BMJ Open

Implementation of an intervention to reduce urine dipstick testing in aged care homes: a qualitative study of enablers and barriers, and strategies to enhance delivery

Lyn-li Lim ,[1,2] Kate Williams,[3] Jill J Francis,[4,5] Melanie Wroth,[6] Juanita Breen[7,8]

To cite: Lim L, Williams K, Francis JJ, *et al*. Implementation of an intervention to reduce urine dipstick testing in aged care homes: a qualitative study of enablers and barriers, and strategies to enhance delivery. *BMJ Open* 2024;**14**:e081980. doi:10.1136/bmjopen-2023-081980

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2023-081980).

Received 10 November 2023
Accepted 11 February 2024

For numbered affiliations see end of article.

Correspondence to
Dr Lyn-li Lim;
lynli.lim@mh.org.au

ABSTRACT

Objective The 'To Dip or Not to Dip' (TDONTD) intervention aims to reduce antibiotic prescribing for urinary tract infection (UTI) by reducing low-value dipstick testing. The aims of this study were to use a qualitative approach to (1) evaluate potential influences on the delivery of the TDONTD intervention in Australian residential aged care homes (RACHs) by identifying perceived barriers and enablers to delivery and acceptance; and (2) propose intervention strategies to address barriers and enhance enablers.

Design A qualitative before–after process evaluation of a multisite implementation study using interviews with nurse and pharmacist implementers.

Setting This study was conducted in 12 Australian RACHs.

Participants Participants included 17 on-site nurse champions and 4 pharmacists (existing contracted providers).

Intervention Resources from England's TDONTD intervention were adapted for an Australian context. Key resources delivered were case-based education, staff training video, clinical pathway and an audit tool.

Results Key barriers to TDONTD were beliefs about nursing capabilities in diagnosing infection, beliefs about consequences (fear of missing infection) and social influences (pressure from family, doctors and hospitals). Key enablers were perceived increased nurse and carer knowledge (around UTI and asymptomatic bacteriuria), resources from a credible source, empowerment of nurse champions to apply knowledge and skills in delivering operational change initiatives, pharmacist-delivered education and organisational policy or process change. Of TDONTD's key components, the clinical pathway substituted dipstick testing in diagnosing UTI, delivery of case-based education was enhanced by their attendance and support of the intervention and the antibiotic audit tool generated feedback that champions shared with staff.

Conclusions Our study confirms the core components of TDONTD and strategies to enhance delivery and overcome barriers. To further reduce barriers to TDONTD, broader advocacy work is required to raise awareness of dipstick testing as a low-value test in older persons and by linking it to healthcare professionals and consumer education.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This is the first known study to undertake a qualitative evaluation of an intervention to improve antibiotic prescribing for urinary tract infections by reducing low-value dipstick testing in aged care homes.
⇒ We report on barriers to delivery and how the key components of the intervention worked mapped to the Theoretical Domains Framework.
⇒ Strategies are proposed to support implementers in enhancing delivery and effectiveness of the intervention.
⇒ Limitations include no control group and sustainability of intervention impact was not assessed.

INTRODUCTION

Antimicrobial resistance (AMR) is a global threat driven by excessive antimicrobial use.[1] Rates of AMR in Australian residential aged care homes (RACH) are higher than in community or hospital settings.[2] Antibiotic usage in Australian RACHs is increasing, with regional variation and inconsistency in prescribing patterns unrelated to prevalence of conditions that increase risk of infection.[3] Urinary tract infection (UTI) is the most common infection treated with antibiotics in Australian RACHs; broad-spectrum antibiotics are prescribed for UTI prophylaxis and treatment, and for asymptomatic bacteriuria (ASB).[4 5]

The 'To Dip or Not to Dip' (TDONTD) intervention aims to reduce antibiotic prescribing for UTI. Since its introduction into England's care homes in 2015,[6] it has now been successfully expanded to other healthcare settings.[7 8] Based on this success, the Aged Care Quality and Safety Commission, Australia's aged care regulator, launched a campaign in October 2020 to focus on antimicrobial stewardship

(AMS), offering adapted TDONTD resources to Australian RACHs.[9]

TDONTD aims to reduce inappropriate antibiotic use for UTIs and conditions that do not require antibiotics, such as ASB, by changing staff urine dipstick testing behaviour. It was proposed that this intervention would be effective in Australian RACHs, where dipstick testing is often unnecessarily performed and positive test results lead to initiation of antibiotics.[10] Nurses are strong influences on prescribing and infection management,[10] with general practitioners (GPs), responsible for prescribing, often off-site and reliant on nursing assessments.

Behaviour change theory (BCT) explores the application of evidence-based practice to identify key determinants of behaviours[11] and forms the basis of TDONTD.[12] BCT can be mapped to the Theoretical Domains Framework (TDF), a research framework consisting of domains that summarise perceived influences (ie, barriers and enablers) on behaviours.[13] The TDF is used to design data collection materials (eg, interview guides and questionnaires to explore these domains), as a coding framework for qualitative analysis, and to design effective strategies to support practice change among healthcare professionals.[14]

The aims of this study were to use a qualitative approach based on the TDF to (1) evaluate potential influences on the delivery of the TDONTD intervention in Australian (RACHs) by identifying perceived barriers and enablers to delivery and acceptance; and (2) propose intervention strategies to address barriers and enhance enablers.

METHODS

Design and setting

A qualitative before–after process evaluation of an implementation study was undertaken in 12 Australian RACHs using interviews with nurse and pharmacist implementers. Baseline and follow-up antibiotic audits were also conducted.

Inclusion criteria: Australian Government funded RACH. Exclusion criteria: Nil.

