Reducing inappropriate urine testing at Hutt Valley District Health Board using Choosing Wisely principles

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ABSTRACT

AIM: Unnecessary treatment of asymptomatic bacteriuria is a concern. Hutt Valley District Health Board sought to reduce clinically inappropriate urine culture requests through removal of urine dipsticks from wards and education of staff using Choosing Wisely principles. The purpose of this research is to quantitatively evaluate the success of these initiatives.

METHODS: The numbers and results of urine cultures performed for Hutt Valley DHB were analysed, for the period from January 2015 to October 2017. Urinalyses were compared between those designated as 'inpatient' and those as 'outpatient', with the latter being the control of this study. The numbers of primary and secondary coded discharge diagnoses of UTIs were used as a measure of the negative impact of the interventions.

RESULTS: There was a 28% reduction in monthly urine culture requests for inpatients, after staff education and removal of urine dipsticks, with no change in those for outpatients (the negative control). After the intervention, a higher proportion of urine cultures were positive for urinary pathogens (25.2% compared to 23.0%) and the average number of diagnoses of UTI in hospital discharges decreased 17% (from 161 to 134).

CONCLUSION: The removal of urine dipsticks from wards and the education of staff significantly reduced the number of urine culture requests and is a useful strategy to reduce the overuse of antibiotics for asymptomatic bacteriuria without an increase in the number of UTIs. These simple interventions could be used at other hospitals as part of measures to reduce unnecessary care and overdiagnosis.

Choosing Wisely is an international campaign which aims to reduce unnecessary and low-value patient care by encouraging medical colleges and speciality societies to identify clinical practices which should be questioned or avoided. A common recommendation, according to the Australasian Society for Infectious Diseases,[1] the Australian & New Zealand Society for Geriatric Medicine[2] and the Royal College of Pathologists of Australasia[3] is that patients should not be given antibiotics for asymptomatic bacteriuria (ASB) unless pregnant or undergoing a urological procedure.[4–6]
ASB describes a patient with no signs or symptoms of a urinary tract infection but from whom a quantitative count of bacteria ($>10^5$cfu/mL)[7] has been isolated from a urine specimen.[4] Signs and symptoms of a urinary tract infection (UTI) include increased frequency of urination, dysuria, suprapubic pain, fever and haematuria.[5] The distinction between ASB and UTI is important because UTIs can lead to serious complications and are a common condition for which antibiotics are recommended.[5] Antibiotic treatment of ASB is contraindicated, not only because it has no benefit to patients, but also because it is associated with harms, including *Clostridium difficile* infections, an increase in urinary infections,[6] adverse drug reactions and an increase in antibiotic resistance.[8–9]

The Choosing Wisely campaign is especially concerned about unnecessary testing and treatment of ASB due to its high prevalence in hospitals. A study of over 4.4 million

patients admitted to hospitals in the US found that 47% were subject to urinalysis and 27% had their urine cultured.[10] ASB is common, with the prevalence higher for females, the elderly and those with indwelling catheters.[4] The over-testing of patients has led to more than half of urine cultures not being clinically indicated[10] and a third of ASB cases being inappropriately treated with antibiotics against guidelines.[7] A New Zealand study of over-65-year-olds in a secondary level care hospital found that only 22% of all bacteriuria cases were true UTIs and 43% of antibiotic courses prescribed were inappropriate.[11]

At Hutt Valley District Health Board (HVDHB) the Antimicrobial Stewardship (AMS) Team aimed to reduce the number of inappropriate urinalyses for inpatients. The campaign began in March 2016 with the cessation of routine urine testing prior to orthopaedic implant surgery. Other interventions included removal of urine dipsticks from inpatient wards and education of staff about guidelines for diagnosis and treatment of UTIs. A timeline of these interventions is shown in Figure 1.

The aim of this study was to evaluate the progress of HVDHB's Choosing Wisely campaign to reduce the number of inappropriate urinalyses.

