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What influences antibiotic initiation? Developing a scale to measure nursing behaviour in residential aged-care facilities

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Abstract

Aim: The purpose of the current study was to develop and assess the psychometric properties of a measure that captures nursing behaviours that have the potential to influence the initiation of antibiotics in residential aged-care facilities.

Design: Cross-sectional online survey.

Method: One hundred and fifty-seven nurses completed an online survey. The survey consisted of two clinical vignettes and measures of tolerance of uncertainty and anxiety. The vignettes consisted of the most common presentations (urinary tract infections and upper respiratory tract infections) of two hypothetical residents in aged-care facilities. The vignettes provided participants with incremental information with varying levels of symptoms, input from other people and availability of test results. Both vignettes were subjected to exploratory factor analysis.

Results: The results focus on the 16 items in the second vignette which resulted in the extraction of three factors. The derived factors were labelled as follows: (i) Noting and Calling GP, (ii) Consult a Colleague and (iii) Immediate Assessment and Antibiotics. Reliability analysis revealed excellent to satisfactory reliability. All three scales were significantly correlated with measures of clinical tolerance of uncertainty, and the 'noting and calling GP' scale was also negatively correlated with measures of anxiety and general tolerance of uncertainty. The measure showed satisfactory reliability and validity for capturing nursing behaviours that have the potential to influence decisions regarding antibiotics. As such, the current study provides a first step towards addressing the lack of ecologically valid measures that capture the complex and nuanced context of nurses' behaviours in RACF that have the potential to inform future stewardship interventions.

KEYWORDS
antimicrobial resistance, anxiety, prescribing, residential aged care, stewardship, tolerance of uncertainty

1 | INTRODUCTION

Antimicrobial resistance (AMR) remains a significant problem in residential aged care facilities (RACF) despite stewardship efforts to reduce knowledge gaps for staff (Beckett et al., 2015; Dowson et al., 2019; Raban et al., 2021). Prescribers have a clearly defined role in antimicrobial stewardship (AMS) and have been the primary focus of measurement of outcomes (e.g., prolonged duration of therapy; high rates of (as required) prescriptions; poor documentation; and prolonged prophylaxis for conditions that are not supported by guidelines) (ACSQHC, 2018; Hall et al., 2022). Antimicrobial overprescribing has been conceptualised as a problem of knowledge deficit with the dissemination of educational AMS interventions (e.g., development of guidelines, educational seminars, audit and feedback for prescribers) (Singh et al., 2022). However, these interventions have been insufficient in addressing the complexities of resident care in RACF (e.g., resident frailty, multiple comorbidities, lack of resources and rotating staff) (Katz et al., 2017; Wu et al., 2018).

Risk aversion among prescribers; interprofessional tensions between prescribers and nurses and pressure from nurses and family members are cited as significant barriers to reducing prescribing (Broom et al., 2019; Degeling et al., 2023; McElligott et al., 2017). More recently, there has been recognition that registered nurses (RNs) and enrolled nurses (ENs) play a significant role in influencing prescribing in RACF. For example, nurses are proximal in monitoring and escalating resident care (e.g., urine testing, calling the prescriber or sending a resident to the hospital); collaborating and relaying information; and managing relationships with off-site prescribers and residents and their family members, as well as managing personal care assistants (Gotterson et al., 2021; Hall et al., 2022).

Similar to prescribers, these decisions are often influenced in a background context of scientific uncertainty (e.g., high levels of comorbidity); practical uncertainty (e.g., limited access to diagnostic testing and/or AMS expertise; unfamiliarity with rotating prescribers/RACF staff) and personal uncertainty (e.g., differing goals of care for older residents, their family members and the prescriber) (Han et al., 2011, 2021; Strout et al., 2018). Diagnostic uncertainty has been recognised as the most common source of anxiety for physicians and is linked to their engagement in practising defensive medicine (Bhise et al., 2017; Lykkegaard et al., 2018). Current decision-making models theorise that clinical decisions are made by both, affective and analytical processes (Djulbegovic et al., 2012). This suggests that an individual's affective experience (e.g., how they feel), beyond an evaluation of risks and benefits influences decision-making (Sobkow et al., 2016). Nurses report that unfamiliarity with aspects of resident care, such as unfamiliar illness or a resident's condition unexpectedly becoming unstable; unfamiliar orders and navigating ethical grey areas of practice (e.g., end-of-life care) are significant sources of uncertainty for them (Cranley et al., 2012). Furthermore, nurses report feeling uncertain in these situations because of; insufficient information, clinical knowledge or time to make decisions, or encountering differing perspectives regarding goals for resident care between nurses and physicians (Cranley et al., 2009). Nurses describe experiencing uncertainty as feeling a lack of self-confidence in their skills and abilities, decision-making and/or actions concerning resident care (Cranley et al., 2012).

