of each item could fit in a yellow disposal bag and dividing this by an estimation of the cost to dispose of the yellow bag. It should be noted that this figure is hypothetical and was not identified by a subject matter expert. The bedpan liner was disposed of via maceration, where one cycle costed £0.15 and could dispose of approximately 2 bedpan liners, resulting in a cost of £0.08 per bedpan liner.

- An optimism bias correction factor of 40% was applied to the calculation.

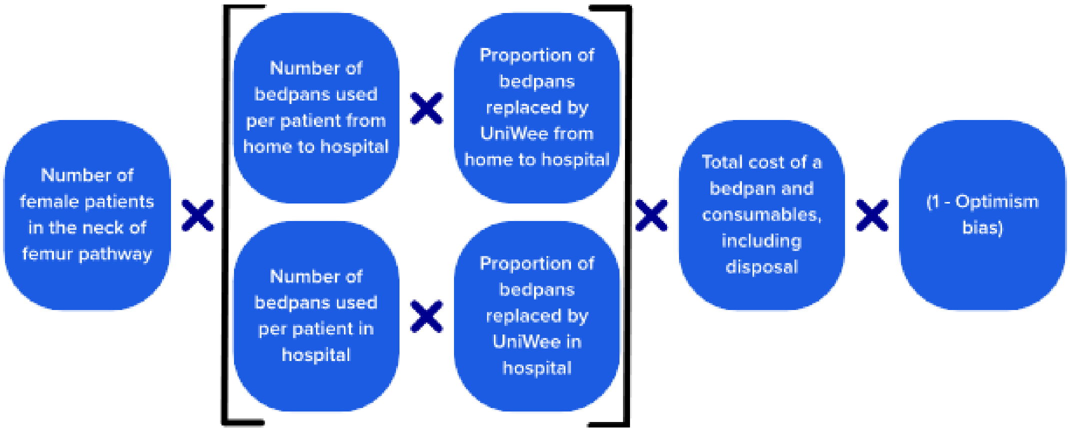


Figure 8: The calculation for benefit stream 4.

Benefit stream 5: A reduction in the costs related to UTI treatments due to fewer catheterisations

The calculation for benefit stream 5 was as follows (Figure 9):

- The number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- The number of catheters used was 1 as identified through pathway mapping.
- The proportion of catheters replaced by UniWee (7%) was calculated as in benefit stream 1c.
- The reduction in the incidence of catheter-associated UTIs (31.4%) was taken from Kamdar et al. (2009).
    - It was assumed that no patients developed a UTI when using UniWee.
- The total cost to treat a catheter-associated UTI was £532, taken from Smith et al. (2019).
    - Inflation was applied, bringing the cost to £674.
- An optimism bias correction factor of 40% was applied to the calculation.

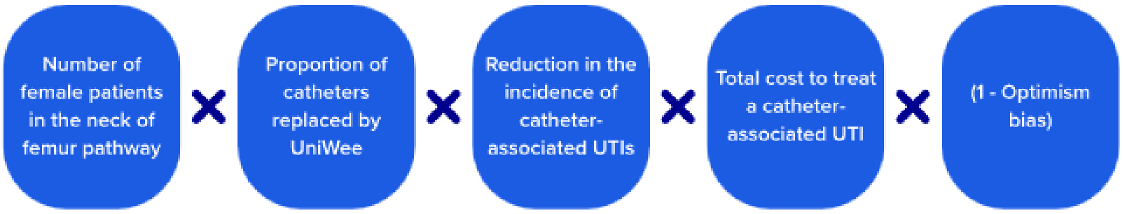


Figure 9: The calculation for benefit stream 5.

Benefit stream 6: A reduction in the costs related to treatment of acute kidney injury from delayed bladder voiding when sitting in an ambulance

The calculation for benefit stream 6 was as follows (Figure 10):

- The number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- The proportion of patients who need to void their bladder in the ambulance on the way to the hospital (6%) was calculated as in benefit stream 1b.
- The chance of developing an AKI due to delayed bladder voiding (3.5%) was taken from Chenitz and Lane-Fall (2012).

- The proportion of patients who could use a UniWee in the ambulance (41%) was taken from the pathway mapping exercise.
- The total cost of treating an AKI (£3,750) was taken from Mistry et al. (2018).
  - Inflation was applied, bringing this cost to £4,854.
- An optimism bias correction factor of 40% was applied to the calculation.