Methods

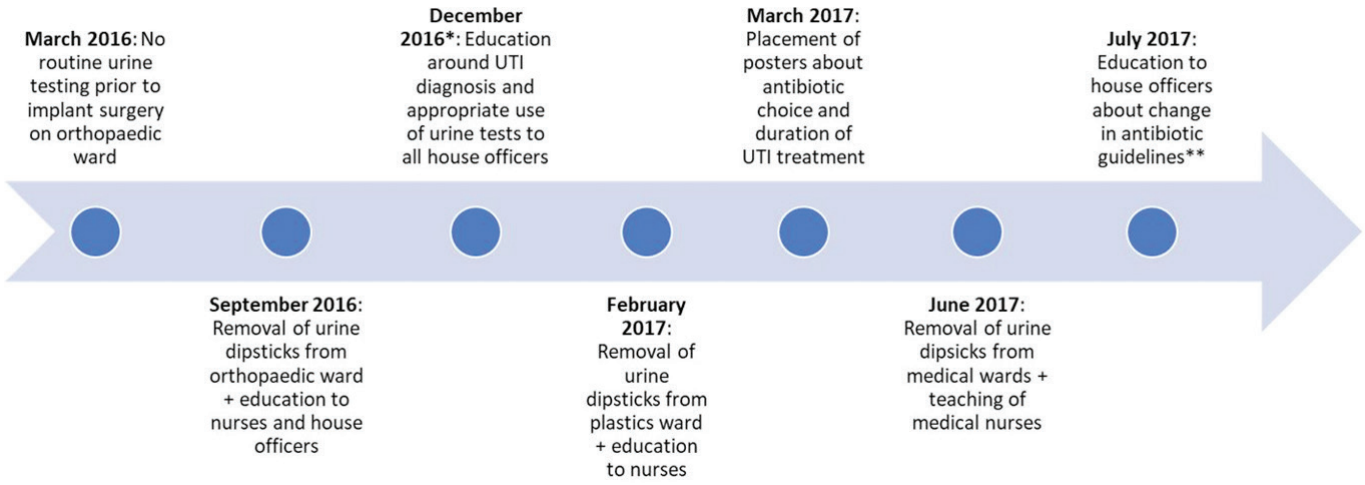
Quantitative data collection

Requests for urinalysis from HVDHB with corresponding urine culture results were obtained for the period January 2015 to October 2017 from the Wellington Southern Community Laboratory (WSCL) database. Urinalysis results from neonatal, paediatric (less than 15 years of age) and mental health services were excluded from the dataset. The setting from which urinalysis requests were made was designated as either 'inpatient' or 'outpatient'.

The interventions to reduce unnecessary urine testing and treatment only involved inpatient wards (orthopaedic, general surgery and gynaecology (GSG), plastics and medical wards) and Medical Assessment and Planning Unit (MAPU)). No specific interventions were done in the emergency department (ED). Intervention was done in MAPU; however, this was the last area targeted and occurred near the end of the study period. Outpatients were the negative control of this study as the outpatient clinics were considered unexposed as they received no formal education from the AMS Team and urine dipsticks were not removed.

Urine culture results were designated as either 'recognised uropathogen' or 'not

Figure 1: A timeline of interventions at HVDHB to reduce inappropriate urinalyses.



*This was repeated September 2017.
**Trimethoprim was removed as first-line treatment for urinary tract infections due to high resistant rates.

significant' based on findings from Blakiston and Zaman[8] and input from infectious diseases physicians at Hutt and Wellington Hospital. In addition to those identified in Blakiston and Zaman,[8] *Aerococcus urinae,* other *Proteus* species, *Raoultella planticola, Staphylococcus lugdunesis, Streptococcus agalactiae, Streptococcus dysgalactiae, Streptococcus pyogenes* and *Trueperella bernardiae* were also classified as 'recognised uropathogens'. All other culture results were classified as 'not significant'.

Additionally, the numbers of primary and secondary coded discharge diagnoses of UTIs were used to assess the negative impact or harm these interventions may have had on patient management. ICD codes used included N39.0—urinary tract infection, site not specified, N30.0—acute cystitis, N30.9—cystitis, unspecified, N30.8—other cystitis.