In Australia, only nursing practitioners (NPs), with specialist training can prescribe some antibiotics. Although RNs and ENs do not prescribe antibiotics, they are tasked with balancing the potential harms of not treating high levels of infections promptly and the risk of unnecessary antibiotic use when making decisions regarding advocating for residents (Lim et al., 2015; Singh et al., 2024). The anxiety that nurses experience due to uncertainty may likely influence their behaviours regarding the escalation of care and relaying of information. In turn, this may be experienced by prescribers as pressure to prescribe antibiotics as a safety net to relieve anxiety (Chaaban et al., 2019; Hall et al., 2022). Despite the complexity of these decisions, little attention has been given to the development of a measure that captures the multiple dynamic factors that influence nurses. Therefore, the current study aimed to develop and validate a measure that captures therapeutic decisions that aged-care RNs and ENs make, including those that are related to stronger preferences for antibiotics. The study also aimed to explore relationships between nurses' anxiety and tolerance of uncertainty with this new measure. It was hypothesised that a scale reflecting decisions with a higher propensity for antibiotic initiation would be positively correlated with measures of nurses' state anxiety and tolerance of uncertainty scores.

2 | METHOD

2.1 | Design and procedure

A cross-sectional, vignette-based approach was adopted in line with previous literature looking at uncertainty with clinicians (Lawton et al., 2019; Quinlan & Deane, 2021). Participants were asked to complete nine demographic questions (e.g., age, sex, education) followed by the Intolerance of Uncertainty Scale – Short form (IUS-12) (Carleton et al., 2007), adapted version of Physicians Reactions to Uncertainty Scale for Nurses (PRUS-N) (PRUS: Gerrity et al., 1990), State-Trait Anxiety Inventory (STAI) (Marteau & Bekker, 1992) and the two case vignettes that describe hypothetical residents with incremental levels of information provided to the participant. Participants were asked to rate the likelihood that they would take the step described in each option (one = not to six = definitely would). STROBE checklist was used for reporting cross-sectional studies.

2.2 | Measures (including validity and reliability/rigour)

2.2.1 | Case vignettes

In developing the case vignettes, initially, a literature review was conducted to identify existing measures of uncertainty used with

nurses, common scenarios of antimicrobial prescribing in RACF and how nurses deal with uncertainty in the medical literature. Development of case vignettes was done by SS and CD (expertise in stewardship in aged care), AM and PD (nursing academics specializing in aged care) and FD (experience with clinical vignette measures, psychometrics and behavioural science). These vignettes were developed to reflect common scenarios RACF staff experience with residents and families. The vignettes were further refined with qualitative interviews with 15 RACF nurses (conducted by SS) by assessing the content validity of the vignettes. The vignettes and questionnaires were pilot tested with five more RACF nurses with feedback integrated into the final vignette design after consultation with the team (see Appendix for full measure). The case vignettes incrementally introduced complicating factors to the scenario, such as:

- Changes in the behaviour of, and symptoms experienced by the RACF resident
- The advice is provided by either prescriber (GP) and family member (Vignette One: Mary) or other aged-care staff (Vignette Two: Navneet).
- Delays in pathology sample collection and testing

Participants were provided choices regarding responding to the scenarios ranging from 'wait and see' approaches (e.g., 'You make a note on Mary's care plan.' and 'You continue to urge the staff to monitor symptoms.'), pro-intervention approaches (e.g., 'calling an ambulance', 'calling GP to urge them to prescribe antibiotics') and decision-deferral approaches (e.g., 'consult a colleague', 'consult a supervisor'). Each step of the vignettes was discussed with AM to determine appropriate responses for nurses at different levels of training and experience. The final version of Vignette One ('Mary') consisted of 22 items and Vignette Two ('Navneet') consisted of 16 items. The addition of new information to the case vignettes was thought to better capture the dynamic nature of resident presentations (e.g., symptom change) as well as a variety of contextual factors that often impact therapeutic decision making (e.g., the influence of others, availability of test results, etc.) (Lim et al., 2015). Further, the measure allows for a variety of potential decisions and behaviours to be endorsed, with a particular focus on developing a measure that captures antibiotic pro-prescribing decisions.

2.2.2 | Tolerance of uncertainty

Two measures of tolerance of uncertainty were used in the study.

- The Physicians Reaction to Uncertainty Scale (PRUS: Gerrity et al., 1990) was slightly modified to provide a measure of tolerance of uncertainty in the clinical context. The PRUS is a widely used scale to measure uncertainty (Scott et al., 2023), and has been identified as an exemplary measure of uncertainty tolerance with healthcare samples (Hillen et al., 2017). The PRUS contains 22 items rated on a six-point Likert-type scale ranging from one = strongly disagree to six = strongly agree. There are two subscales: stress from uncertainty (13 items) and reluctance to disclose uncertainty (nine items). The stress from uncertainty subscale measures negative affective responses to uncertainty (e.g., 'I find the uncertainty involved in patient care disconcerting'). The reluctance to disclose uncertainty subscale measures fear of disclosing uncertainty to others (e.g., 'The hardest thing to say to patients or families is "I don't know"'). Scores are obtained by summing all items, with higher scores suggesting lower tolerance of uncertainty (i.e., higher intolerance of uncertainty). The PRUS was modified in consultation with PD and AM by (i) replacing the referents 'physician' with 'nurses'; 'patient' with 'client'; (ii) changing two items about 'diagnosis' to 'procedure', and (iii) modifying one item regarding 'If I don't make a diagnosis, the referring doctor will stop sending patients to me' to 'If I don't have enough information for the doctor to make a diagnosis, they will lose confidence in me'.

