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ORIGINAL ARTICLE

Development and psychometric evaluation of the Attitudes Towards Recognising Early and Noticeable Deterioration (ATREND) scale

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Abstract

Aims and objectives: To develop and evaluate the psychometric properties of an instrument that measures nurses' Attitudes Towards Recognising Early and Noticeable Deterioration (ATREND).

Background: General ward nurses play an important role in recognising patient deterioration. However, their attitudes towards early recognition of clinical deterioration have not been adequately explored due to the lack of a valid and reliable scale.

Design: An instrument development and validation study.

Methods: A three-phase structure that followed the STROBE checklist was used: (1) item generation, (2) content and face validity assessment and (3) psychometric properties evaluation. The scale items were developed based on a comprehensive literature review and content validity assessment by 15 international experts from five countries. The psychometric properties of the ATREND scale were tested on 434 registered nurses, with retest evaluations ($n = 100$) at two hospitals. Exploratory and confirmatory factor analyses were used to examine the factor structure of the scale. The scale was also evaluated for its internal consistency, test–retest reliability and convergent validity.

Results: The scale's content validity was 0.95. A 3-factor solution was identified from the final 11 items: (1) beliefs about importance of patient observation, (2) use of broader patient assessment skills and (3) confidence in recognising clinical deterioration. The internal consistency reliability of the scale was supported with an acceptable Cronbach's alpha value of 0.745. Test–retest reliability of the scale was excellent, with an intraclass correlation coefficient of 0.825. The ATREND scale shows evidence of good convergent validity.

no role in the design and conduct of the study, the collection, management, analysis and interpretation of the data, or the preparation, review or approval of the manuscript.

Conclusion: The final 11-item ATREND scale demonstrates adequate initial evidence of reliability and validity for use in acute ward settings.

Relevance to clinical practice: Nursing educators and clinicians may use this scale to assess ward nurses' attitudes and practices towards early recognition of clinical deterioration and then enhance their competencies and behaviours in the recognition of clinical deterioration.

KEYWORDS
attitudes, clinical deterioration, instrument development, nurses, nursing, patient assessment, reliability, validity

1 | INTRODUCTION

Timely recognition of and response to deteriorating hospitalised patients has been an international patient safety priority among healthcare institutions over the past two decades (Australian Commission on Safety & Quality in Health Care, 2021; Liaw et al., 2020; Smith et al., 2019). Nurses play a pivotal role in recognising and responding to clinical deterioration in a timely manner, because they are the healthcare professional responsible for ongoing patient observation and often spend the most time with patients (Chua et al., 2019; Iddrisu et al., 2018). Despite adoption of track-and-trigger tools in hospitals, such as early warning scores, delays in recognition of acute clinical deterioration and escalation of care by ward nurses continues (Eddahchouri et al., 2021; Ede et al., 2020; Tirkkonen et al., 2020). To date, researchers have investigated compliance with track-and-trigger tools and explored factors related to protocol compliance. However, research investigating ward nurses' attitudes and practices towards early recognition of clinical deterioration is lacking because of the absence of a valid scale. Attitude is a modifiable construct that can be addressed to drive behaviour change and improve practices related to the care of deteriorating patients. Thus, it is important to identify aspects of nurses' attitudes towards recognising early signs of clinical deterioration.

What does this paper contribute to the wider global clinical community?

- We developed and validated the Attitudes Towards Recognising Early and Noticeable Deterioration (ATREND) scale, and the following three domains were identified: beliefs about detection of patient deterioration, use of broader patient assessment skills and confidence in recognising clinical deterioration.
- The 11-item ATREND scale is a short scale that could be useful for nurse educators, researchers and clinicians to assess which aspects of nurses' attitudes towards recognising early signs of clinical deterioration need to be improved and consequently, develop focused interventions to enhance ward nurses' competencies and behaviours in the recognition of clinical deterioration.

2 | BACKGROUND

Hospitalised patients who deteriorate in general ward settings are at risk of serious adverse outcomes, such as unplanned admissions to the intensive care unit, respiratory or cardiac arrest or death (Tirkkonen et al., 2016; Vincent et al., 2018). Studies have shown that most serious adverse events are often preceded by a period of recognisable abnormalities in vital signs from minutes up to 24 h, and this can occur at any time during patients' hospitalisation (Al-Moteri et al., 2019; Andersen et al., 2016; Kause et al., 2004; McGaughey et al., 2007). Failure to recognise deleterious changes to vital signs, combined with a failure to seek appropriate medical help and intervene in a timely manner, has prompted the widespread adoption of physiological track-and-trigger tools in acute hospitals (Australian Commission on Safety & Quality in Health Care, 2021; Credland et al., 2021; Royal College of Physicians, 2017). The physiological track-and-trigger tools typically include nursing staff recording routinely measured vital signs and when the patient's vital signs fall outside of the predetermined acceptable parameters, the staff is required to "trigger" an escalation process that stipulates clinical actions and response times (Shiloh et al., 2016). The purpose of physiological track-and-trigger tools is to aid ward nurses to detect signs of deterioration in patients and then initiate interventions according to the escalation protocols, in order to prevent further clinical deterioration (McGaughey et al., 2017).

