



A Novel Device to Monitor Gross Hematuria After Urologic Surgery



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Introduction

- Continuous bladder irrigation (CBI) is a common post operative intervention in urologic surgery such as transurethral resection of prostate (Figure 1), and is also used for patients who spontaneously develop significant gross hematuria (Abdelrahman *et al.* 2017)
- The colour of the urine effluent is subjectively assessed, and if urine is too bloody, the rate should be increased, and if it is clear, the rate can be safely reduced
- However, there is no standard metric for nurses or physicians to determine when it is safe to reduce the flow rate of the saline irrigation
 - If the flow of CBI is too low, blood clots can form, blocking the catheter tubing that can cause multiple patient quality and safety concerns
 - Rapid bladder distention and intense urge to void
 - Manual bladder irrigations from nurses or residents which are uncomfortable for patients
 - Bypassing of the catheter with wetting of bed and gown
 - Bladder perforation requiring operative repair
- It is important to ensure that CBI is administered properly, and any issues are addressed urgently to avoid patient morbidity
- Physicians and nurses are not always taught how to perform CBI during their training, with only 5% of doctors, and 35% of nurses having been formally taught this skill throughout their training (Murtaza *et al.* 2015)
- A sensor in the CBI efflux might allow for prediction of developing complication, which will be helpful in communication between nurses and physicians as well as knowing when it is safe to decrease the inflow rate
- There may be a better way to perform CBI which would improve the patient experience and safety profile of the intervention, as well as reduce nursing burden.