The modified version of PRUS for nurses (PRUS-N) demonstrated excellent internal consistency ($\alpha = 0.91$) in the current sample, similar to the original scale. The subscales of the PRUS are highly correlated and represent related dimensions within a global concept (Gerrity et al., 1990), therefore, a total score was utilised in line with previous studies (Lawton et al., 2019; Quinlan & Deane, 2021).

- The Intolerance of Uncertainty scale (IUS-12) (Carleton et al., 2007) is a 12-item that has been used to evaluate (i) reactions to ambiguous situations; (ii) implications of being uncertain and attempts to control the future in general life (Carleton et al., 2007; Freeston et al., 1994). Participants rate each item on a five-point Likert scale, ranging from one (not at all characteristic of me) to five (entirely characteristic of me). Higher scores on the IUS-12 suggest greater intolerance to uncertainty. The IUS-12 has been used to evaluate clinician tolerance to uncertainty and has excellent consistency (Cronbach's $\alpha = 90$) (Bongelli et al., 2021) and demonstrated good internal reliability in the current sample (Cronbach's $\alpha = 0.87$).

2.2.3 | Anxiety

The six-item state version of the State-Trait Anxiety Inventory (STAI-6: Marteau & Bekker, 1992) was used to measure participants' 'in the moment' anxiety symptoms (e.g., 'I feel calm' and 'I am worried') before being presented with the vignettes. State anxiety was measured using the six-item state version of the State Trait Anxiety Inventory (STAI: Marteau & Bekker, 1992). Respondents rate the degree to which they agree with each item on a four-point scale (one = 'not at all' to four = 'very much'). Higher scores on the STAI-6 indicate higher state anxiety. In the current sample, the STAI-6 demonstrated good internal consistency (Cronbach's $\alpha = 0.86$).

2.3 | Sampling and recruitment

Participants were recruited to an online Qualtrics survey using snowballing technique. Participation in the research was open to all registered and enrolled nurses currently working or having previously worked in residential aged-care facilities in Australia. Initially email invitations were sent to 1,400 gerontological specialist nurses and allied healthcare practitioners working in clinical practice, education, research and policy areas who were members of the Ageing and Dementia Health Education and Research (ADHERe) Centre at the University of Wollongong. The survey was also posted through nursing organisations (e.g., the New South Wales Nursing and Midwives Association – NSWNMA) and social media. Participants were recruited through Farron Research, a third-party market research company. Participants recruited from social media and the community were eligible to enter a draw to win one of five $200 gift cards. Participants recruited through Farron Research were each remunerated $50 (paid by the research lab).

2.4 | Sample size and power

Two hundred and thirty-seven participants initiated the survey; however, 80 respondents were excluded because of incomplete responses. Tabachnick and Fidell (2013) note that the recommended sample size for factor analysis is between 5 and 10 respondents per item, which was satisfied within the current sample ($N=157$). An a priori power analysis was conducted using G*Power version 3.1.9.7 (Faul et al., 2007) to determine the minimum sample size required. Results indicated the required sample size to achieve 80% power for detecting a medium effect, at a significant criterion of $\alpha=0.05$, was $N=84$ for bivariate normal models. Thus, the obtained sample size of $N=150$ is adequate.

2.5 | Data analysis

SPSS 28 and JASP 0.16.4 were used for statistical analyses. SPSS was used to check for outliers, seven cases were identified as outliers and deleted. Inter-item correlations, using $r>0.3$ as a criterion for inclusion and Bartlett's Test of Sphericity (BTS) and the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy were satisfied (Hills, 2011). An Exploratory Factor Analysis (FA) and reliability analysis were performed on each vignette separately. JASP 0.16.4 was used to conduct Parallel analysis using promax rotation to determine the appropriate number of factors (Hayton et al., 2004; Osborne et al., 2008). The pattern matrix was inspected for each of the items; items with factor loadings >0.3 were included (Osborne et al., 2008; Osborne, 2015). There were no cross-loading or negatively loaded items. The internal consistency (i.e., reliability) of items assigned to a factor was assessed using Cronbach's alpha, with Cronbach's $\alpha=0.7$ considered the minimum acceptable level to retain the factor (Taber, 2017). SPSS was used to run bivariate correlations between the final scales and the PRUS-N, IUS-12 and STAI-6. There was some evidence of curvilinear relationships, which can underestimate the degree of correlation. Therefore, Spearman's correlation was used as it can cope better with curvilinear relationships (Hills, 2011).

2.6 | Ethical statement

The study was approved by the Health and Medical Human Research Ethics Committee Human Research Ethics Committee of the University of Wollongong (HREC: 2021/015). The study was conducted following the ethical principles of the World Medical Association (WMA) Declaration of Helsinki (WMA, 2013). Participants were given information about the aims, methods, sources of funding, any possible conflicts of interest, institutional affiliations of the researcher, the anticipated benefits and potential risks of the study and the discomfort it may entail, post-study provisions and any other relevant aspects of the study. Participants were reminded that participation in the research was voluntary and that they could withdraw from the study at any time, written consent was obtained electronically. Participant data was anonymised using research codes, with access to the raw data only shared between the research team explicitly named within the participant information summary. No harm was anticipated to participants, and resources and appropriate helpline numbers were provided, with psychologists available for debriefing if needed.