Statistical analysis

In these statistical analyses the 'intervention' is considered to begin in September 2016 with the first removal of urine dipsticks and education of staff and was applied across all departments due to potential for cross-talk and the fact that registered medical officers (RMOs) can work in multiple wards or clinics.

Monthly and quarterly urine culture request data were analysed by taking the total count of urine culture requests in the period before the first removal of urine dipsticks and education of staff (January 2015 '2015-Q1' to September 2016 '2016-Q3') and using a two-tailed Student t-test to compare to the total count of urine culture requests in the period after the intervention (October 2016 '2016-Q3' to October 2017 '2017-Q3'). A Taylor series was applied for the calculation of 95% confidence intervals for each monthly rate, and the confidence interval for the rate ratio between the unexposed and exposed groups was calculated using the Byar method. Statistical significance is defined as no overlap in the confidence interval and a rate ratio confidence interval that does not include the null value, 1.

This study was approved under a Category B Application by the University of Otago Ethics committee (ref D17/431). All statistical analyses were performed using OpenEpi (www.openepi.com).

Figure 2: Monthly inpatient and outpatient urine culture requests from HVDHB from January 2015 to October 2017.

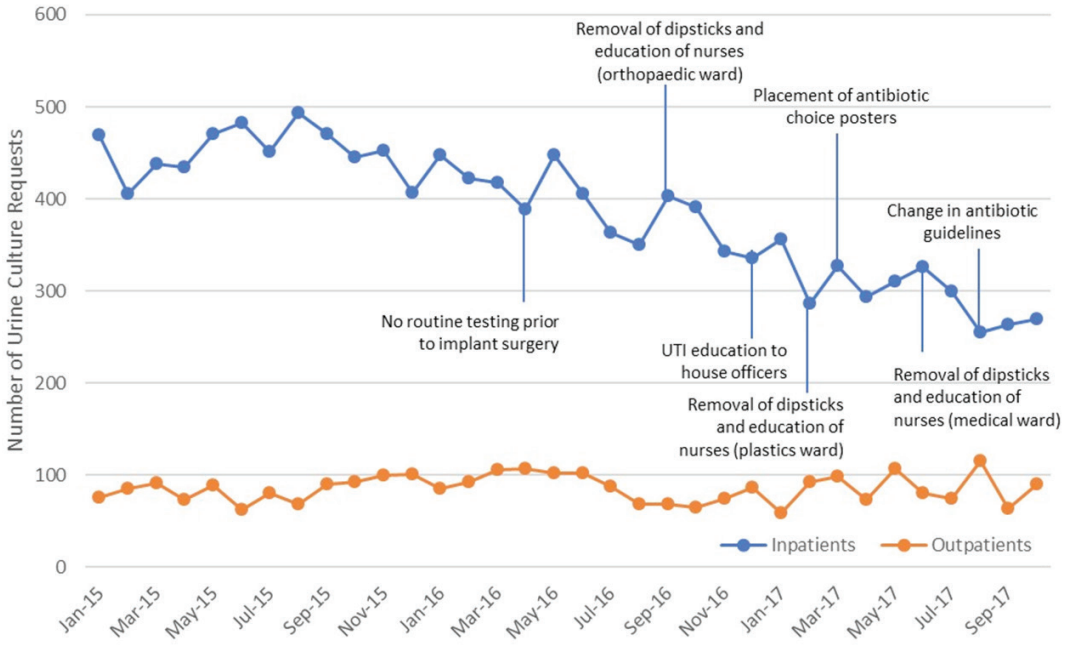


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Table 1: Rates of urine culture requests per month for inpatients and outpatients, before and after the interventions at HVDHB.