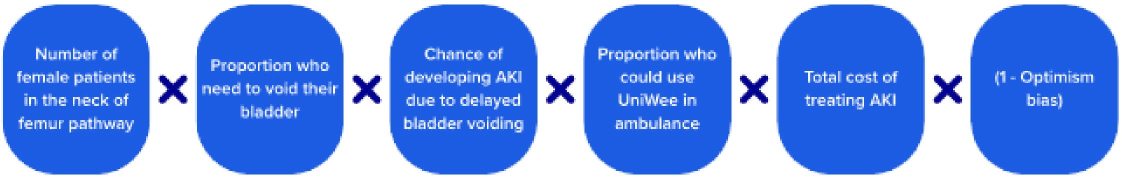


Figure 10: The calculation for benefit stream 6.

Cost stream 1: UniWee device cost and disposal

The calculation for cost stream 1 was as follows (Figure 11):

- Number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- Frequency of bladder voiding was calculated as follows:
  - At home: 20%, as identified in benefit stream 1a.
  - In ambulance: 6%, as identified in benefit stream 1b.
  - At hospital: 13.75, as identified in benefit stream 1c.
- The proportion of methods the UniWee replaced was calculated as follows:
  - At home: 41%, by summing the proportion of bladder voiding episodes that require an incontinence pad (17%) or a bedpan (24%) to void their bladder and that could use a UniWee, as identified through pathway mapping.
  - In ambulance: 41%, by summing the proportion of bladder voiding episodes that require an incontinence pad (17%) or a bedpan (24%) to void their bladder and that could use a UniWee, as identified through pathway mapping.
  - At hospital: 48%, by summing the proportion of bladder voiding episodes that require a catheter (7%), incontinence pad (17%) or a bedpan (24%) to void their bladder and that could use a UniWee, as identified through pathway mapping.

- Total cost of a UniWee and consumables, including disposal cost was estimated at £0.38 using the following method:
    - The cost of a UniWee was £0.14, as provided by UniWee.
    - Conversations with a hospital trust identified the consumables required to use a UniWee, alongside their costs (£0.26):
        - Pair of gloves: £0.03 (disposed of via yellow disposal bag)
        - Incontinence sheet: £0.09 (disposed of via yellow disposal bag)
        - Antimicrobial wipes (one wipe required): £0.0028 per wipe (disposed of via yellow disposal bag)
    - The cost to dispose of a UniWee was suggested to be £0.08, as provided by UniWee.
    - Consumables disposal cost was assumed to be £0.43. This figure was based on estimating the size of yellow disposal bags and how many of each item could fit in a yellow disposal bag and dividing this by an estimation of the cost to dispose of the yellow bag. It should be noted that this figure is hypothetical and was not identified by a subject matter expert.
- A cost correction of 40% was applied to the calculation.

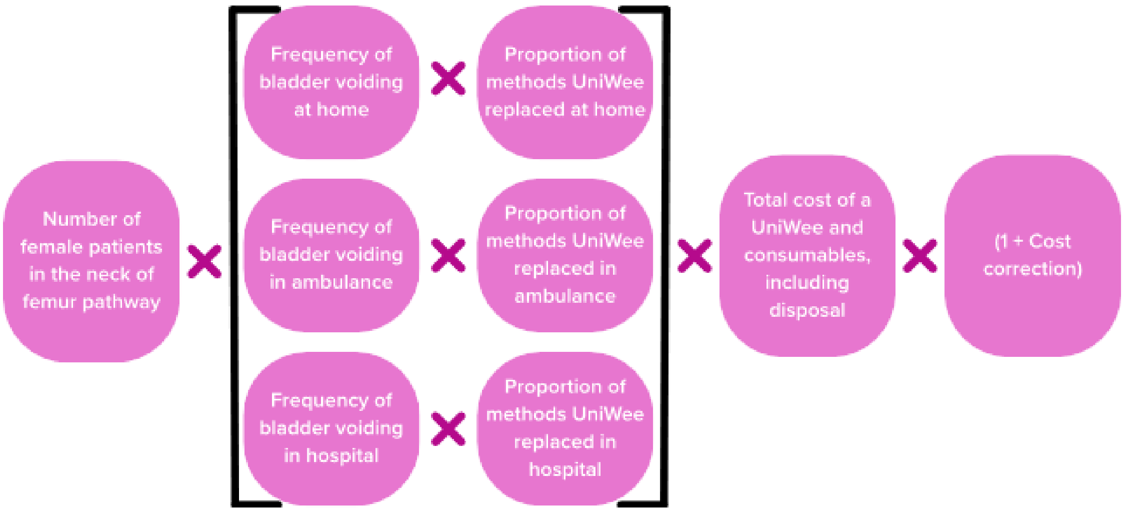


Figure 11: The calculation for cost stream 1.