3 | RESULTS

3.1 | Sample characteristics

One hundred and fifty-seven nurses completed all items in the survey. The total sample consisted of 111 female participants with an average age of 42.7 years (SD = 14.5) and 46 male participants with an average age of 40.76 years (SD = 10.8). Most participants worked in New South Wales (NSW) (46.5%), followed by Queensland (17.8%), Victoria (16.6%), Western Australia (7.6%), Australian Capital Territory (ACT) (6.4%), South Australia (3.2%) and Tasmania (1.3%). One participant worked in New Zealand but had previously worked in NSW. Most participants (75.3%) had at least 3 years of work experience, 16.6% of the participants had 1–2 years of work experience and 8.3% had less than 1 year of experience in the residential aged-care sector. Just over half of the participants worked in direct clinical care (52.9%), followed by management (16.7%), education (7%), and policy (1.3%). The remaining 22.3% of participants selected 'Other' and tended to work in a combination of management, education and policy development. For educational levels, 41.4% of the participants had a Bachelor's degree, 25.5% with a Master's degree, 17.2% had a graduate certificate and 9.6% had received hospital-based education. One participant had a PhD, seven had a Diploma, and one participant had a Certificate IV qualification (polytechnic education).

3.2 | Clinical vignettes

Two clinical vignettes were developed; Vignette One: 'Mary', who experienced a urinary Tract Infection, and Vignette Two: 'Navneet', who experienced an Upper Respiratory Tract Infection. Vignette One produced factors that could not be interpreted and described as a coherent underlying construct, therefore the results from Vignette Two are presented and are the focus of the analysis here.

All items from Vignette Two were included in the FA (see Appendix; Table 2). The data's general suitability was supported by a KMO index >0.5 (0.838) and a significant BTS ($p < 0.001$) with strong communalities (>0.5). Parallel Analysis indicated a three-factor model (summarised in Table 1), accounting for 63.2% of the variance explained. All items had factor loadings of >0.4 except 1 item (Item 15: 'Antibiotics that are usually given for a chest infection are available. Although it hasn't been three days, during the handover you are advised that the previous nurse has started the antibiotics. You continue administering the antibiotics'), which was excluded. No items suffered from cross-loads. Factor 1: Noting and Call GP (NCGP) consisted of seven items and showed excellent levels of internal consistency ($\alpha = 0.91$), Factor 2: Consult a Colleague (CC) consisted of four items and showed good internal consistency ($\alpha = 0.86$) and Factor 3: Immediate Assessment and Antibiotics (IAA) consisted of four items and showed satisfactory internal consistency ($\alpha = 0.75$).

3.3 | Inter-factor correlations, IUS-12, PRUS-N and STAI

Descriptive statistics and correlations are reported in Table 2. Nurses scores for general intolerance of uncertainty ranged from 12 to 49, with a mean of 28.85 (SD = 8.01). This is higher than a non-clinical control group (M = 19.55, SD = 5.40) but lower than a clinical group diagnosed with generalised anxiety disorder (GAD) (M = 35.96, SD = 10.57) (Wilson et al., 2017). The scores for nurses in this study were also lower than nursing students (M = 37.18, SD = 10.10: Şentürk & Bakır, 2021); a group of healthcare workers consisting of medical consultants and nurses amid the COVID-19 Pandemic (M = 31.81; SD = 8.52: Temsah et al., 2022); and Australian general practitioners (M = 30.2; SD = 7.2: Cooke et al., 2013).

For clinical intolerance of uncertainty, nurses scores ranged from 40 to 124, (M = 85.69; SD = 19.35). This is higher in comparison to previous studies with 190 psychologists (M = 69.64, SD = 17.48) (Quinlan et al., 2021). On a subscale level, participants in our sample had a baseline mean of 43.92 (SD = 10.87) for stress from uncertainty, slightly higher than the sub-scale mean reported in the initial scale development study that utilised 428 medical physicians (M = 44, SD = 11: Gerrity et al., 1990) but lower than the mean reported for psychologists (M = 46.97, SD = 10.35: Quinlan & Deane, 2021). Participants had a baseline mean of 28.25 (SD = 6.17) for reluctance to disclose uncertainty, which was also higher than the sub-scale mean previously reported (M = 23, SD = 6: Gerrity et al., 1990) but similar to the mean reported for psychologists (28.41, SD = 5.20: Quinlan & Deane, 2021).

Nurses state anxiety ranged from 6 to 21, with a mean of 11.57 (SD = 3.83). This state anxiety is slightly lower than state anxiety for psychologists in a similar vignette study comparing anxiety regarding clinical case formulation (M = 12.31, SD = 3.33: Quinlan & Deane, 2021), but slightly higher than scores of a group of 3rd-year university undergraduates enrolled in a psychology course during normal class time (M = 9.07, SD = 2.38) (Taylor & Deane, 2002).