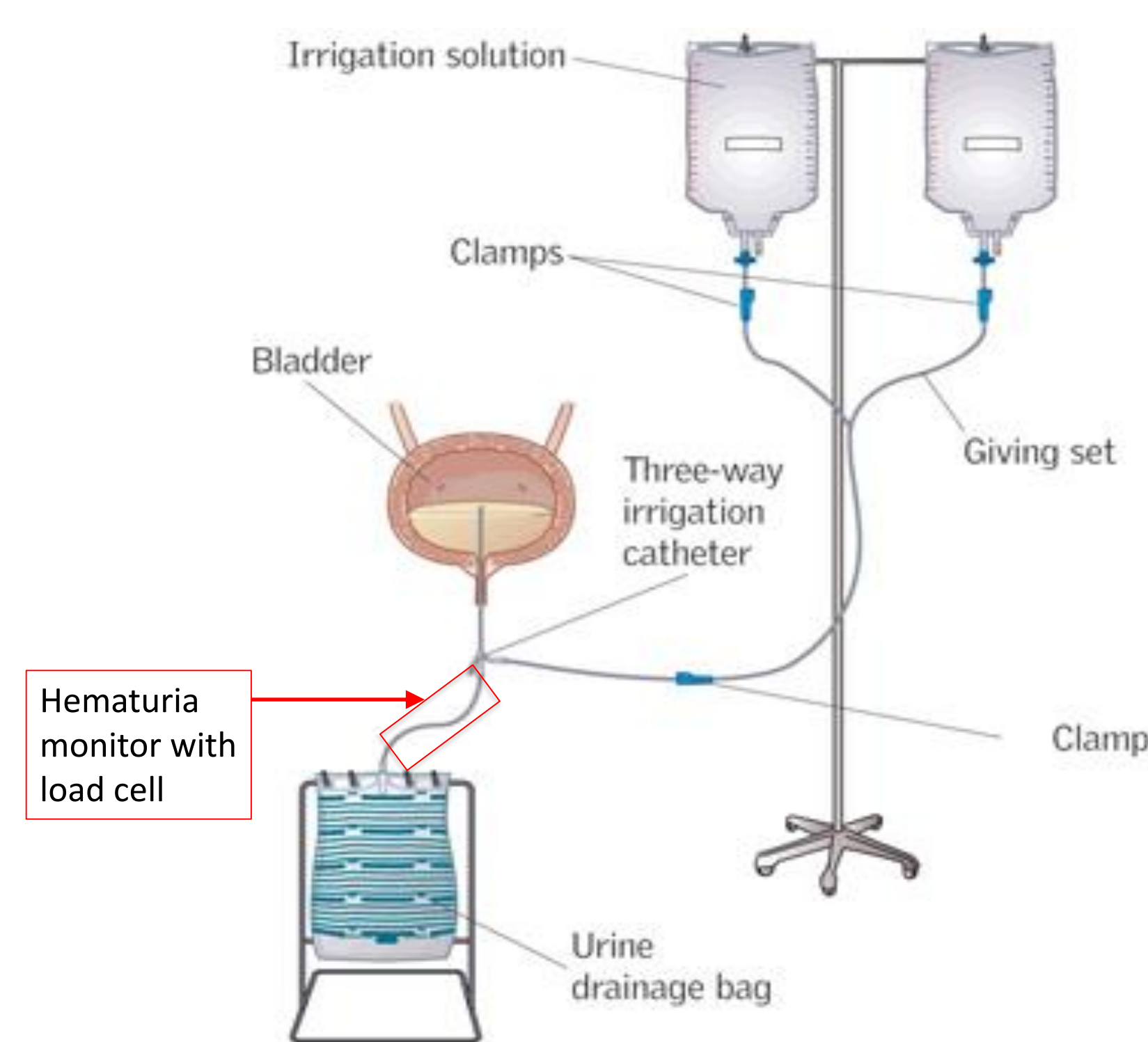


Figure 1. Standard CBI setup with location of novel device on outflow tube

Objectives

- AIM1: Our project aims at assessing nurses' comfort with the current methods of continuous bladder irrigation and whether there is an unmet need for a more objective way to measure, control, and create alerts for CBI.
- AIM2: We aim to create an affordable and easy to use device that will assess the colour of urine output based on light transmission through catheter tubing and a load sensor that will assess for flow rate.

Methods

- A poll was created to survey nurses on place of work, years of experience, comfort with CBI, and themes around a device which could monitor gross hematuria and continuous bladder irrigation
- Contained 15 questions in total and distributed to Clinical Nurse Educators to distribute to the units where nurses use CBI in 2 major hospitals in Vancouver
 - Surgical Wards
 - Medical Wards
 - Post Anesthetic Care Unit
 - Emergency Department
- Anonymized results gathered using an online survey run through Qualtrics®
- Results tabulated using the Microsoft Excel® and the built in Qualtrics® software for analysis and reporting

Results

- 77 responses to survey
- Average length of nursing career was 8.3 years (Range 0.25 to 32 years)
- Nurses who responded were mainly surgical, full time employees, and used CBI at least once per month