Cost stream 2: Implementation costs

The calculation for cost stream 2 was as follows (Figure 12):

- Staff training cost was estimated at £148, calculated by:
    - The UniWee design team suggested that clinical champions would spend 4 hours a year training and encouraging staff members to use a UniWee.
    - This was multiplied by the unit cost of the staff member per hour (£37) as identified in benefit stream 1c.
- The proportion of patients with female genitalia who take an information leaflet (5%; assumption[1]) was multiplied by:
    - The total number of patients with female genitalia in the neck of femur fracture pathway (320) as calculated in benefit stream 1a to equal 16 patients who would take an information leaflet.
    - This was then multiplied by the cost per information leaflet, estimated as £0.10 by UniWee.
- A cost correction of 40% was applied to the calculation.

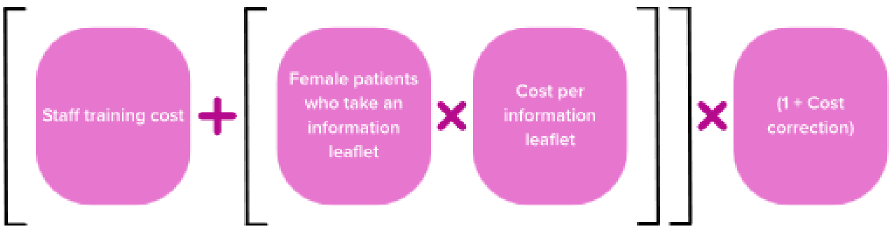


Figure 12: The calculation for cost stream 2.

[1] Throughout the document, a source labelled '*assumption*' is an estimated figure based on sources that are close but not exactly accurate to the current context, combined to provide the best available approximation.

8.4. Appendix D: High-level carbon impact analysis methodology

General modelling assumptions

- Figures identified in the pathway mapping exercise, such as the proportion of catheters replaced by UniWee, represented the average NHS hospital in England.
- The hospital only used the following methods when a female patient needed to void their bladder in the neck of femur fracture pathway: catheter, disposable bedpan, incontinence pad, and a UniWee.
- The hospital had a maceration facility.

Optimism bias

Optimism bias was applied in the high-level carbon impact analysis, using the same method as in ‘Appendix C: Health economic modelling methodology continued’.

Streams

Stream 1: A reduction in the number of catheters used by females in the neck of femur fracture pathway due to use of the UniWee, leading to a reduction in kgCO$_2$e

The calculation for stream 1 was as follows (Figure 13):

- The number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- The proportion of catheters replaced by the UniWee (7%) was calculated as in benefit stream 1c.
- The number of times a catheter needs maintaining during the patient’s hospital stay (5 times) was calculated as in benefit stream 2.
- The carbon footprint of maintaining a catheter, including consumables required, was estimated at 0.20kgCO$_2$e and was calculated using the following method:
    - The consumables required to maintain a catheter included was identified as in benefit stream 2.
    - The carbon footprint of consumables was identified as the sum of:
        - One apron: 0.07kgCO$_2$e (taken from Rizan et al., 2022)
        - One pair of gloves: 0.05kgCO$_2$e (taken from Rizan et al., 2022)
        - One disposable pulp male urine bottle: 0.08kgCO$_2$e (assumption)
- The carbon footprint of inserting a catheter and consumables required to do so was estimated at 3.52kgCO$_2$e and was calculated using the following method:

- The carbon footprint of consumables was identified as the sum of:
  - Catheter: 1.68kgCO_2e (taken from John et al., 2025).
    - It was assumed that patients only had one catheter inserted across their length of stay.
  - Gel: 0.05kgCO_2e (assumption based on non-expert judgement)
  - Cleaning solution: 0.05kgCO_2e (assumption based on non-expert judgement)
  - Syringe: 0.05kgCO_2e (assumption based on non-expert judgement)
  - Apron: 0.07kgCO_2e (taken from Rizan et al., 2022)
  - Two pairs of gloves: 0.1kgCO_2e total (taken from Rizan et al., 2022)
  - One antimicrobial wipe: 0.12kgCO_2e (taken from Maloney et al., 2022)
  - Plastic bag for catheter: 1.35kgCO_2e (taken from John et al., 2025)
  - One 400ml urine meter: 0.05kgCO_2e (assumption based on non-expert judgement)
- An optimism bias correction factor of 40% was applied to the calculation.