There was a moderately significant correlation between the Noting and Call GP scale and general intolerance of uncertainty, and small significant correlations between clinical intolerance of uncertainty and anxiety measures. Similarly, there were small significant correlations between both Immediate Assessment and Antibiotics and Consult a Colleague scales and clinical intolerance of uncertainty. Importantly, the Noting and Call GP scale was negatively correlated with state anxiety and both, clinical and general intolerance of uncertainty. Conversely, both Consult a Colleague and Immediate Assessment and Antibiotics scales were positively correlated with clinical intolerance of uncertainty but not state anxiety or general intolerance of uncertainty.

4 | DISCUSSION

Prescribers perceive interprofessional tensions and specifically, pressure from nurses to prescribe antibiotics as a significant barrier to reducing overprescribing in RACFs (Hall et al., 2022; McKelvie et al., 2019). The primary aim of the current study was to develop a scale that measures nursing behaviours related to antibiotic initiation in RACF. As expected, the pro-prescribing items (e.g., urging the GP to prescribe earlier) were loaded with other items that were also pro-intervention (e.g., getting the resident assessed for an emergency). To the best of the authors' knowledge, this is the first study to capture behaviours that are pressing for a more urgent or immediate response towards the initiation of antibiotics. The Immediate Assessment and Antibiotics subscale is likely to be useful in future research and it correlates in a meaningful way with intolerance of uncertainty in a clinical context. This confirms theoretical links with intolerance of uncertainty (Strout et al., 2018), lending further support (in addition to the factor analysis) to the validity of the scale.

Given theory and prior empirical research identifying relationships between intolerance of uncertainty, anxiety and clinical decision-making, the study also correlated nurses' anxiety and intolerance of uncertainty with this new measure. The scale containing items suggesting a push for antibiotics initiation was positively correlated with nurses' clinical intolerance of uncertainty but not with their general intolerance of uncertainty and state anxiety. These findings taken together suggest that the clinical context of uncertainty is important in influencing the perceived need for antibiotics in RACFs.

Previous research has identified antibiotics to be associated with higher perceptions of care for nurses and family members of RACF

TABLE 1 Factors for vignette two.

Items (numbering from Appendix)	Mean (SD)	Factor 1: Noting and calling GP (NCGP)	Factor 2: Consult a colleague (CC)	Factor 3: Immediate assessment and antibiotics (IAA)
5. You update Navneet's care plan, noting the loss of appetite and worsening of cough. You continue to urge staff to monitor Navneet's symptoms	5.46 (1.00)	0.848		
1. You make a note on Navneet's care plan to ensure that other care staff keep an eye on him	5.47 (0.95)	0.846		
11. You note the doctor's instructions on Navneet's care plan and urge staff to continue monitoring Navneet's symptoms over the next 2–3 days	5.36 (1.08)	0.841		
8. You arrange a call to the consulting GP in regards to Navneet's symptoms and check regarding other steps	5.45 (0.96)	0.839		
12. You update Navneet about the doctor's instructions, and explain why the cough has worsened	5.32 (1.02)	0.807		
3. You arrange a call to the consulting GP in regards to Navneet's increased symptoms (e.g., increased sputum, cough sounding 'wetter')	5.31 (1.03)	0.752		
7. You arrange to book an appointment for the visiting radiographer to take an x-ray of Navneet's chest, subject to the GP writing a radiology request	5.13 (1.19)	0.502		
13. You consult another colleague about how to handle Navneet's situation regarding the potential risk of pneumonia and ask them what the best way forward might be.	4.59 (1.23)		0.897	
2. You consult another colleague about Navneet's symptoms and ask them what the best way to deal with them might be	4.57 (1.30)		0.896	
6. You consult another colleague about Navneet's symptoms and ask their opinion on the best way to deal with them	4.55 (1.29)		0.768	
14. You seek your manager's opinion about giving Navneet antibiotics just in case he gets worse	4.55 (1.41)		0.474	
16. You ask your manager whether you should call an ambulance and get him assessed at casualty/emergency to assess him quicker	3.61 (1.49)			0.538
10. You ask your manager whether you should call an ambulance to get Navneet assessed at casualty/emergency	3.68 (1.42)			0.736
9. Given Navneet's presentation, you urge the GP to start antibiotics over the phone	3.89 (1.34)			0.774
4. You suggest to your supervisor that you need to contact the GP to start the antibiotics earlier	4.08 (1.38)			0.606

residents (Singh et al., 2022; Hall et al., 2022). These findings are in line with previous literature regarding lower tolerance of uncertainty for both, patients and physicians in primary care resulting in higher antibiotic prescribing in primary care (Wang et al., 2021). Interestingly, although general tolerance of uncertainty and state anxiety were not significantly correlated with the Immediate Assessment and Antibiotics subscale, clinical intolerance of uncertainty was positively correlated. The more clinical intolerance of uncertainty the higher were scores reflecting Immediate Assessment and Antibiotics. This suggests that it is the clinical context that is particularly relevant in the relationships between uncertainty and pro-antibiotic decisions and not just a general or more trait-like uncertainty. This is in line with previous literature about medical decision-making, which stipulates that contextual factors (e.g., safety climate, team culture, resource availability) are significant influencers of clinician's ability to tolerate uncertainty and make clinical decisions (Djulbegovic et al., 2012; Katz et al., 2017). These findings taken together suggest that the clinical context of uncertainty is important in influencing the perceived need for antibiotics in RACFs.