Intervention and delivery

Resources were adapted from England's TDONTD intervention.[7 12] The clinical pathway was developed from the Therapeutic Guidelines: Antibiotics,[15] the most widely accepted Australian guideline for managing aged care residents with suspected UTI. Clinicians following the pathway could consider dipstick testing to rule-out UTI, but only after considering alternative diagnoses.

Australian resources for TDONTD delivery were Commission branded.[9] Resources that supported core requirements for delivery were the case-based education, staff training video, clinical pathway and an audit tool. Additional resources comprised a flyer explaining TDONTD, posters on hydration and dipstick testing, and a consumer brochure explaining ASB and antibiotic risks. Champions were provided with a facilitator guide to case-based education and guide to using the clinical pathway.

A pragmatic approach to delivery was used, with delivery of key resources within a 6-month period the only core requirement. Researchers presented all resources to implementers and described how they should be used. Nurse champions were on-site nursing staff who coordinated local planning and delivery. Pharmacists were existing contracted providers, involved in medication governance, education and training activities. Pharmacists facilitated case-based education and supported TDONTD as required. A TDONTD resource pack was provided to champions for GPs.

Sampling and recruitment

The study was conducted between November 2021 and July 2022. Recruitment involved identifying pharmacists providing services to RACHs. Expressions of interest were sought from three pharmacists and a pharmacy service provider organisation. Researchers approached facility managers of RACHs suggested by pharmacists. Of 12 homes initially approached, 2 withdrew and were replaced before the project began.

The sample of RACH implementers included 17 nurses from 12 homes and 4 pharmacists.

Data collection

Interview guides (online supplemental files 1 and 2) were informed by the TDF domains[13] and literature reviews.[10 16–18] Overall content was not restricted by TDF to allow for the emergence of unanticipated topics during the interviews.[19] One or more open-ended questions were developed for each theoretical domain. Questions were iteratively reviewed by the team to ensure that target behaviours were appropriately captured and domains covered. In the final version, questions relating to four domains were omitted (intentions, goals, emotions and behavioural regulation) to further focus on exploring domains considered more relevant to the target behaviour. Semistructured components were developed from open-ended questions for each theoretical domain. The interview schedule was iteratively reviewed to ensure that target behaviours were appropriately captured, and for comprehensibility and clarity. The semistructured interview schedule allowed interviewers to ask follow-up questions to explore TDF domains such as knowledge, skills, professional role and identity around urine dipstick testing, infection detection and management and beliefs about capabilities in delivering quality improvement interventions and education. At follow-up, the interview schedule also allowed interviewers to ask follow-up questions to explore beliefs about capabilities, consequences, environmental context and resources including TDONTD, social influences and behavioural regulation.

Two interviews were conducted with nurse champions and pharmacists at each facility: at baseline and after 3–6 months of each facility's project initiation. Online interviews were undertaken by a trained facilitator

(LLL or JB), with an observer present. Transcripts were produced from observer documentation, with additional field notes by the facilitator, after cross-checking to ensure triangulation and concurrence of accounts.

Antibiotic audit data were collected by nurse champions and/or pharmacists using the TDONTD audit tool[9] at baseline, and 3 and 6 months.

Analysis

From the interviews, perceived enablers and barriers to delivery of TDONTD were identified using reflexive thematic analysis, allowing exploration of target behaviours without strict theoretical constraints.[20] Researchers (LLL, JB, KW) familiarised themselves with the interviews, made notes and discussed findings. Two researchers (LLL, JB) independently coded transcripts, shared codebooks and then discussed until a high level of consensus was achieved. Disagreements were resolved by discussion with a third person (KW). Using a hybrid inductive and deductive approach, emerging themes were hierarchically coded on NVivo V.12[21] and organised into themes and subthemes, then mapped and interpreted. As themes were identified, they were cross-checked, and consensus was reached through discussion. Exemplar quotations supporting themes were captured by one researcher (LLL).

Researchers (LLL, JB, KW) then related these themes to the TDF domains[13] and mapped them to selected implementation strategies identified as relevant to AMS behaviour change in aged care.[22] To ensure key intervention components were reported, the Template for Intervention Description and Replication (TIDierR) checklist[23] was applied to findings.

Researchers undertook analyses of submitted deidentified audit data to report 1-day point prevalence of oral antibiotic use in the home, use for urinary tract conditions, appropriateness of prescribing for urinary tract indication and duration (where appropriateness was assessed against national guidelines[15]).

Patient and public involvement

None.

RESULTS

Facility, nurse champion and pharmacist demographics are presented in table 1. Champions were experienced in delivering new clinical processes, and two-thirds had formal training in infection prevention and control equivalent to a postgraduate tertiary degree. Pharmacists were experienced in educating RACH nurses and had established relationships with facility staff. Pharmacists

Table 1 Facility and participant characteristics

Facility characteristics (n=12)	
Location (Australian jurisdiction, number of homes)	Queensland—8, Victoria—4 Metropolitan—7, Regional/Rural—5
Size (number of beds) Breakdown by facility size	Median- 76 beds ► Up to 40 beds—1 (40 beds) ► 41–100 beds—6 (range 51–90 beds) ► 101–150 beds—2 (range 105–107 beds) ► >150 beds—3 (range 176–183 beds)
Type	► Not for profit (religious, charitable or community)—10 (2 dementia-specific homes) ► For profit—2
Participant characteristics	
Nurse champions (n=12, at baseline)*	*Role* 58% Infection Prevention and Control Lead† 42% Clinical manager/Director of Nursing/Clinical care coordinator *Experience and training* Number of years working in residential aged care: 5–32 (median 12) 67% Formal training in antimicrobial stewardship Previous experience in receiving or delivering antimicrobial stewardship education or training to aged care clinicians: ► 50% informal feedback and education to staff ► 50% formal education session for staff ► 25% modules on eLearning platforms
Pharmacist champions (n=4)	*Experience as quality use of medicines pharmacist*‡- 15–40 years (median 31) *Experience in delivering activities*: ► 100% Member of Medication Advisory Committee in facility ► 100% Develop policy and procedure ► 100% Education ► 100% Auditing

*At follow-up, five new champions were interviewed due to staffing changes.
† Goverment mandate introduced in late 2020 for a nurse who has completed specialist IPC training to lead IPC at the RACH
‡ Quality Use of Medicines pharmacists are funded by the Australian governemment to provide contracted services to RACHs including education, training, support in developing policies and procedures and participate in governance activities.

were all members of the RACH's medication governance committees. A description of TDONTD using the TIDieR checklist[21] is available (online supplemental file 3).