Inpatients		
	Jan 2015 to Sept 2016 (before intervention)	**Oct 2016 to Oct 2017 (after intervention)**
Total number of urine culture requests	9,064	4,057
Rate of urine culture requests per month (95% CI in brackets)	432 (423–441)	312 (303–322)
Rate ratio (unexposed cf. exposed group)		0.72 (0.70–0.75)
Outpatients		
	Jan 2015 to Sept 2016 (before intervention)	**Oct 2016 to Oct 2017 (after intervention)**
Total number of urine culture requests	1,820	1,082
Rate of urine culture requests per month (95% CI in brackets)	87 (83–91)	97 (78–88)
Rate ratio (unexposed cf. exposed group)		0.96 (0.89–1.03)

Results

Wellington Southern Community Laboratory data

From January 2015 to October 2017, 18,992 urine culture requests were received by WSCL from HVDHB. After excluding results from patients aged under 15 years and results from mental health services, there were 16,658 urine culture requests.

Analysis of the monthly urine culture requests from HVDHB can be seen in Figure 2 and Table 1. Average monthly urine culture requests for inpatients dropped 28% from 432 before interventions began to 312 after September 2016. For outpatients (negative control) there was no statistically significant change over the same period.

The laboratory listed price for a urine test is currently $29 per test. When comparing pre- and post-intervention inpatient urine test requests, this equates to an annual savings of $41,760. These savings do not include the additional savings made by reducing nursing workload or the costs of urine dipsticks or antibiotics.

Figure 3: Quarterly (Q) urine culture requests from HVDHB for emergency department and medical ward, from 2015-Q1 to 2017-Q3.