Additionally, we found that nurses in our study had similar 'stress from uncertainty' but higher 'reluctance to disclose

TABLE 2 Descriptive statistics and Spearman's rho correlations ($N = 150$).

	Mean (SD)	IUS-12	PRUS-N	STAI
Vignette two				
Noting and Call GP (NCGP)	66.93 (10.18)	−0.31**	−0.24**	−0.29**
Consult a Colleague/Manager (CC)	18.29 (4.33)	0.07	0.20*	−0.09
Immediate Assessment + Antibiotics (IAA)	15.25 (4.33)	0.16	0.27**	0.08
IUS-12	28.85 (8.01)			
PRUS-N	85.69 (19.35)	0.61**		
STAI	11.57 (3.83)	0.41**		

Abbreviations: IUS-12, Intolerance of Uncertainty- short scale; PRUS-N, Physicians Reactions to Uncertainty Scale – Nurses; STAI-6, State-Trait Anxiety Inventory – 6 items.

*$p < 0.05$ (2-tailed), **$p < 0.01$ (2-tailed).

uncertainty' compared with physicians (Gerrity et al., 1990). Furthermore, they had a higher overall intolerance of uncertainty in the clinical context when compared with other healthcare workers, such as psychologists (Quinlan & Deane, 2021). Previous studies indicate that when compared with prescribers, nurses perceive family members to have greater influence in prescribing decisions (Scales et al., 2016) and perceive that family members associate antibiotics with greater perceptions of care (Hale et al., 2017). Conversely, family members report describing prescribers, rather than nurses as the holders of information regarding antibiotics and associate prescriber involvement with higher-quality care (Ahouah et al., 2019; Degeling et al., 2023). These findings taken together highlight the tensions that nurses might experience in disclosing uncertainty regarding a resident's medical status and maintaining the relationship with family members. Given that family members are perceived to generally want some kind of immediate intervention (e.g., antibiotics), acknowledging uncertainty might leave nurses vulnerable to being seen unfavourably and affect relationships with the family members.

Against this background, the Immediate Assessment and Antibiotics scale consisted of items that would be considered more likely to trigger antibiotic prescriptions, such as urging the GP to prescribe antibiotics and seeking hospitalisation for residents. Similarly, the 'Consult a Colleague' scale consisted of strategies that involved deferring the decision to a colleague or manager. If decisions included in the 'Immediate Assessment and Antibiotics' and 'Consult a Colleague' scales are a function of high levels of uncertainty then they may be pursued to alleviate the anxiety associated with uncertainty, to 'cure' or reject uncertainty (Han et al., 2021). Nurses who had a lower tolerance of uncertainty, specifically in the clinical context were more likely to favour these strategies. Prior research has found that nurses report consulting a colleague as common practice over accessing medical or academic journals in reducing uncertainty (Cranley et al., 2012). Given the time constraints in RACF and the ready availability of colleagues compared to other resources of information, consulting with them is likely to produce a more immediate response (and anxiety reduction). In the current study, the 'Noting and Call GP' scale was negatively correlated with both general and clinical intolerance of uncertainty as well as measures of nurses' anxiety. These findings suggest that nurses with a higher tolerance to uncertainty and lower scores of state anxiety are more likely to engage in 'wait and see' strategies, such as noting changes in the resident's presentation and urging colleagues to continue monitoring the resident. These 'wait and see' strategies acknowledge the experience of uncertainty rather than attempts at curing uncertainty (Han et al., 2021).

The findings from the current study indicate that nurses with a low tolerance for uncertainty are more likely to make decisions consistent with pro-prescribing than nurses with a high tolerance for uncertainty. Further, the clinical context of uncertainty is salient in influencing decisions, beyond general tolerance of uncertainty and anxiety. The impact of the intolerance of uncertainty on both, clinicians, patients and the economic impact on the system is well-established. Further, Han et al. (2021) developed a taxonomy to describe the breadth of strategies that physicians use to manage both, uncertainty and the negative effects experienced by being aware of their uncertainty. Since the tolerance of uncertainty has been described as a multidimensional, partially mutable state that can be targeted through specific interventions (Hillen et al., 2017; Quinlan & Deane, 2021) finding a relationship between pro-prescribing decisions and clinical intolerance of uncertainty in nurses offers new avenues for future stewardship interventions (e.g., clinical supervision, practice case formulation or reflective diaries). Given that the current study had a significant number of experienced nurses (>3 years) working in RACF, it is unlikely that the phenomena observed are due to a lack of experience or education, but likely due to the specific tensions present in managing care in RACF.

5 | LIMITATIONS

There were several limitations to the current study. The study was observational in design, such that the vignette described intentions rather than measuring diagnosis and actual prescribing behaviours. As such, there is a need to further validate the new vignette measure and its subscales with nursing diagnosis, or use of clinical tools (e.g., McGreer criteria) and/or actual prescribing behaviour. Additionally, the small to moderate correlations in this study suggest that

decisions made by clinicians regarding seeking antibiotics might only in part be predicted by clinicians' ability to tolerate uncertainty and anxiety. Other factors, such as past experiences (e.g., with residents, families and prescribers), team norms and attitudes, and perceptions regarding role might be other non-clinical barriers that have not been explored in the current study. Lastly, the use of economic benefits through compensation for participation in recruiting participants has the potential to introduce social desirability bias in their responses. However, the online and anonymised nature of the study, the use of a third-party recruitment agency and the large variability in the training, experience and roles of the group with multiple aged-care facilities across Australia that was recruited increase confidence in the findings of the current study.