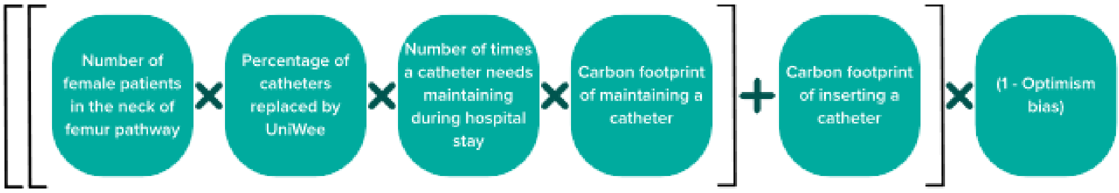


Figure 13: The calculation for stream 1.

Stream 2: A reduction in the number of bedpans used by females in the neck of femur fracture pathway due to use of the UniWee, leading to a reduction in kgCO_2e

The calculation for stream 2 was as follows (Figure 14):

- The number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- The frequency of bladder voiding was calculated as follows:
  - Home to hospital: 0.26; as identified in benefit stream 4.
  - Hospital: 13.75; as identified in benefit stream 4.

- The proportion of disposable bedpans replaced by UniWee at home and in the ambulance (24%) as identified in benefit stream 1a and 1b.
- The proportion of disposable bedpans replaced by UniWee in hospital (24%) as identified in benefit stream 1c.
- The carbon footprint of a disposable bedpan and other consumables was 0.41kgCO_2e, calculated as follows:
    - The consumables required to use a disposable bedpan was identified as in benefit stream 4.
    - The carbon footprint of consumables (0.35kgCO_2e) was identified as:
        - Disposable bedpan liner: 0.06kgCO_2e each (taken from Centre for Sustainable Healthcare & South Warwickshire University NHS Foundation Trust, 2023).
        - Two pairs of gloves: 0.05kgCO_2e for one pair (taken from Rizan et al., 2022).
        - Antimicrobial wipes: 0.12kgCO_2e each (taken from Maloney et al., 2022).
        - Incontinence sheet: 0.12kgCO_2e (taken from Geene, 2023).
- An optimism bias correction factor of 40% was applied to the calculation.

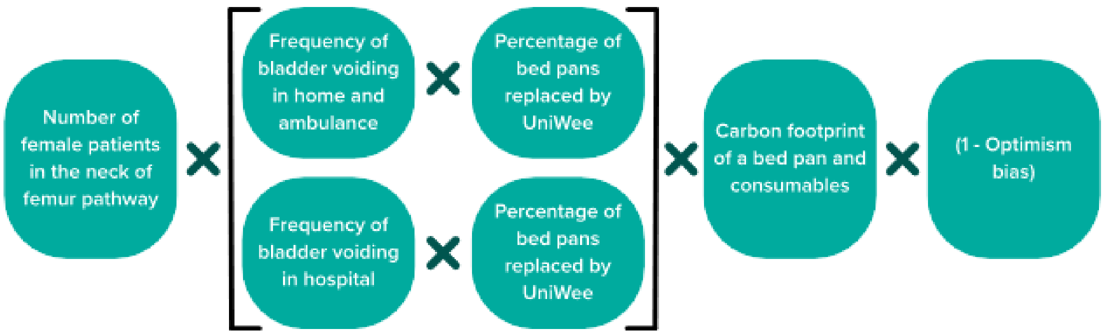


Figure 14: The calculation for stream 2.

Stream 3: A reduction in the number of incontinence pads used by females in the neck of femur fracture pathway due to use of the UniWee, leading to a reduction in kgCO_2e

The calculation for stream 3 was as follows (Figure 15):

- The number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.

- The frequency of bladder voiding was calculated as follows:
    - Home to hospital: 0.26; as identified in benefit stream 3.
    - Hospital: 13.75; as identified in benefit stream 3.
- The proportion of incontinence pads replaced by UniWee at home and in hospital (24%) was calculated as in benefit stream 1a and 1b.
- The proportion of incontinence pads replaced by UniWee in hospital (17%) was calculated as in benefit stream 1c.
- The carbon footprint of an incontinence pad and consumables was estimated at 1.13kgCO_2e, calculated as follows:
    - The consumables required to use an incontinence pad was identified as in benefit stream 3.
    - The carbon footprint of consumables was identified as:
        - Incontinence pad: 0.20kgCO_2e (assumption).
        - Pair of gloves: 0.05kgCO_2e (taken from Rizan et al., 2022).
        - Antimicrobial wipes (3 wipes required; 0.37kgCO_2e): 0.12kgCO_2e each (taken from Maloney et al., 2022).
        - Bedding change: 0.51kgCO_2e (taken from John et al., 2024)
- An optimism bias correction factor of 40% was applied to the calculation.