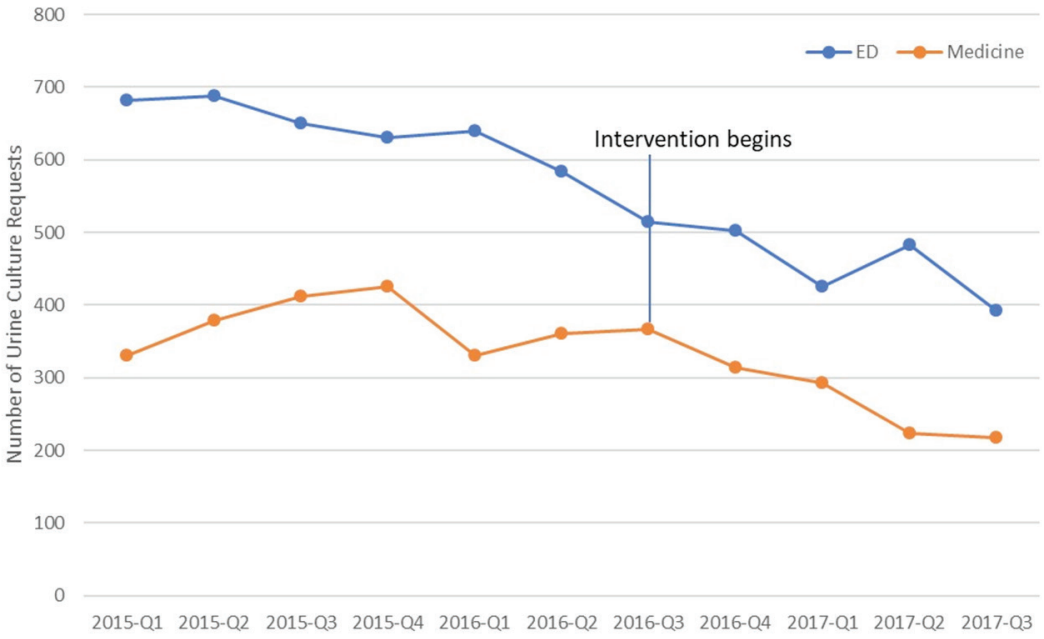

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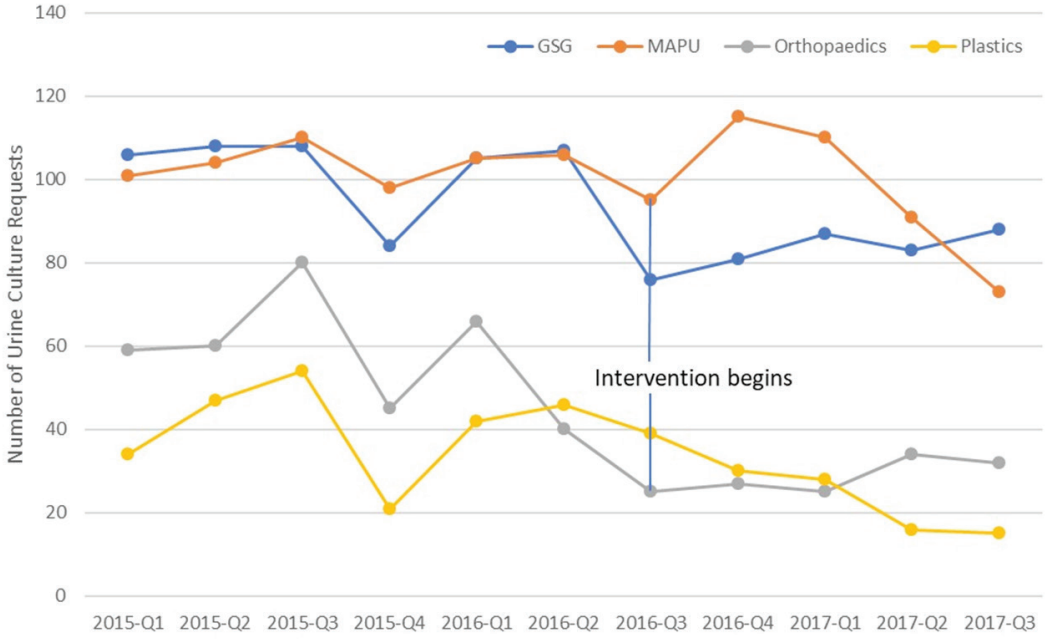
Figure 4: Quarterly urine culture requests from HVDHB separated by inpatient wards, general surgery and gynaecology (GSG), medical assessment and planning unit (MAPU), orthopaedics and plastics, from 2015-Q1 to 2017-Q3.



A comparison between the main areas at Hutt Valley Hospital—ED, medical ward, GSG, MAPU, orthopaedics ward and plastics ward—can be seen in Figures 3 and 4. All departments analysed at HVDHB except for MAPU showed statistically significant decreases in the average number of quarterly urine culture requests before and after September 2016 when interventions began. These decreases in urine culture requests ranged from 15% to 45%. MAPU showed a late trend for decreasing requests (Figure 4). Data values can be found in Appendix 1.

The proportion of urine cultures which grew recognised uropathogens increased following the intervention (Figure 5). Data

Figure 5: Proportion of positive urine culture results from HVDHB each quarter from 2015-Q1 to 2017-Q3.