6 | FUTURE RESEARCH

The current study did not compare the perceived need for antibiotics with actual behaviours. Future studies could collect data regarding prescriptions within nursing homes alongside these scales to establish whether there is a link between nursing behaviours and prescribing outcomes or administer the measure by asking nurses about their diagnostic process and/or looking at some of the specific behaviours over the past week/month (i.e., Timeline Follow-back method). Additionally, findings from the studies highlight the complexity inherent in making decisions regarding the appropriate prescribing of antibiotics in aged care. Further studies could elaborate on these factors by modifying the vignettes to include prescribers' reactions (e.g., anger, dismissal) or regret regarding the deterioration of a resident. The majority of the participants in this study were experienced nurses, with more than 3 years of work experience in RACF. Given several studies report conflicting findings regarding the effects of clinician training and experience on tolerance of uncertainty and behaviours (Strout et al., 2018), future studies could also explore how years of experience affect these variables. Lastly, given that several stewardship interventions to date have been educational, future studies could modify the vignettes to include this strategy as one of the responses to elaborate on nurses' perceptions regarding the use of guidelines and/or educational resources.

7 | CONCLUSION

Despite these limitations, the current study provides preliminary evidence for the use of the Immediate Assessment and Antibiotics scale in measuring pro-prescribing nursing behaviours in RACFs. Further, the study provides empirical support for nurses' clinical intolerance of uncertainty as potentially influencing the perceived need for antibiotics in RACFs. Furthermore, nurses' intolerance of uncertainty and state anxiety also has the potential to influence nurses' ability to engage in 'wait and see' strategies. These findings suggest that there is a need for interventions that help nurses manage uncertainty and anxiety, particularly regarding managing relationships with residents and their family members when making clinical decisions to reduce some of the inappropriate initiation of antibiotics in RACFs.

8 | IMPLICATIONS FOR PRACTICE

These findings have significant implications for stewardship and policy. Psychosocial factors, such as anxiety, uncertainty and perceptions of risk have been largely unexplored in the stewardship literature despite being identified as barriers to reducing some of the overprescribing in residential aged-care facilities. There is a lack of valid measures that recognise and capture the complex and nuanced context of decisions contributing to antibiotic initiation made in residential aged care facilities. This study provides a first step towards understanding how contextual factors (such as pressure from colleagues and/or families) have the potential to influence nursing behaviours adjacent to antibiotic prescribing. Further, the study also provides potential direction for future stewardship efforts to expand beyond traditional educational paradigms that have been unsuccessful in addressing these contextual barriers. This is particularly relevant for nursing educators, administrators and team leaders in acknowledging uncertainty regarding the need for antibiotics and modelling strategies to manage anxiety in making decisions regarding resident care.

AUTHOR CONTRIBUTIONS

SS collected, analysed and interpreted the data. FD, CD and PC helped in analysing and interpreting the data, with major contributions in writing the manuscript. AM and PD provided significant help in developing the scale and writing the manuscript from a nursing perspective. All authors read and approved the final manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Deidentified data is available on request from the corresponding author.

ETHICS STATEMENT

The study was approved by *The University of Wollongong and Illawarra and Shoalhaven Local Health District Health and Medical Human Research Ethics Committee*: HREC: 2021/015. The authors have checked to make sure that our submission conforms as applicable to the Journal's statistical guidelines. FD and PC have experience in quantitative methods and analysis on the author team. The author(s) confirm that the methods used in the data analyses are suitably applied to our data within our study design and context, and the statistical findings have been implemented and interpreted correctly. The author(s) agrees to take responsibility for ensuring that the choice of statistical approach is appropriate and is conducted and interpreted correctly as a condition to submit to the Journal.

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APPENDIX

'NAVNEET' VIGNETTE: UPPER RESPIRATORY TRACT INFECTION VIGNETTE (URTIV)

Navneet is an 80 year old male client of the aged care facility. He is mobile and active but needs to live in care because of his dementia. Navneet is also on ACE Inhibitors and Beta blockers for congestive heart failure which is reasonably well controlled, but can occasionally lead him to have a dry and hacking cough when he first gets up in the morning. Navneet has no family living nearby so his main social connections are with the nursing staff and other residents.

During winter Navneet contracts a cold that has started to circulate among the clients. He develops a mild fever (37.9°C) and has a blocked nose, but feels much better after he has been given some paracetamol to control symptoms. However, after a few of days of feeling lousy, Navneet's cough begins to become productive so Navneet frequently needs to clear sputum and the cough itself sounds 'wetter'. His temperature is still a bit high (varying between 37.0C and 38.5) when the paracetamol wears off – but for the first 2–3 h after administration this medication continues to alleviate some of his symptoms so that he is still mobile and spending time in the dining hall and shared lounge with other residents. The centre remains closed to non-essential visitors because of the COVID-19 pandemic – but because of the risk Navneet and all other clients have recently had a COVID test, which returned negative.