TDONTD core requirements were fully delivered in 10 homes. Case-based education was delivered in 11 homes; it was not delivered in the remaining facility due to competing infection control priorities. The clinical pathway was introduced in 10 homes, but not in 1 due to competing priorities, and 1 dementia-specific site which elected to incorporate elements of the pathway into its existing UTI surveillance tool. Interview results revealed changes to urine dipstick testing practice. At baseline, none of the homes had formal dipstick testing protocols, relying instead on unwritten *agreed practices*. Personal carers commonly initiated dipstick testing. At follow-up, 10 of 12 homes had adopted the TDONTD clinical pathway as the dipstick testing protocol and reported that personal carers no longer initiated dipstick testing. Results of antibiotic prescribing audits at baseline and follow-up have been reported.[8] They showed a reduction in prescribing in oral antibiotics for UTI indications from 3% (baseline) to 2.6% (3 months) and 1.6% (6 months) respectively. For antibiotics used for treatment of UTI, there was an increase in prescribing appropriateness (for indication and duration) from 27% (baseline) to 58% (3 months) and 100% (6 months).

Barriers and enablers to implementation of TDONTD

Barriers and enablers were mapped to behavioural domains from the TDF; barriers mapped to 7 behavioural domains (table 2 and online supplemental file 4) and enablers mapped to 10 behavioural domains (table 3

Table 2 Mapping of TDONTD barriers to Theoretical Domains Framework (TDF) domains—summary findings (detailed findings with mapping to implementation strategies in online supplemental file 4)

TDF domain	Perceived barriers to TDONTD
Professional role and identity	► Nurses do not identify that they have an influential role in – determining the success of an AMS intervention to reduce antibiotic prescribing – changing antibiotic prescribing behaviour of other professional groups for example, doctors – changing urine dipstick behaviour of other professional groups for example, doctors – initiating shared decision-making discussions with residents and families around antibiotic prescribing, as this is the responsibility of the prescriber
Beliefs about capabilities	► Nurses are confident in relying on urine dipstick testing to diagnose UTI ► Nurses are less confident – in clinical assessment of residents with cognitive impairment to diagnose infection without the help of urine dipstick testing – about using clinical pathways to assess residents with cognitive impairment because of difficulty ascertaining symptoms and signs – in interpreting and applying UTI infection surveillance data to improve provision of care – that dipstick practice change and antibiotic overuse could be achieved without GP practice change – that changes to practice and antibiotic use could be achieved without resident and family engagement – in engaging GPs and families around urine dipstick practice change – in engaging peers in practice change if resistance encountered
Beliefs about consequences	The following were barriers, and beliefs that were very strongly held by a minority. ► Concern about potential increase in missed infections ► Concern that reducing dipstick testing would contribute to safety risks such as missing an infection diagnosis ► Concern about peer criticism and judgement ► Concern about criticism from GPs ► Concern about resistance and complaints from families ► Concern about additional work required to use a different process to assess residents for suspected infection ► Concern about sanctions from the regulatory agency for missing infection ► (Less) concern about AMR ► (Less) confident that non-prescriber behaviour would influence antibiotic overuse and AMR
Intentions	► Staff choosing not to use the clinical pathway as it would require more effort to change practice ► Staff resistance to change practice
Social influences	► Family pressure (anticipated or real) on aged care staff to perform dipstick testing to diagnose UTI ► Influential nurse peers reluctant or refusing to change dipstick testing behaviour ► Pressure from GPs requesting aged care staff to perform urine dipstick testing ► External groups (eg, hospitals outreach programmes, dementia support specialists, Emergency Department teams) providing conflicting advice around UTI diagnosis and use of dipstick testing to support diagnosis ► Perceived negative feedback to RACH from external groups.
Goals, including goal priorities	Competing priorities were barriers. These are common reasons identified: response to community COVID-19 or other transmissible infection activity and outbreaks, staff (including nurse champion) turnover.
Emotion	► Fear and anxiety about missing an infection.

AMR, antimicrobial resistance; AMS, antimicrobial stewardship; GP, general practitioner; RACH, residential aged care homes; TDONTD, To Dip or Not to Dip; UTI, urinary tract infection.

Table 3 Mapping of TDONTD enablers to Theoretical Domains Framework (TDF) domains—summary findings (detailed findings with mapping to implementation strategies in online supplemental file 5)