Even with the implementation of track-and-trigger tools, successful recognition of early clinical deterioration mostly depends on the quality and frequency of vital signs measurements, interpretation of vital signs readings and compliance with subsequent escalation protocol-driven actions (Eddahchouri et al., 2021). Recent research continues to show evidence of patient deterioration being detected late or being missed, contributing to the development of serious adverse events, despite the high level of adoption of physiological track-and-trigger tools in hospitals (Eddahchouri et al., 2021; Ede et al., 2020; Tirkkonen et al., 2020). Contributing factors to delayed or missed recognition of deteriorating patients among ward nurses include infrequent and incomplete vital signs

measurements and charting (Al-Moteri et al., 2019; Credland et al., 2018; Eddahchouri et al., 2021), insufficient knowledge of normal vital signs values and lack of appreciation of some vital signs (Al-Moteri et al., 2019; Mok et al., 2015; Wood et al., 2019), lack of supervision of nursing staff delegated to vital signs monitoring (Chua et al., 2019, 2022; Smith et al., 2021a), excessive workloads (Allen, 2020; Wood et al., 2019) and privileging vital signs readings over own clinical judgement and holistic patient assessment (Osborne et al., 2015; Wood et al., 2019).

Patients can also develop early and subtle abnormal changes in their clinical condition that are not reflected in observable changes in vital signs, such as altered respiratory effort, mental status fluctuations, change in behaviours, pallor and acute pain (Cioffi et al., 2009; Douw et al., 2015). Subjectively, a patient's condition may be deteriorating, but the objective vital signs measurements may not be severe enough to trigger the escalation protocols. As opposed to rule-based behaviour assisted by track-and-trigger tools, recognising and acting upon subtle and early cues of clinical deterioration demands knowledge-based behaviour using assessment and observation skills, clinical nursing experience and cognitive processing (Credland et al., 2018). Routine vital signs measurements aside, ongoing patient assessment and observation are necessary throughout a patient's hospitalisation in order to detect subtle cues that may provide the opportunity for earlier intervention (Osborne et al., 2015). Yet, existing studies collectively highlight that failure to recognise clinical deterioration is partly due to nurses' inadequate physical assessment skills (Douglas et al., 2014; Tan et al., 2021). Additionally, the response to patients who are "trending" towards clinical deterioration or exhibiting subtle signs of deterioration, while their vital signs remain within the acceptable parameters, is often delayed because nurses are more inclined to wait for more objective and quantifiable data to become available (Chua et al., 2017, 2020). In addition to concerns of having their clinical judgement undermined without the presence of quantifiable evidence of patient deterioration, another reason for nurses' lack of actions is related to insufficient confidence in their patient assessments and clinical judgement (Chua et al., 2019; Tan et al., 2021).

In recent years, there are increasing calls for a behavioural focus approach to address gaps in nurses' early recognition and actions on clinical deterioration (Credland et al., 2018; Smith et al., 2019, 2021b; Walker et al., 2021). While education is an important prerequisite for behaviour change, it alone is rarely sufficient to achieve desired behavioural change (Arlinghaus & Johnston, 2017). For decades, the attitude construct has played an important role in analysing behaviour because of strong attitude–behaviour relations (Ajzen & Fishbein, 1977; Guyer & Fabrigar, 2015). Early behavioural theories, in particular the theory of reasoned action, posit that attitude influences intention, and that intention is a direct precursor of behaviour (Ajzen & Fishbein, 1977). Attitude can be expressed as a set of emotions, beliefs and behaviours towards an object, event or situation (Eagly & Chaiken, 2007). It is acquired and formed through experience, learning processes and social factors (Frymier & Nadler, 2017). Modifying attitudes can strengthen the intention to enact a desired behaviour and, therefore, increase the probability that the behaviour is enacted (Ajzen & Fishbein, 2000; Presseau et al., 2019).