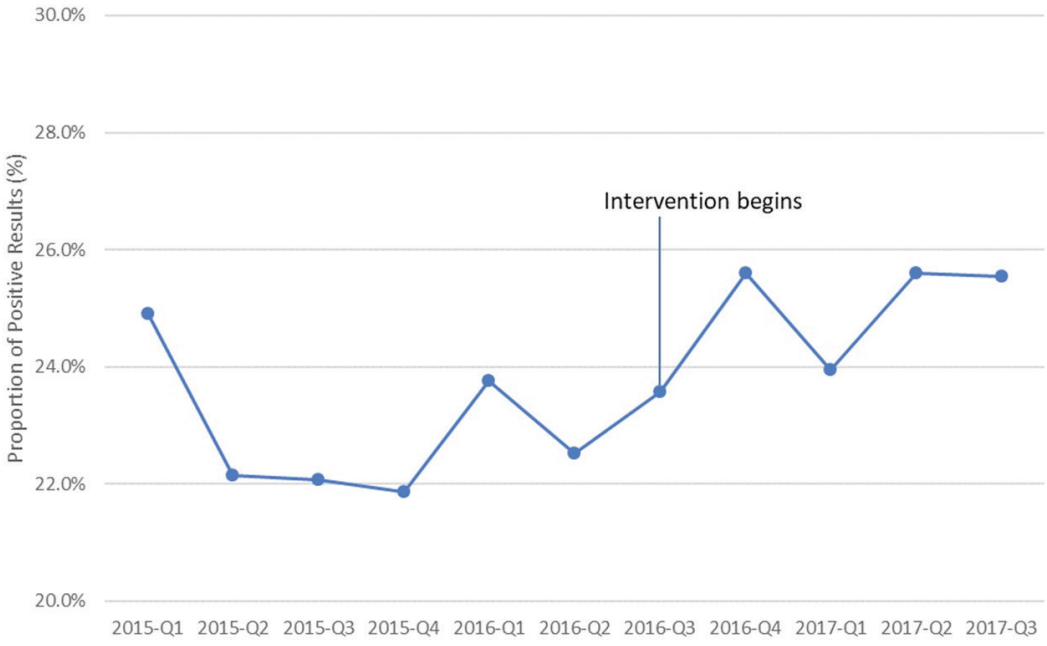


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Table 2: Mean proportion of positive urine culture results before interventions began at HVDHB and after.

	2015-Q1 to 2016-Q3 (before intervention)	2016-Q4 to 2017-Q3 (after intervention)
Mean proportion of positive urine culture results (95% CI in brackets)	23.0% (21.9–24.1%)	25.2% (24.4–26.0%)
Mean difference		2.2 (0.8–3.6)
P-value (two-sample independent T-test)		0.006

shown in Table 2 shows a statistically significant increase with a mean difference of +2.2% before and after the intervention.

Primary and secondary coded discharge diagnoses of urinary tract infections

Figure 6 and Table 3 show that the average number of primary and secondary diagnoses of UTI fell from 161 to 134 before and after interventions began, representing a decrease of 17%.

Discussion

The 28% reduction in monthly urine culture requests for inpatients between January 2015 and October 2017 demonstrates significant progress towards reducing the number of unnecessary urine tests and subsequent overtreatment. While not all inpatients wards have had urine dipsticks removed, they were all analysed together for two reasons: The AMS Team are only targeting inpatients with their ongoing interventions; and due to staff cross-talk and house officers working across multiple wards, all inpatient wards were likely to be affected by interventions. No significant change in the volume of monthly urine culture requests was seen for outpatients, which suggests that the reduction in urine testing in inpatients was due to the interventions implemented in the wards. However, which specific aspect of the intervention had the biggest effect is unknown.

The orthopaedics, plastics and medical wards (where urine dipsticks were removed, and nurses were educated further

Figure 6: Quarterly primary and secondary diagnoses of urinary tract infections at HVDHB between 2015-Q1 and 2017-Q3.