TDF domain	Perceived enablers to TDONTD
1.Knowledge	► Participants strongly expressed opinions that TDONTD provided increased knowledge around UTI, ASB and urine dipstick as a low-value test
Skills	► Nurses have skills in leading operational change initiatives ► Nurse and pharmacists have skills to deliver education on principles of AMS and better use of medicines
Professional role and identity	► Nurses identified that they have an important role in diagnosing and requesting antibiotics to be initiated on residents in a timely fashion
Beliefs about capabilities	► Nurses are confident in introducing and using new initiatives to improve clinical care in settings with competing priorities and little allocated time
Beliefs about consequences	► Belief that TDONTD improves UTI management and evidence-based clinical care ► Belief that urine dipstick testing may result in incorrect clinical diagnoses, which negatively impacts residents
Reinforcement	► TDONTD provides benefits for continuous improvement in the RACH ► TDONTD is endorsed by the Commission as an AMS improvement activity
Intentions	► Champion commitment in time and effort to coordinate and deliver a new initiative ► Facility manager commitment to allocate resources and support intervention
Environmental context and resources	► TDONTD resources and information from a credible source, relevant as education and training material for nurses and personal carers in RACHs ► Clinical pathway provides nurses with an alternative approach to diagnosing UTI instead of performing dipstick testing, and could be used as communication tool at handover or over the phone with GP ► Prompts updating of RACH policies and processes around urine dipstick testing (eg, stop testing asymptomatic residents on admission, routine surveillance, after completing antibiotics for UTI) ► Encourages review of current UTI surveillance approach in RACH, and offers new approach to deliver practice improvements
Social influences	► Supportive facility leadership, a persuasive champion, a nursing and personal carer staff group who is willing to accept TDONTD ► Practice of GPs perceived by nursing staff to be concordant with TDONTD ► Opportunity for staff to discuss impact of practice change and concerns
Behavioural regulation	► Organisational policies and procedures ► Incorporating TDONTD into clinical workflows ► Incorporating TDONTD into existing staff training programme ► Repeating TDONTD training ► External groups ► Updating of advice provided in guidelines and by staff on detection of UTIs and urine dipstick testing ► Updating of forms from software vendors where templates include urine dipstick testing on admission documentation as part of infection screening

AMS, antimicrobial stewardship; ASB, asymptomatic bacteriuria; GP, general practitioner; RACH, residential aged care homes; TDONTD, To Dip or Not to Dip; UTI, urinary tract infection.

and online supplemental file 5). Of note, intentions and behavioural regulation domains emerged in interviews and were included in the analysis.

Key barriers to TDONTD were the beliefs about capabilities of nursing staff (higher confidence in diagnosing UTI using dipstick testing, lower confidence in using clinical assessment only, especially in residents with cognitive impairment), beliefs about consequences (fear of missing infection), social influences (pressure from family, GPs and hospitals to use dipstick testing to detect UTI) and professional role and identity (nurses and pharmacists in aged care are not confident determining the success of an AMS intervention that does not target prescribers).

Key enablers to TDONTD were perception that TDONTD increased nurse and personal carer knowledge (around clinical presentation of UTI, ASB, differential diagnoses for clinical presentations with falls and behaviour change), provision of TDONTD resources from a credible source, that TDONTD delivery empowered nurse champions to apply their knowledge and skills in delivering operational change initiatives, pharmacist skills in delivering education and organisational policy or process changing to align with TDONTD.

Three overarching themes were identified as enablers or barriers to implementation of TDONTD.

Influences on changing practice

Participants acknowledged that reliance on dipstick testing to guide antibiotic prescribing was deeply ingrained.

> It's very hard to get the nurses to not do the dipstick. It's not written policy or process, but we just do it. (Nurse 1)

Conflicting practice and advice from peers, GPs, hospitals and other organisations contributed to the difficulty of changing practice.

> We have been told over the years…to do delirium and dementia behaviour screens which makes you dipstick automatically…dipstick is always the first step. RNs (registered nurses) have…been made to feel bad if they don't dip—it's the path of least resistance. (Nurse 11)

Participants felt that families often requested dipstick testing to reduce diagnostic uncertainty and saw it as contributing to quality of care.

> Sometimes the family demands dipsticks and it's easier just to do it to prevent escalation. (Nurse 12)

TDONTD encouraged conversations between staff and families regarding dipstick testing as a low-value test, use of alternative strategies to diagnose UTI and the risks of unnecessary antibiotic use.

> It is official…the pathway, information, and evidence-based…This helps when explaining it to families. We can say 'it's not that we don't want to collect the urine but…'…This provides (nurses with) confidence and reassurance. (Nurse 5)

Benefits of urine dipstick testing

Urine dipstick testing was seen as an attractive response as it favoured action over inaction.

> Attitudes are hard to change, dipstick is easy to do, we feel like we have a plan, an action and doing something. (Nurse 10)

Nurse champions expressed fears about missing an infection if dipstick testing was not performed, and that these concerns often took precedence over AMS considerations.

> There is this attitude of 'better to be safe than sorry'. They (nurses) don't want to get things wrong. If (the nurses) don't dipstick and it turns out to be a nasty UTI then they are scared they will get in trouble… (Nurse 7)

Some reported that dipstick testing increased diagnostic confidence in ruling-out UTI and some nurses had greater confidence in the test result than in their clinical diagnostic skills.

> New (nursing graduates) find it difficult to identify symptoms. They don't know the resident and they find it just easier to dipstick. (Nurse 5)

Dipstick testing was also favoured for ruling-in UTI for residents who had fallen or with non-specific clinical presentations. A positive test result was described as helping to confirm a diagnosis of UTI, possibly incorrectly, and reinforcing preconceived beliefs about common clinical presentations for UTI.

> There was a resident with frequent falls. Pathway says no dipstick. We did a dipstick which was positive, then MSU, so we diagnosed UTI. (Nurse 1)

Reliance on dipstick testing was increased when staff assessed residents who were unable to reliably express their symptoms.

> If the resident has behaviour change[#], it is probably a UTI. This is the main sign or symptom in our residents… (Nurse 3)
>
> [#]Described by participants as including changes to usual behaviour such as new or increased agitation, confusion, aggression or sleepiness.

Champions found the clinical pathway offered a reasonable alternative to dipstick testing. Nurses were less likely to assume that presentations were due to UTI, and more likely to assess for other causes.

> TDONTD makes you look for other things—in hindsight we didn't do this as much as we should have. (Nurse 11)

Communication with GPs changed, as nurses shifted from requesting antibiotics based on positive dipstick results to conveying clinical information to support clinical decision-making.