The attitudes of ward nurses towards early recognition of clinical deterioration can affect their compliance with track-and-trigger tools, provision of vigilance to patients at-risk of deterioration, and awareness of the importance of physical assessments to recognise early changes in a patient's clinical status. However, general ward nurses' attitudes towards early recognition of clinical deterioration have not been adequately explored because of a lack of a valid and reliable scale. Knowing and understanding aspects of suboptimal attitudes and practices towards recognising early signs of clinical deterioration are crucial to the development of educational strategies and targeted behaviour change interventions to enhance ward nurses' competencies in recognising clinical deterioration. Therefore, the aim of this study was to develop and test the psychometric properties of a new scale that measures ward nurses' attitudes towards recognising early and noticeable deterioration in general wards.

3 | METHODS

3.1 | Design

This scale development study followed three stages: (1) generation of the item pool of the Attitudes Towards Recognising Early and Noticeable Deterioration (ATREND) scale, (2) assessment of content and face validity, and (3) refinement and evaluation of the psychometric properties of the ATREND scale (Figure 1). The study report adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies (von Elm et al., 2007) (Supplementary File 1 in Appendix S1).

3.1.1 | Stage 1: Item generation

The item pool was generated on the basis of a comprehensive literature review on this topic and two previously published qualitative studies on nurses' experiences with recognising clinical deterioration on general wards (Chua et al., 2019, 2022). From the initial review of literature, six themes related to nurses' recognition of early signs of clinical deterioration were identified: awareness of clinical deterioration, vital signs assessment, application of physical assessment skills, confidence, technology and equipment, and reliance on others. For confirmation that the themes identified from the literature were reflective of nurses working in the general wards and captured salient attitudes to recognising clinical deterioration, content analysis was performed on the transcripts of the aforementioned qualitative studies. The transcripts were read and reread by the study team. Key quotes that reflected the views and opinions of nurses about the recognition of early signs of clinical deterioration in general wards were identified, refined and then converted into attitudinal descriptors.