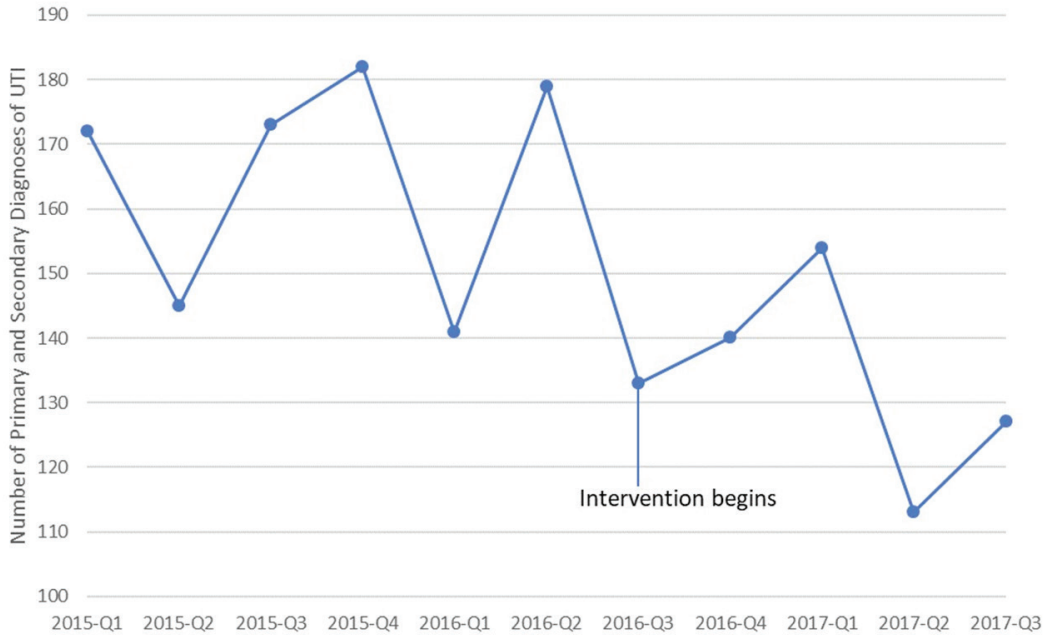

Table 3: Rates of primary and secondary urinary tract infection diagnoses per quarter before and after interventions begun at HVDHB.

	2015-Q1 to 2016-Q3 (before intervention)	2016-Q4 to 2017-Q3 (after intervention)
Total number of primary and secondary UTI diagnoses	1,125	534
Rate of UTI diagnoses per quarter (95% CI in brackets)	161 (152–170)	134 (122–145)
Rate ratio (unexposed cf. exposed group)		0.83 (0.75–0.92)

around urine testing) showed the greatest decrease in urine culture requests compared to areas where dipsticks were not removed. The emergency department—not specifically targeted by the intervention—also showed reductions, and this could be explained by: a flow of information between staff of different departments; the fact that house officers from all departments were educated as part of the intervention; the effect of educational posters around the hospital; and/or further factors not identified by this study. It is unclear why emergency department appeared to have been trending down prior to the intervention. Because we did not investigate this specifically, any explanation would be speculative, such as the possibility that practice was already changing due to the fact that avoiding treatment of asymptomatic bacteriuria was a Choosing Wisely message of several speciality groups. Rates of urine dipstick testing in MAPU did not change, but this area was only targeted at the end of the study period.

While a reduction in unnecessary urine testing is desired, it is important that patients with a legitimate indication for testing were still tested. The statistically significant increase of 2.2% in the proportion of urine culture with recognised uropathogens suggests that it is more likely that urine tests have been requested for patients presenting with signs and symptoms of UTIs.

Two possible conclusions could be drawn from the decrease in the number of primary and secondary coded diagnoses of UTIs. Either the decrease in urine culture requests has caused patients to not have their UTI diagnosed, or there is a decrease in inappropriate diagnoses of UTI. Given that the proportion of urine cultures with significant uropathogens increased over the two-year period, this suggests that there were fewer urine tests being performed on patients who had no urinary symptoms. It is possible that due to the improved education at HVDHB there is better understanding of ASB, which has led to fewer misdiagnoses of UTIs. The overall 28% reduction in urine tests is consistent with the expected proportion of inappropriate urine tests as demonstrated in other New Zealand and international research.[7,10–11] The AMS team were not made aware of any cases of harm resulting from urine testing not being performed.

Policy implications

There is a worldwide tendency to over-test and over-treat UTIs, especially asymptomatic bacteriuria in the elderly despite evidence-based guidelines. Our study illustrates the effectiveness of a simple bundle of interventions on the number of urine culture requests. By removing urine dipsticks from hospital wards, along with education to staff around the reasons behind this intervention, significant reductions in urine culture requests can be achieved. This is an effective, inexpensive and straightforward intervention that could easily be implemented in other hospitals as a Choosing Wisely initiative. As urine dipsticks are one trigger for unnecessary urine culture testing and subsequent unnecessary antibiotic treatment, the removal of these dipsticks contributes to the goal of reducing overdiagnosis and unnecessary treatment. This is likely to reduce harm to patients, as some of those who are misdiagnosed with UTI and treated unnecessarily with antibiotics will go on to experience complications from this

treatment. In addition, there is a broader population benefit in terms of combatting antimicrobial resistance through reducing inappropriate use of antibiotics, as well as more efficient use of New Zealand's public health resources by reducing wasteful testing and treatment.