> Before we used to put words in GPs' mouths, asking them to prescribe, now it's up to them. We are giving them the (information to decide) now. This is a big change. (Nurse 12)

Previous reliance on dipstick testing to confirm a UTI shifted to increased reliance on clinical assessment and sending urine cultures for residents with suspected UTIs, leading to changed beliefs around 'blaming everything on a UTI'.

> TDONTD has changed the attitude of staff, it has got them to ask more questions…UTI was always blamed for everything and that is not the case now. It has changed practice, our way of thinking and decision-making. (Nurse 6)

Some participants felt strongly that residents with dementia presented challenges in detecting symptoms and signs of UTI as some could not verbalise symptoms. In these circumstances, they considered dipstick testing was a critical primary test to ensure infection was not missed.

> Only one (resident) would be able to communicate if she was experiencing pain or dysuria. The others would be unreliable… We cannot use the (TDONTD clinical) pathway—we can only call the doctor for antibiotics. (Nurse 3)

Engagement in AMS and improvement approaches

Common nurse champion attributes were enthusiasm, perseverance and a willingness to seek support for

TDOND. Education alone was insufficient to implement TDONTD; champions delivering TDONTD were required to be persuasive and persistent in encouraging staff, GPs and consumers.

> It has taken time out of everyday tasks, but I can see benefit…There has been some resistance to change… You need to spend time explaining the benefits to them (staff). Sometimes they accept only reluctantly, they say "I've never seen this before". (Nurse 12)

Facility managers mostly supported champions, but a formal quality improvement approach was not described, and responsibilities often fell to a single champion.

> …the only thing that could improve (TDONTD) would be more hours in the day. (Nurse 11)

Information technology systems supported the clinical pathway's useability in some homes, but could be a barrier when electronic clinical forms were not updated to reflect best-practice

COVID-19 omicron outbreaks and the recent introduction of aged care mandatory quality indicators related to psychotropic prescribing resulted in competing priorities, overshadowing TDONTD implementation.

> (There is) so much focus on avoiding psychotropics—just treat UTI with an antibiotic. (Pharmacist 1)

Competing priorities reduced time for staff to adopt new practices. Prescribing for infections was potentially affected by facility lockdowns reducing on-site medical assessments.

> (Without COVID) maybe there would have been increased awareness (of TDONTD), and staff would have been a bit more conscious of it. COVID overshadowed a lot of things. (Nurse 4)

Support from facility management was a strong enabler of practice change, resulting in changed policies or processes stopping routine dipstick testing of residents on admission, or as weekly or monthly screening. The clinical pathway itself became the agreed protocol for dipstick testing in most homes.

> The clinical pathway is straight forward, one page with all the information you need on it. It's easy to follow and straight forward. (Nurse 5)

Some homes embedded TDONTD into existing processes.

> We have been doing lots of work communicating with GPs using ISBAR format (ISBAR is a clinical tool for communication around handover in a healthcare setting), TDONTD fits in with this… (Nurse 12)

Commission branding increased TDONTD's credibility with staff, GPs and consumers.

> The Commission crest on top of pathway helps… (it's an) authoritative source on aged care. That carries a lot of weight when you are trying to communicate with doctors. (Nurse 11)

Case-based education, the clinical pathway and training video were key tools in delivering education and practice change. Support from nurse clinical leaders for TDONTD, including at the education sessions, was important for acceptance.

> We had two sessions in the same facility. (There were) different discussions in the two groups. The first group was very large… GP resistance was raised as an issue; "they just tell you they want you to dip". The second group was smaller…more interactive. The (nurse champion) was in that session. The discussion was…more about residents and families and resistance from them can be an issue and prophylaxis use. (Pharmacist 3)

The clinical pathway was described as easy to understand and simple to follow. The training video was seen as insightful and engaging when used in case-based education, however, was rarely offered to staff who did not attend training.

Antibiotic audits were mostly conducted by champions or pharmacists. Results were informally shared by champions with nursing staff and GPs. Audit results were rarely used to drive process improvements. Data from antibiotic dispensing reports displaying time trends in antibiotic prescribing were more likely to be used. Some audits were tabled at RACHs' Medicines Advisory Committee, but champions were uncertain of further actions. Some champions were uncertain with whom responsibility lay for sharing audit results.

Personal carers were often not included in case-based education, but champions recognised their importance due to their involvement in care delivery and initiating dipstick testing.

> Education is focussed on the nursing team, but they don't spend the day on floor. Carers want to know the why as well as the what. (Pharmacist 2)

Strategies to address implementation barriers to TDONTD

Box 1 (with further detail on online supplemental file 6) presents a summary of strategies to enhance TDONTD intervention and delivery as well as approaches to ensure sustainability. Key considerations include using a formal quality improvement approach to deliver the intervention, and using a team, rather than relying on an individual champion, to share responsibility for delivering the intervention. Delivery of TDONTD is supported by identifying existing RACH barriers to change, such as organisational policy and processes that encourage dipstick testing, and key opinion leaders to engage in the planning phase. Considerations in the delivery phase include development and use of simple behavioural techniques

Box 1 To Dip or Not to Dip (TDONTD) implementation strategies: recommendations to enhance TDONTD (further detail in online supplemental file 6)