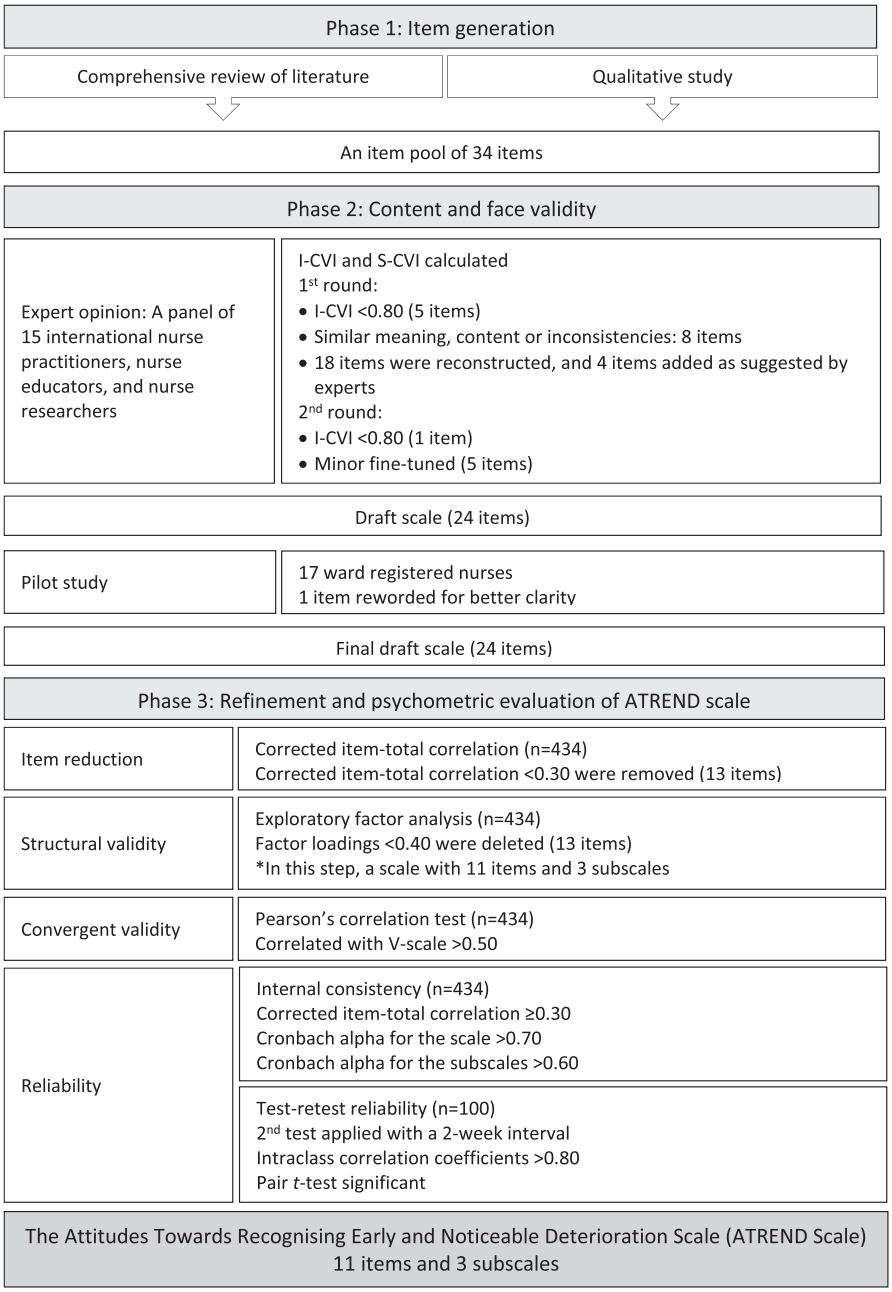

FIGURE 1 Process of development of the Attitudes Towards Recognising Early and Noticeable Deterioration Scale (ATREND Scale)

A total of 34 positively and negatively worded items were constructed, representing six domains of nurses' attitudes towards recognising early signs of clinical deterioration. All items were designed to be rated using a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The negative worded items were required to be reverse scored, and a higher composite score represented a more positive attitude towards early recognition of clinical deterioration.

3.1.2 | Stage 2: Content and face validation

Following item generation, a panel of 15 content experts evaluated the content validity of these 34 items. The content experts comprised nurse practitioners, nurse educators and nurse researchers from Australia (n = 3), the Netherlands (n = 2), New Zealand (n = 1), Singapore (n = 7) and the United Kingdom (n = 2). The experts were chosen on the basis of their extensive work in the field of clinical deterioration, rapid response system and critical care outreach. The experts rated the relevance of each item using a 4-point Likert scale (1 = not relevant to 4 = very relevant) and were also invited to provide comments and suggestions for additional items.

The item-content validity index (I-CVI) was calculated for each item, and the scale-content validity index (S-CVI) was calculated for the total scale. The I-CVI and S-CVI were calculated as the number of experts who gave a rating of 3 or 4, divided by the total number of experts, and the average I-CVI, respectively (Polit & Beck, 2006). Acceptable content validity was defined as I-CVI ≥ 0.80 and

S-CVI ≥ 0.90 if the number of expert was 6 or greater (Lynn, 1986; Polit & Beck, 2006).

After two rounds of content validity assessment by the same panel of experts, the preliminary scale was piloted on 17 ward nurses of varied years of nursing experience to evaluate the scale for its clarity, ease of use and appropriateness. The nurses were asked to first complete the scale and provide written comments about the scale in terms of the format, content, comprehensibility and ease of reading. They were also asked to make suggestions for improvement of the scale.

3.1.3 | Stage 3: Refinement and psychometric evaluation of the ATREND scale

Setting

The psychometric evaluation of the preliminary ATREND scale was conducted at two public hospitals within the National University Health System in Singapore. Hospital A is a 700-bed acute general hospital that offers a range of comprehensive medical services for adults, while Hospital B is a 1200-bed tertiary hospital that offers a comprehensive suite of specialist care, including transplant services, for adults and children.

Participants

All registered nurses (RNs) with job grades of staff nurse, senior staff nurse or assistant nurse clinician who were working in the adult general wards were eligible for the study. RNs who held more senior nursing positions, such as nurse manager, nurse educator, nurse administrator or advanced practice nurse, were not eligible because they were less likely to be involved in the provision of bedside care compared with RNs in more junior clinical nursing positions. RNs who were in the hospital's induction programme or had not practised independently in the inpatient ward setting (i.e. under probation) were also excluded from the study.

A convenience sample of 434 RNs from the hospitals completed the questionnaires. A total of 100 out of the 434 RNs indicated their interest and participated in the retest to assess the test-retest reliability of the scale. This exceeded the estimated minimum sample size of 52 that is required to obtain the desired intraclass correlation coefficient (ICC) value of 0.80 for retest, with a significance level of 0.05 and a power of 80% (Shoukri et al., 2004).