Strengths and limitations

The major strength of this study was the ability to retrieve data for every urine culture requested by HVDHB from January 2015 to October 2017. This allowed for accurate reporting of trends over time. The main drawback was the inability to link urine culture data to patient details due to extensive labour that would have been required. This meant that it was only possible to categorise the culture results as 'recognised uropathogen' and 'not significant', where 'recognised uropathogen' will have included causes of both UTIs and ASB. We were unable to assess for any unintended negative implications of the interventions, for example in terms of patients with a genuine UTI missing out or having delayed treatment. We did not investigate whether there were any differences in results for patients based on age, sex or ethnicity.

Future research is needed to better gauge staff opinions towards Choosing Wisely, and whether they believe these recommendations to reduce unnecessary care are improving patient management. This will require larger sample sizes and looking at focus groups or one-on-one interviews.

Conclusion

The results of this research indicate that HVDHB significantly reduced the number of urine tests, and likely the number of unnecessary urine tests, through the removal of urine dipsticks from hospital wards and the education of staff through a Choosing Wisely initiative.

Appendix

Appendix 1: Rates of urine culture requests per month for the emergency department (ED), medical ward general surgery and gynaecology (GSG), medical assessment and planning unit (MAPU), orthopaedics and plastics ward, with comparisons made between the periods before and after interventions started at HVDHB.

ED		
	2015-Q1 to 2016-Q3 (before intervention)	**2016-Q4 to 2017-Q3 (after intervention)**
Total number of urine culture requests	4,387	1,804
Rate of urine culture requests per quarter (95% CI in brackets)	627 (608–646)	451 (430–472)
Rate ratio (unexposed cf. exposed group)		0.72 (0.68–0.76)
Medical ward		
	2015-Q1 to 2016-Q3 (before intervention)	**2016-Q4 to 2017-Q3 (after intervention)**
Total number of urine culture requests	**2,606**	1,048
Rate of urine culture requests per quarter (95% CI in brackets)	**372 (358–387)**	262 (246–278)
Rate ratio (unexposed cf. exposed group)		0.70 (0.66–0.76)

Appendix 1: Rates of urine culture requests per month for the emergency department (ED), medical ward general surgery and gynaecology (GSG), medical assessment and planning unit (MAPU), orthopaedics and plastics ward, with comparisons made between the periods before and after interventions started at HVDHB (continued).

GSG		
	2015-Q1 to 2016-Q3 (before intervention)	**2016-Q4 to 2017-Q3 (after intervention)**
Total number of urine culture requests	694	339
Rate of urine culture requests per quarter (95% CI in brackets)	99 (92–107)	85 (76–94)
Rate ratio (unexposed cf. exposed group)		0.85 (0.75–0.97)
MAPU		
	2015-Q1 to 2016-Q3 (before intervention)	**2016-Q4 to 2017-Q3 (after intervention)**
Total number of urine culture requests	719	389
Rate of urine culture requests per quarter (95% CI in brackets)	103 (95–111)	97 (88–107)
Rate ratio (unexposed cf. exposed group)		0.95 (0.84–1.07)
Orthopaedics		
	2015-Q1 to 2016-Q3 (before intervention)	**2016-Q4 to 2017-Q3 (after intervention)**
Total number of urine culture requests	375	118
Rate of urine culture requests per quarter (95% CI in brackets)	54 (48–59)	30 (24–35)
Rate ratio (unexposed cf. exposed group)		0.55 (0.45–0.68)
Plastics		
	2015-Q1 to 2016-Q3 (before intervention)	**2016-Q4 to 2017-Q3 (after intervention)**
Total number of urine culture requests	283	89
Rate of urine culture requests per quarter (95% CI in brackets)	40 (36–45)	22 (18–27)
Rate ratio (unexposed cf. exposed group)		0.55 (0.43–0.70)

Competing interests:
Dr Matthew Kelly, whose interventions were being evaluated, assisted in data analysis. Dr McBain and Mr Wilson report grants from Council of Medical Colleges during the conduct of the study.

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