Implementation strategy and recommendations to enhance TDONTD

1. Organisational policies and procedures: *align policies and procedures to practice recommendations*
   - To review organisational policies and processes related to dipstick testing to align with TDONTD
2. Champions and leadership team: *select staff members who will dedicate themselves to supporting and facilitating practice change implementation, help overcome resistance and engaging other staff to strengthen buy-in*
   - To adopt a quality improvement approach in delivering TDONTD by usings a team rather than single champion, provide sufficient resources to deliver TDONTD
   - To identify enablers to support successful spread of change by devising simple behaviour techniques applicable to local context, identify opportunities to integrate TDONTD into clinical workflows
   - To identify barriers to successful spread and develop approaches to address by leveraging relationships within and between professional groups to deliver change, engaging consumers in TDONTD, ensuring clinical processes align with TDONTD clinical pathway.
3. Local opinion leaders: *individuals perceived to have influence with the facility and involve them in supporting practice change*
   - Cultivate champions with skills, confidence and persuasive skills
   - Engage early those with most power to impede spread to ensure they feel included, heard and important
   - Tailor messages to meet anticipated knowledge gaps and concerns of different groups
   - Engage with personal carers in TDONTD activities
   - Share TDONTD audit results and early success stories to get buy-in
   - To address concerns of local opinion leaders including safety concerns
4. Local consensus processes: *identifying opportunities to discuss the problem and practice changes with staff to gain agreement*
   - Ensure presence of supportive nurse clinical leader to facilitate the discussion at case-based education
   - Share local audit results to nurses and personal carers in the session
   - Involve staff in decision-making on how to embed new practice
   - Offer regular opportunities for staff to discuss and share experiences related to practice change, more frequent in the first weeks
5. Formal education: *delivering education about issues of treating asymptomatic bacteriuria (ASB) and desired practice change around urine dipstick testing practice and diagnosing urinary tract infection (UTI)*
   - Include delivery of TDONTD education to personal carers and offer alternative education opportunities for staff unable to participate in the case-based education session
   - Allocate TDONTD as a professional development activity for nurses
6. Providing information and education to families: *distributing resources and providing education to families and residents*
   - Encourage nurses to practice and model conversations around (1) dipstick testing as a low-value test and (2) explaining ASB to consumers and external stakeholders
   - Develop an interdisciplinary approach (nurses, pharmacists and general practitioners (GPs)) for review of antibiotic prescriptions identified in the audit as outside of guidelines, and where one of the outcomes is a shared decision-making conversation with the consumer
7. Outcome and process surveillance
   - Use existing UTI surveillance and incident reviews to ensure serious infections are not missed
   - Track TDONTD sustainability by regular review of surveillance data on antibiotic prescriptions for UTI
8. Audit and feedback: *providing feedback to staff on opportunities for improvement*
   - Use audit findings to identify prescriptions for review
   - Use audit to generate reports of antibiotic appropriateness, a metric that is clinically relevant to consumers and prescribers
   - Disseminate audit results to GPs, consumer and personal carers
   - Peer-to-peer feedback and engage pharmacists in providing feedback
9. Distributing, redistributing educational resources as reminders of practice change
   - Plan to repeat education annually to ensure sustainability
10. Revising and improving existing TDONTD resources
    - Provide a TDONTD implementation guide for champions
    - Develop TDONTD as a nurse and pharmacist continuing professional development activity
11. Advocacy with external groups
    - Dissemination of TDONTD intervention, intervention outcomes at international and national clinical, infection prevention and control, infectious diseases and pharmacy conferences and journal publications
    - Increase health professional and consumer awareness of urine dipstick testing as a low-value test that can result in inappropriate antibiotic use in older people

Implementation strategy cross-checked and verified against Chambers A, MacFarlane S, Zvonar R *et al*. A recipe for antimicrobial stewardship success: Using intervention mapping to develop a program to reduce antibiotic overuse in long-term care. Infect Control Hosp Epidemiol. 2019 Jan;40(1):24-31.

applicable to the local context, use of TDONTD audit data on antibiotic use to get stakeholder buy-in and integration of TDONTD into existing clinical workflows. After delivery of the intervention, forward planning to repeat TDONTD education annually to staff was identified as an approach to maintain sustainability.

Other approaches identified as potentially effective in enhancing TDONTD included raising public and health professional awareness of dipstick testing as a low-value practice to diagnose UTI in older persons, and inclusion of TDONTD in health professional continuing professional development activities.

DISCUSSION

TDONTD aims to reduce use of urine dipstick testing, a problem that contributes to overdiagnosis of UTI in older persons and overuse of antibiotics in residential aged care. By undertaking an analysis underpinned by the

TDF of how the intervention was delivered in practice, barriers to delivery and how the key components of the intervention worked, we provide an understanding of the intervention and its implementation. Key barriers can be addressed by a range of strategies to enhance delivery; we propose that those intending to deliver TDONTD adopt a quality improvement approach in planning and when delivering TDONTD.[24] As part of the planning phase, selection of a suitable champion, with engaged leadership support,[25] are important considerations to maximise likelihood of TDONTD's success. Broader advocacy work promoting dipstick testing as a low-value test in older persons, and linking UTI, ASB and dipstick testing education to healthcare professional development activities can further reduce barriers to TDONTD.

Nurse champions reported that TDONTD changed urine dipstick behaviour among aged care nursing and personal care staff who had a long-standing reliance on dipstick testing for UTI diagnosis. While changed behaviour was not measured through direct observation or documentation, this finding is supported by an observed increase in appropriateness of antibiotic prescribing for UTI.[6] TDONTD is an example of a deimplementation intervention, which aims to decrease an ineffective healthcare practice, rather than an implementation intervention that promotes the uptake of a new procedure. Education, training and audit feedback delivered increased knowledge and challenged pre-existing beliefs about capability of detecting UTI without use of dipstick testing and the likelihood of missing an infection. Replacing dipstick testing with the clinical pathway is an example of behaviour substitution and allows clinicians to act differently, a technique more frequently reported in deimplementation than implementation interventions.[26]

We have described an AMS intervention targeted at nursing and personal care staff. A recent systematic review reports that interventions to improve prescribing in aged care typically target physicians and nursing staff,[27] with interventions targeting nurses and personal carers less commonly reported.[17 28] A Danish study introducing education sessions and reflection and communication tools for nurses and nursing assistants reported positive qualitative (staff behaviour change in performing clinical assessments)[17] and quantitative (reduced antibiotic prescribing for UTI) outcomes.[28] The success of these interventions recognises the strong influence of these groups on prescribing decisions, as physicians often rely on nurses for residents' clinical information, which can be impacted by nurses' workload, educational level, or if basic assessment information is lacking.[16] For UTI management, we found that personal carers were often relied on to identify clinical change in residents and initiate dipstick testing, and inclusion of this group in TDONTD was identified as important by champions.