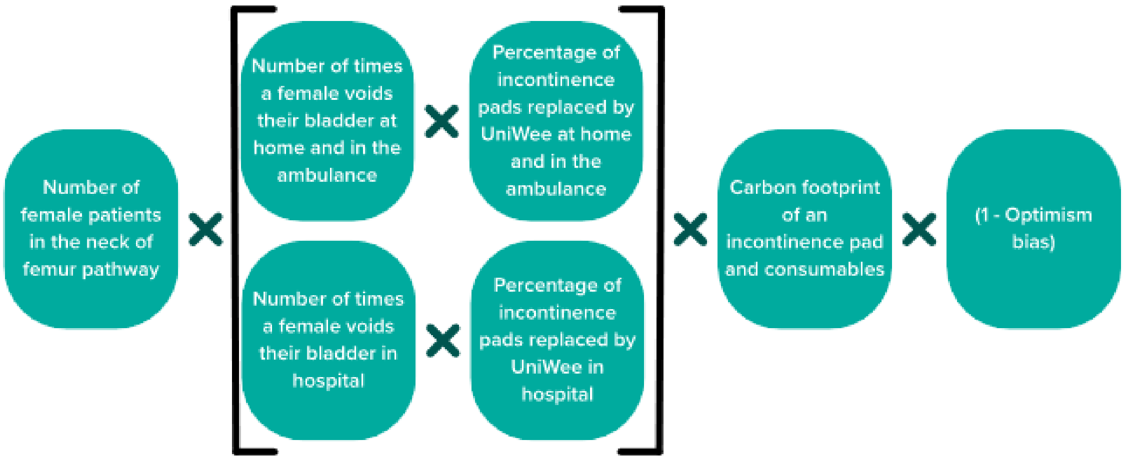


Figure 15: The calculation for stream 3.

Stream 4: Usage of the UniWee ($kgCO_2e$ associated with the use of UniWee products)

The calculation for stream 4 was as follows (Figure 16):

- The number of patients with female genitalia in the neck of femur pathway (320) was calculated as in benefit stream 1a.
- The frequency of bladder voiding was calculated as follows:
  - At home (20%) and in ambulance (6%): 26%, as identified in benefit stream 1a.
  - At hospital: 13.75, as identified in benefit stream 1c.
- The proportion of methods replaced by UniWee (home to hospital: 41%; hospital: 48%) was identified via the pathway mapping exercise.
- The carbon footprint of a UniWee and other consumables was estimated at $0.25kgCO_2e$, calculated as follows:
  - Conversations with a hospital trust identified the consumables required to use a UniWee, as highlighted in cost stream 1.
  - Carbon footprints were identified for each consumable:
    - UniWee: $0.08kgCO_2e$ (taken from Centre for Sustainable Healthcare & South Warwickshire University NHS Foundation Trust, 2023).
    - Incontinence pad: $0.12kgCO_2e$ (taken from Geene, 2023).
    - Pair of gloves: $0.05kgCO_2e$ (taken from Rizan et al., 2022).
- An optimism bias correction factor of 40% was applied to the calculation.

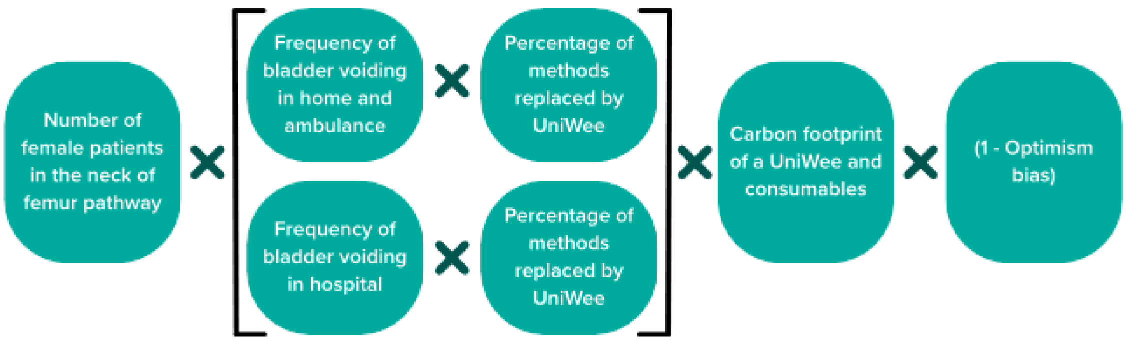


Figure 16: The calculation for stream 4.

Unity Insights

Analytics and evaluation for positive change

unityinsights.co.uk