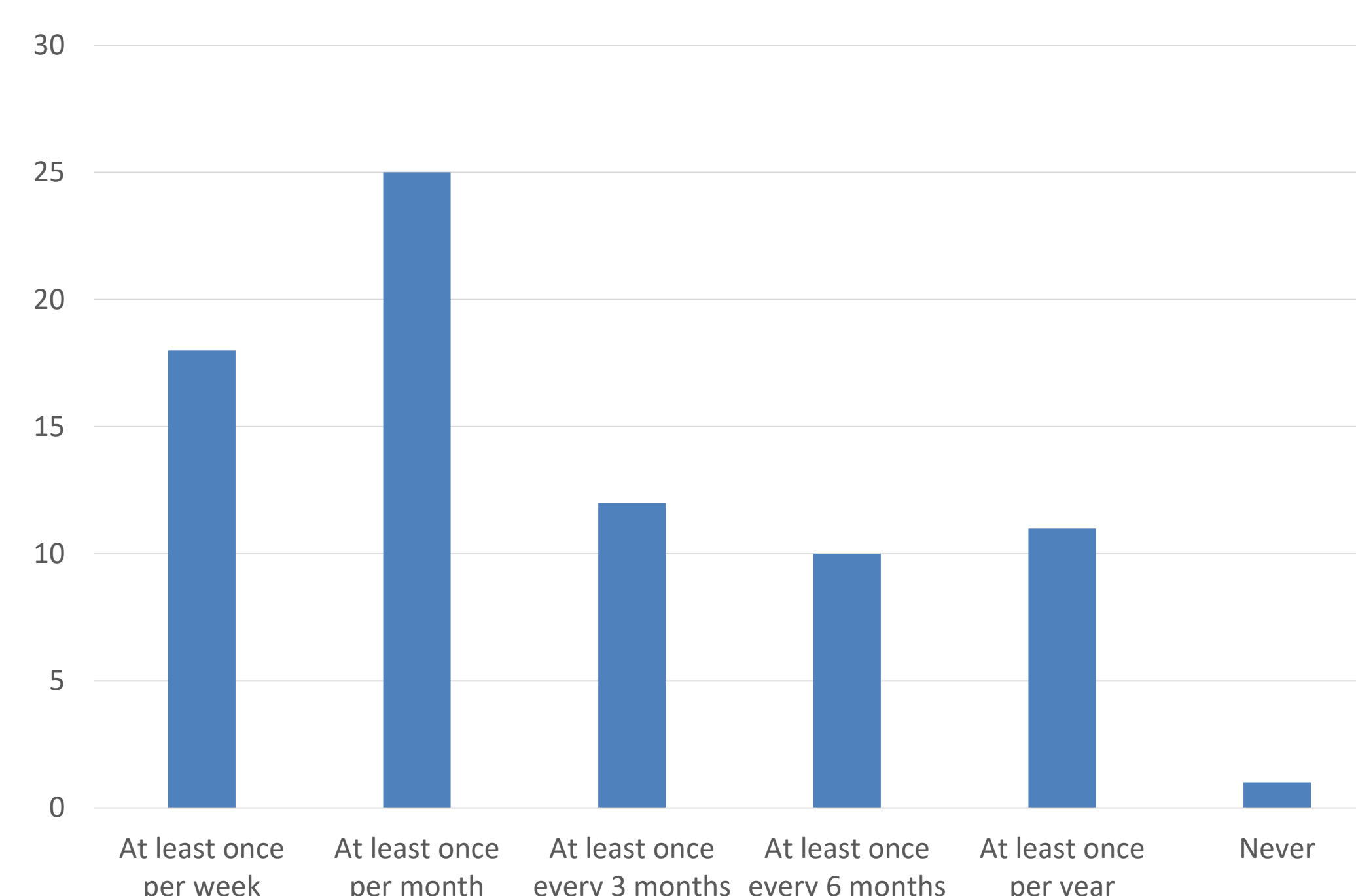


Figure 2. Frequency of CBI use

- 85.7% of nurses agree or strongly agree that they are confident managing a patient on CBI
 - Of those nurses, 54.5% had patients with CBI at least once per month
- 46.8% of nurses agreed or strongly agreed that it is hard to communicate extent of bleeding
 - 77% of nurses on Medical wards agreed or strongly agreed
 - 36% of nurses on Surgical wards agreed or strongly agreed
 - 45% of nurses in the Emergency Department agreed or strongly agreed
- 45.5% of nurses agreed or strongly agreed that it was difficult to know when to call the Urology team to report issues with CBI
 - 84.6% of nurses on Medical wards agreed or strongly agreed
 - 36.4% of nurses on Surgical wards agreed or strongly agreed
- 87.0% of nurses agreed or strongly agreed that managing a patient on CBI is time intensive
- 94.8% of nurses agreed or strongly agreed that a notification system would be beneficial
- 94.8% of nurses agreed or strongly agreed that a CBI automation device would be beneficial
- Only 5.2% of nurses agreed or strongly agreed that the current practice of CBI is ideal