TDONTD was delivered by facility champions, supported by pharmacists. Using facility-based staff as a model is attractive as champions were engaged in undertaking TDONTD as part of the facility's programme of continuous improvement and understood the culture and workflow of the facility, important factors in facilitating healthcare change efforts.[25] Facility management and champion engagement in the intervention are instrumental as competing priorities and high staff turnover[29] are common challenges to delivering aged care quality improvement interventions.

Limitations

A pragmatic approach was taken for TDONTD delivery by RACHs to best reflect real-world conditions. Delivery was influenced by competing priorities, particularly high community COVID-19 activity. As there was no control group, data were collected at baseline and project exit. This study examines acceptability of the intervention primarily through the experiences of those delivering it. Interviews with other nursing staff, personal carers, GPs and consumers would have provided important perspectives to further explore acceptability and refine the intervention, and should be considered in future research. The sustainability of the intervention's impact was not assessed. In view of high direct care staff turnover in Australian homes (29% in 12 months),[30] it would be useful to study the maintenance of urine dipstick practice change 6–12 months later.

One further area that we did not fully investigate was the effectiveness of TDONTD in residential aged care settings where the majority of residents had severe cognitive impairment. It was reported that some nurses rejected the clinical pathway and believed a dipstick test was essential for ensuring UTI was not missed in these residents if behavioural change was observed. Cognitive impairment is common in Australian RACHs, with approximately 54% of residents diagnosed with dementia,[30] and strong drivers of prescribing in this population exist. Perceived risk of not initiating antibiotics has been identified as a driver of prescribing.[16] Dysuria, frequency, urgency and suprapubic pain are frequently difficult to assess for in those with advanced dementia; antibiotics are often prescribed for clinical suspicion of UTI on the basis of mental status change or fever.[31] In a randomised control trial involving residents with advanced dementia, no significant reduction (clinically or statistically) in antibiotics prescribed for UTI was observed following delivery of intensive education, training and feedback to nursing and physician staff.[32] Although intervention acceptability was not measured, this may have provided further insights into the study's outcomes. These results emphasise the need for designing AMS interventions for residents with advanced dementia as an important area for research.

Conclusions

Urine dipstick testing is routinely performed by nursing and personal carer staff in residential aged care which often results in overdiagnosis of, and antibiotic overprescribing for, UTI in residents. By providing nurses and personal carers with education, training, a clinical pathway and audit for feedback, and challenging staff

beliefs about capabilities and consequences, TDONTD effectively delivers behaviour change around dipstick testing. Delivery of TDONTD by local champions increases engagement in delivery and the identification of solutions to address local barriers. As a successful and viable intervention project, TDONTD should be implemented widely in Australian RACHs; however, broader advocacy work promoting dipstick testing as a low-value test in older persons, in healthcare and consumer awareness campaigns, is required. There is also a pressing need to consider people with severe cognitive impairment in the design of future AMS interventions in aged care settings.

Author affiliations
[1]Department of Infectious Diseases, Faculty of Medicine Dentistry and Health Sciences, The University of Melbourne, Melbourne, Victoria, Australia
[2]Australian Government Aged Care Quality and Safety Commission, Melbourne, Victoria, Australia
[3]Australian Government Aged Care Quality and Safety Commission, Canberra, Australian Capital Territory, Australia
[4]School of Health Sciences, The University of Melbourne Melbourne School of Health Sciences, Melbourne, Victoria, Australia
[5]Department of Health Services Research, Peter MacCallum Cancer Centre, Melbourne, Victoria, Australia
[6]Aged Care Quality and Safety Commission, Sydney, New South Wales, Australia
[7]University of Tasmania College of Health and Medicine, Hobart, Tasmania, Australia
[8]Aged Care Quality and Safety Commission, Hobart, Tasmania, Australia

Contributors Substantial contributions to the conception or design of the work (LLL, JB, KW, MW); or the acquisition (LLL, KW, JB), analysis (LLL, JB, KW) or interpretation of data for the work (JJF); and drafting the work or reviewing it critically for important intellectual content (all authors); and final approval of the version to be published (all authors); and agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved (LLL).

Funding This study was commissioned by the Aged Care Quality and Safety Commission.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval The Eastern Health Office of Research (QA21-041) reviewed the protocol and approved it as a Quality Assurance study. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplementary information.