Please indicate your level of agreement with each of the questions below:

Navneet's situation makes me feel anxious.

Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1	2	3	4	5	6

Please rate each of the choices below in terms of how likely is it that you would implement the following decisions in response to Navneet's symptoms?

1. You make a note on Navneet's care plan to ensure that other care staff keep an eye on him.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

2. You consult another colleague about Navneet's symptoms and ask them what is the best way to deal with them is

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

3. You arrange a call to the consulting GP in regards to Navneet's increased symptoms (e.g., increased sputum, cough sounding 'wetter')

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

4. You suggest to your supervisor that you need to contact the GP to start the antibiotics earlier.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

On a scale of 1–100, how confident do you feel about your decisions?

(0 = I am not very confident about my decisions; 100% confident = I am very confident about my decisions).

_____.

Please indicate your level of agreement with each of the questions below:

These decisions fall within the scope of my role.

Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1	2	3	4	5	6

My decisions were influenced by people other than the patient who are involved in this case (e.g., family, colleagues, manager, doctors/GP).

Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1	2	3	4	5	6

The next day you are told by other carers that Navneet seems to be losing his appetite – and has not eaten more than half of his last 3 meals. Even though he has a persistent mild fever and his cough is more noticeable, his blood pressure, pulse rate and oxygen saturation are normal – Navneet seems to be managing okay. Near the end of your shift on a Wednesday one of the nursing assistants involved in his care tells you he is worried that Navneet might be developing a lower respiratory tract infection and urges you to do something about it.

Please indicate your level of agreement with each of the questions below:

Navneet's situation makes me feel anxious.

Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1	2	3	4	5	6

Please rate each of the choices below in terms of how likely is it that you would implement the following decisions in response to Navneet's symptoms?

5. You update Navneet's care plan, noting the loss of appetite and worsening of cough. You continue to urge staff to monitor Navneet's symptoms.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

6. You consult another colleague about Navneet's symptoms and ask them what the best way to deal with them might be.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

7. You arrange to book an appointment for the visiting radiographer to take an x-ray of Navneet's chest, subject to the GP writing a radiology request.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

8. You arrange a call to the consulting GP in regards to Navneet's symptoms and check regarding other steps.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

9. Given Navneet's presentation, you urge the GP to start antibiotics over the phone.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

10. You ask your manager whether you should call an ambulance to get Navneet assessed at casualty/emergency.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

On a scale of 1–100, how confident do you feel about your decision?

(0 = I am not very confident about my decision; 100% confident = I am very confident about my decision).

_____.

Please indicate your level of agreement with each of the questions below:

This decision making falls within my scope of role.

Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1	2	3	4	5	6

My decisions were influenced by people other than the patient who is involved in this case (e.g., family, colleagues, manager, doctors/GP).

Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1	2	3	4	5	6

On Friday a few days later Navneet's cough becomes worse again, so you start taking regular measures of some of his vital signs. To you, he still seems fairly alert and responsive but his temperature persistently remains above 38®C. The GP is called and organises a time to come and visit. After Navneet is examined by the GP she tells you that it is likely he has a post-viral cough – which is exacerbated by his heart failure. She instructs you to increase the dose of his heart medications and writes Navneet a script for an antibiotic – telling you to go and get it filled if Navneet is not improving in 2 to 3 days.

The next day Navneet is coughing a little bit more frequently and complaining that it hurts when he coughs but he is eating a bit more and his temperature is lower, even though he still has a very mild fever. Your colleague, the nursing assistant suggests that you should start giving him the antibiotic now – just in case waiting the extra few days will lead him to get pneumonia. On Sunday Navneet seems much the same, he still has a productive cough, is uncomfortable during and immediately after coughing, and still has a mild fever when not on Paracetamol.

Please indicate your level of agreement with each of the questions below:

Navneet's situation makes me feel anxious.

Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1	2	3	4	5	6

Please rate each of the choices below in terms of how likely is it that you would implement the following decisions in response to Navneet's symptoms?

11. You note the doctor's instructions on Navneet's care plan and urge staff to continue monitoring Navneet's symptoms over the next 2–3 days.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

12. You update Navneet about the doctor's instructions, explain why the cough has worsened.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

13. You consult another colleague about how to handle Navneet's situation regarding the potential risk of pneumonia and ask them what the best way forward might be.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

14. You seek your manager's opinion about giving Navneet antibiotics just in case he gets worse.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

15. Antibiotics that are usually given for a chest infection are available. Although it hasn't been 3 days, during handover you are advised that the previous nurse has started the antibiotics. You continue administering the antibiotics.

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

16. You ask your manager whether you should call an ambulance and get him assessed at casualty/emergency to assess him quicker

Definitely not	Highly unlikely	Somewhat unlikely	Somewhat likely	Highly likely	Definitely would
0	1	2	3	4	5

On a scale of 1–100, how confident do you feel about your decisions?

(0 = I am not very confident about my decisions; 100% confident = I am very confident about my decisions).

_____.

Please indicate your level of agreement with each of the questions below:

These decisions fall within the scope of my role.

Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1	2	3	4	5	6

My decisions were influenced by people other than the patient who is involved in this case (e.g., family, colleagues, manager, doctors/GP).

Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1	2	3	4	5	6