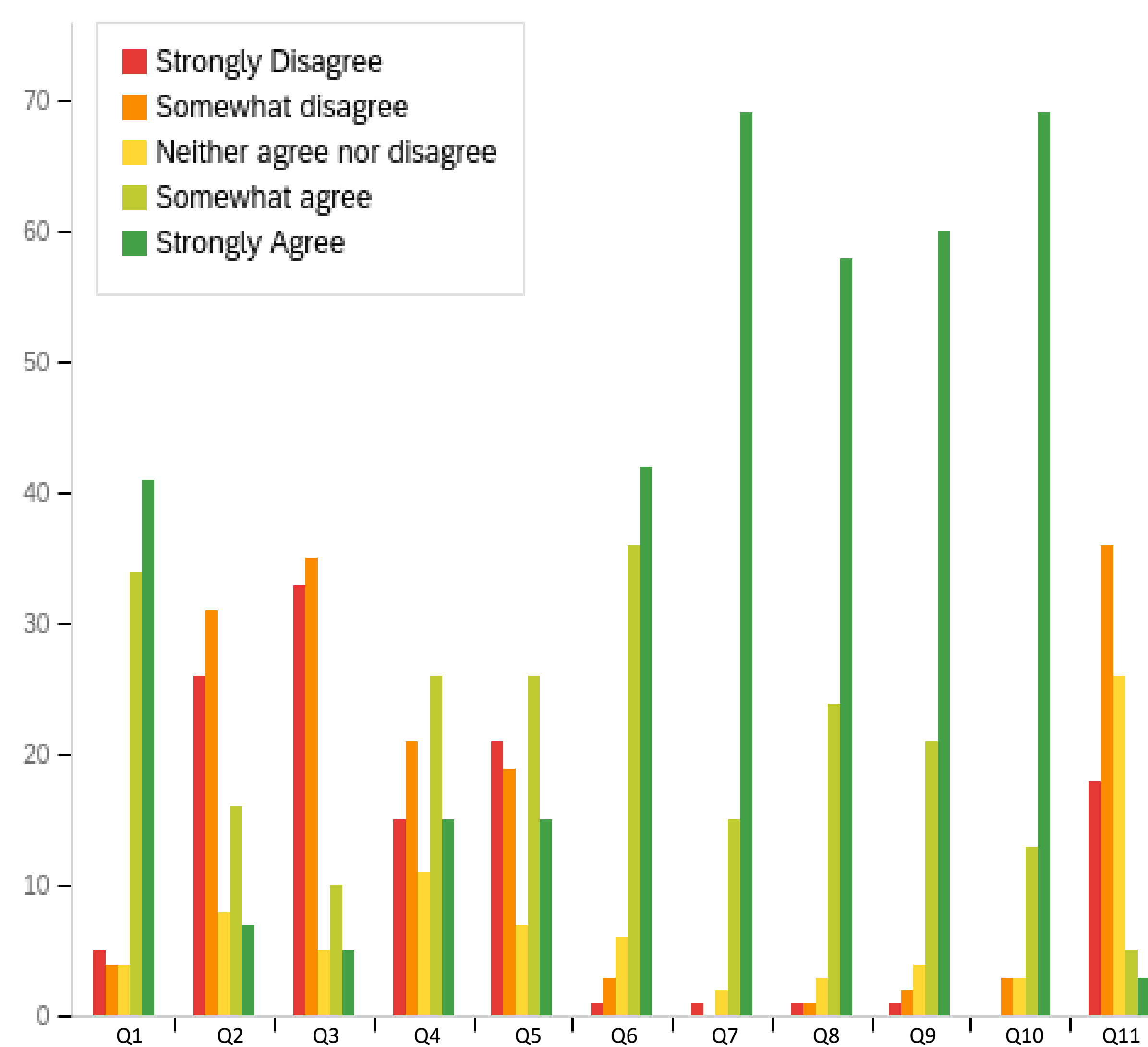


Figure 3. Survey results

Questions:

- Q1 - I feel confident managing patients on CBI
- Q2 - I find it difficult to determine when to increase/decrease flow
- Q3 - I have trouble knowing when the catheter is blocked
- Q4 - It is difficult to relay to the Urology team the degree of bleeding in the catheter on CBI
- Q5 - It is difficult to know when to call the Urology team to report an issue with CBI
- Q6 - Managing a patient on CBI is time intensive
- Q7 - Patients care suffers when CBI issues are not addressed in timely fashion
- Q8 - A notification system for CBI problems would be helpful in managing patients
- Q9 - A reminder for when CBI fluid runs dry would be helpful
- Q10 - An automated device to control CBI would be beneficial
- Q11 - The current methods for monitoring CBI are ideal

Discussion

The Survey

- This is the first survey of frontline providers assessing need for improvements on CBI
- Nurses who use CBI more frequently are more comfortable managing patients on CBI and knowing when to call for help
- Nurses on medical wards were more likely to find it difficult to assess the color of CBI effluent and respond accordingly
- Limitations of this survey include the self reported nature of the survey (ie. Knowledge may not necessarily correlate with experience or comfort level with CBI)

The Device

- After receiving overwhelming support by nursing staff regarding the potential benefit of a device to assist with CBI, construction began on a novel device
- Previous groups have tried to create a device to monitor CBI, but none have been able to incorporate flow rate, colour, and an alert system for nursing staff
 - The proposed device (Figure 4) will incorporate all three
- A study from Ding *et al.* in 2016 on 146 patients used a novel CBI monitoring device which was able to regulate inflow of irrigation fluid based on colour of the outflow
 - This device reduced the total amount of irrigation fluid used, reduced catheter obstructions, and reduced bladder spasms
 - The device was seen to reduce hospital admission duration from 5.9 to 5.4 days which was statistically significant
 - The average length of hospital admission was much longer than our current practice in Canada, indicating that the study may not be applicable to our situation
- The novel device proposed here will have the following differences
 - Load cell to detect flow rate changes
 - Ability to alert nurses in realtime of developing issues with CBI
 - Having outflow colour outside of a preselected tolerable range will trigger an alert
 - Having flow stop without notice will trigger an alert
 - Alerts will be in the form of an alarm, but may eventually be pushed to a central nursing station monitor via bluetooth or WiFi such as ECG monitored beds currently do
 - The device will be cheap to make and end-user friendly