ORCID iD
Lyn-li Lim http://orcid.org/0000-0003-1782-7875

REFERENCES

1 World Health Organization. Antimicrobial resistance. n.d. Available: https:/www.who.int/news-room/fact-sheets/detail/antimicrobial-resistance
2 Australian Commission on Safety and Quality in Health Care. AURA 2021: Fourth Australian report in antimicrobial use and resistance in human health, Available: https://www.safetyandquality.gov.au/our-work/antimicrobial-resistance/antimicrobial-use-and-resistance-australia-surveillance-system/aura-2021
3 Sluggett JK, Moldovan M, Lang C, *et al*. Contribution of facility level factors to variation in antibiotic use in long-term care facilities: A national cohort study. *J Antimicrob Chemother* 2021;76:1339–48.
4 Australian Government. Antimicrobial prescribing and infections in Australian residential aged care facilities: Results of the 2020 aged care national antimicrobial prescribing survey report, Available: https://www.amr.gov.au/resources/antimicrobial-prescribing-australian-residential-aged-care-facilities-results-2020-aged-care-national-antimicrobial-prescribing-survey
5 Bennett N, Malloy MJ, James R, *et al*. Prophylactic antimicrobial prescribing in Australian residential aged-care facilities: improvement is required. *Drugs Real World Outcomes* 2022;9:561–7.
6 Government UK. UK 5-year action plan for antimicrobial resistance 2019 to 2024, Available: https://www.gov.uk/government/publications/uk-5-year-action-plan-for-antimicrobial-resistance-2019-to-2024
7 PrescQIPP. Antimicrobial Stewardship, Available: https://www.prescqipp.info/our-resources/webkits/antimicrobial-stewardship
8 Lim L, Wroth M, Williams K, *et al*. P01 the Australian experience of adapting and implementing 'to dip or not to dip' in residential aged care facilities. *JAC-Antimicrobial Resistance* 2023;5:dlad077.
9 Aged Care Quality and Safety Commission. AMS clinician resources, Available: https://www.agedcarequality.gov.au/antimicrobial-stewardship/clinician-resources
10 Lim CJ, Kwong MW-L, Stuart RL, *et al*. Antibiotic prescribing practice in residential aged care facilities – health care providers' perspectives. *Med J Aust* 2014;201:98–102.
11 Carey RN, Connell LE, Johnston M, *et al*. Behavior change techniques and their mechanisms of action: A synthesis of links described in published intervention literature. *Ann Behav Med* 2019;53:693–707.
12 Royal College of General Practitioners. Getting the most form the TARGET toolkit, Available: https://elearning.rcgp.org.uk/mod/book/view.php?id=12645
13 Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci* 2012;7:37.
14 Atkins L, Francis J, Islam R, *et al*. A guide to using the theoretical domains framework of behaviour change to investigate implementation problems. *Implement Sci* 2017;12:77.
15 Expert Group for Antibiotics. Urinary tract infection in aged-care facility residents. In: *Therapeutic Guidelines*. Melbourne, Vic: Therapeutic Guidelines Limited, 2019.
16 van Buul LW, van der Steen JT, Doncker SMMM, *et al*. Factors influencing antibiotic prescribing in long-term care facilities: a qualitative in-depth study. *BMC Geriatr* 2014;14:136.
17 Kousgaard MB, Olesen JA, Arnold SH. Implementing an intervention to reduce use of antibiotics for suspected urinary tract infection in nursing homes - a qualitative study of barriers and Enablers based on normalization process theory. *BMC Geriatr* 2022;22:265.
18 Kistler CE, Beeber AS, Zimmerman S, *et al*. Nursing home Clinicians' decision to prescribe antibiotics for a suspected urinary tract infection: findings from a discrete choice experiment. *J Am Med Dir Assoc* 2020;21:675–82.
19 McGowan LJ, Powell R, French DP. How can use of the theoretical domains framework be Optimized in qualitative research? A rapid systematic review. *Br J Health Psychol* 2020;25:677–94.
20 Braun V, Clarke V. Using thematic analysis in psychology. *Qualit Res Psychol* 2006;3:77–101.
21 QSR International Pty Ltd. Nvivo qualitative data analysis Software(Version 12). 2018. Available: https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home
22 Chambers A, MacFarlane S, Zvonar R, *et al*. A recipe for antimicrobial stewardship success: using intervention mapping to develop a program to reduce antibiotic Overuse in long-term care. *Infect Control Hosp Epidemiol* 2019;40:24–31.

23 Hoffmann TC, Glasziou PP, Boutron I, *et al*. Better reporting of interventions: template for intervention description and replication (Tidier) checklist and guide. *BMJ* 2014;348:bmj.g1687.
24 Institute for Healthcare Improvement. IHI "Seven Deadly Sins, Available: https://www.ihi.org/resources/Pages/Tools/IHISevenSpreadlySins.aspx
25 Bonawitz K, Wetmore M, Heisler M, *et al*. Champions in context: which attributes matter for change efforts in Healthcare *Implement Sci* 2020;15:62.
26 Patey AM, Grimshaw JM, Francis JJ. "Changing behaviour, 'more or less': do implementation and de-implementation interventions include different behaviour change techniques" *Implement Sci* 2021;16:20.
27 Raban MZ, Gasparini C, Li L, *et al*. Effectiveness of interventions targeting antibiotic use in long-term aged care facilities: a systematic review and meta-analysis. *BMJ Open* 2020;10:e028494.
28 Arnold SH, Nygaard Jensen J, Bjerrum L, *et al*. Effectiveness of a tailored intervention to reduce antibiotics for urinary tract infections in nursing home residents: a cluster, randomised controlled trial. *Lancet Infect Dis* 2021;21:1549–56.
29 Australian Institute for Welfare and Health. Department of Health 2020 Aged Care Workforce Census, Available: https://www.gen-agedcaredata.gov.au/Resources/Dashboards/Department-of-Health-2020-Aged-Care-Workforce-Cens
30 Australian Institute for welfare and health. Dementia in Australia. n.d. Available: https://www.aihw.gov.au/reports/dementia/dementia-in-aus/contents/summary
31 D'Agata E, Loeb MB, Mitchell SL. Challenges in assessing nursing home residents with advanced dementia for suspected urinary tract infections. *J Am Geriatr Soc* 2013;61:62–6.
32 Mitchell SL, D'Agata EMC, Hanson LC, *et al*. The trial to reduce antimicrobial use in nursing home residents with Alzheimer disease and other Dementias (TRAIN-AD): A cluster randomized clinical trial. *JAMA Intern Med* 2021;181:1174–82.