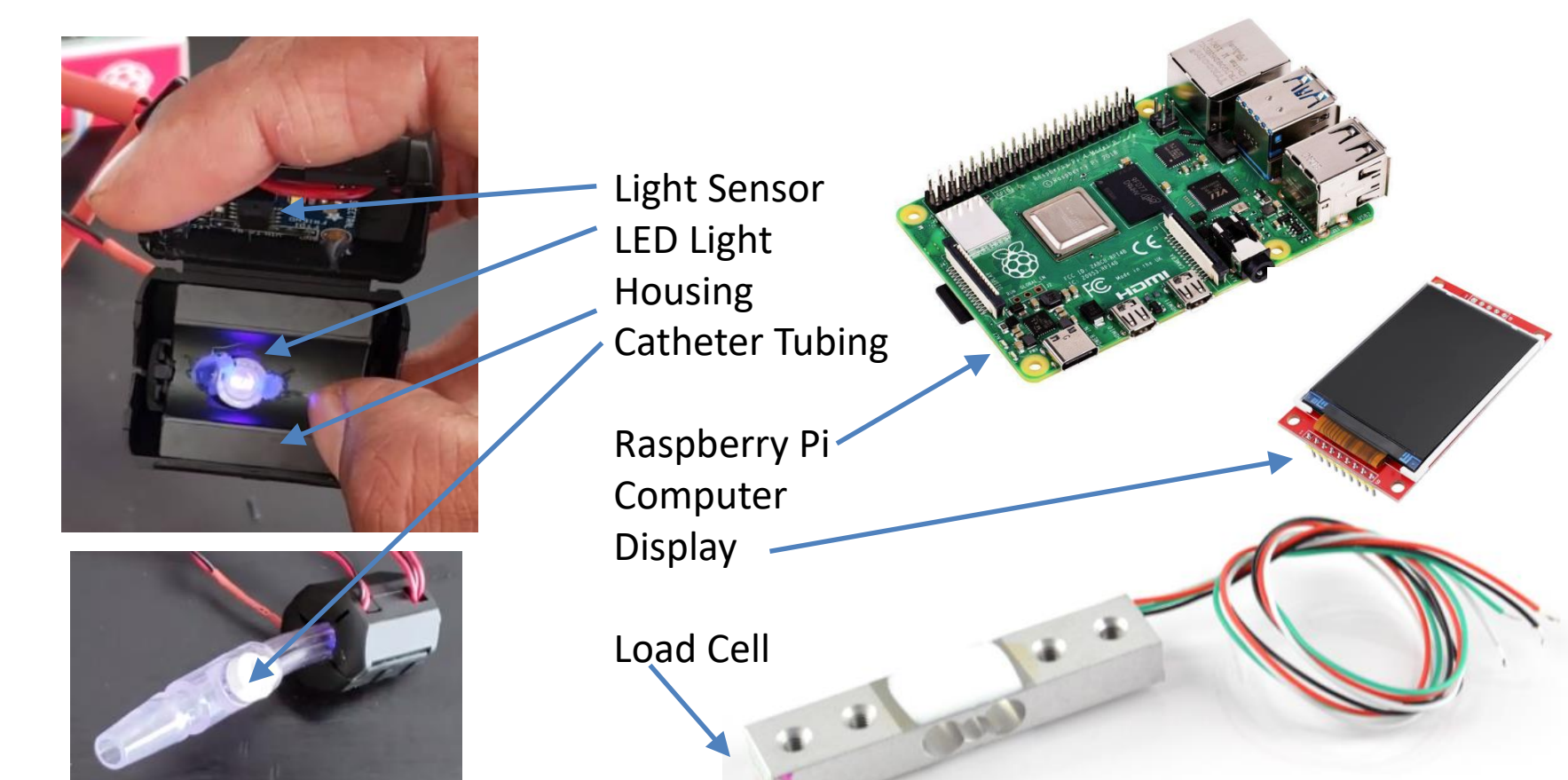


Figure 4. Preliminary prototype for the gross hematuria monitor, separated into components

Conclusions and Future Direction

- The majority of nursing staff agree that a more objective assessment of gross hematuria would be helpful, and a device to assist in CBI may be helpful
- A gross hematuria monitor may be helpful at reducing patient harm while on CBI
 - A study using the completed device analyzing nurses experiences, as well as patient outcomes is warranted
- Field testing of the device will begin on preliminary device for patients undergoing TURP
 - Patient outcomes and length of time on CBI will be used to determine the benefit to nurses and patients
- It is important to note that this device will not replace the clinical decision making of the nursing staff or ordering physicians, but serve as another tool for providers to use during patient care.

References

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