Validating measure

The V-scale developed by Mok et al. (2015), which measures nurses' attitudes towards vital signs monitoring in the detection of clinical deterioration in general wards, was administered as a comparator for assessing the convergent validity of the ATREND scale. The V-scale, with a total of 16 items, measures five domains: key indicators of vital signs deterioration, knowledge, workload, communication and technology. Participants were asked to rate their views on a 4-point Likert scale, anchored from "1 = strongly disagree" to "4 = strongly agree." A higher total score reflects a more positive attitude towards vital signs monitoring. The psychometric properties of the scale had previously been tested among a convenience sample of 234 registered and enrolled nurses who were working in the general wards of the acute care hospital in Singapore. The study yielded good empirical evidence for the construct validity and reliability of the V-scale. The overall Cronbach's alpha for scale was 0.71, and the overall ICC was 0.85 (95% CI [0.760–0.917], $p < .01$; Mok et al., 2015). Permission to use the V-scale was sought from the authors.

Data collection

Data collection took place between June and July 2021. All eligible RNs were invited to complete the online questionnaire in their own time. The online questionnaire comprised a cover letter that explained the purpose of the study, the content validated ATREND scale, the 16-item V-scale and demographics questions. The retest of the ATREND scale was administered 2 weeks after completion of the first test. A 2-week interval between test administrations was used to reduce carry-over effects owing to memory responses, which could possibly inflate the reliability estimates (Marx et al., 2003). Likewise, the retest was conducted through an online questionnaire. All participants received a small token of remuneration for their time.

3.2 | Data analysis

In the analysis of the content validity assessment of the scale items, the I-CVI and S-CVI were computed accordingly. In the validity and reliability testing of the ATREND scale, statistical analyses were performed using IBM SPSS version 26.0 (IBM Corp, 2019) and the R Project for Statistical Computing "paran" package (R-3.5.124; R Core Team, 2018). All negatively worded items were reverse coded. The sample size of 434 satisfied the minimum sample-to-item ratio of 5:1 for performing exploratory factor analysis (EFA; Costello & Osborne, 2009). Descriptive statistics were used to summarise the sample characteristics.

Corrected item-total correlation was used to evaluate how well items related to the instrument and to each other. Items with a corrected item-total correlation of less than 0.30 were deleted (Boateng et al., 2018). An EFA, using principal component analysis (PCA) with varimax rotation, was conducted to examine structural validity. Horn's parallel analysis, using the Monte Carlo Simulation Technique with 10,000 replications (Horn, 1965) and factor loadings of ≥0.40 (DeVellis, 2017), was applied to determine the factor structure. Subsequently, the factor structure derived from the prior EFA was tested with confirmatory factor analysis (CFA), using the diagonally weighted least square estimator. The following indices and its cut-off criteria were used to assess the model fit of the CFA model: χ^2/degree of freedom ($\chi^2/df < 3$), adjusted goodness-of-fit index (AGFI ≥ 0.90), comparative fit index (CFI ≥ 0.95), goodness-of-fit index (GFI ≥ 0.95), incremental fit index (IFI ≥ 0.95), normed fit index (NFI ≥ 0.95), root mean square error of approximation (RMSEA < 0.60), standardised root mean square residual (SRMSR ≤ 0.80) and Tucker–Lewis

Index (TLI ≥ 0.95; McDonald & Ho, 2002; Schreiber et al., 2006). Convergent validity of the ATREND scale was examined by correlating scores of the ATREND scale and the V-scale using Pearson's product-moment correlation test.

Internal consistency reliability of the ATREND scale was examined using Cronbach's alpha, with an acceptable cut-off value of ≥0.70 for the overall scale (Boateng et al., 2018). Test–retest reliability was assessed using the pair-samples *t*-test and the ICC test, with a value of ≥0.80 considering good test–retest reliability (Koo & Li, 2016).

The presence of floor and ceiling effects of the ATREND scale were also examined. The commonly used 15% threshold for participants endorsing the highest (5 = strongly agree) and lowest (1 = strongly disagree) point of the Likert scale to define ceiling and floor effect respectively, was adopted (Lim et al., 2015). The relationships between the subscale scores were analysed using Pearson's correlation analysis. The associations between nurse and workplace characteristics and nurses' attitudes towards recognising early signs of clinical deterioration were examined using the independent samples *t*-test and one-way analysis of variance. For all analyses, the level of statistical significance was set at 0.05.

3.3 | Ethical considerations

Ethics approval for the study was obtained from the National Healthcare Group Domain Specific Review Board (Ref: 2020/01135). All potential participants were provided with information about the study and were recruited for the study on a voluntary basis. All participants gave informed consent and were assured of confidentiality.

4 | RESULTS

4.1 | Content and face validity

The content validity of the initial 34 items generated was evaluated by a panel of 15 content experts. In the first round of assessment, the I-CVI ranged from 0.62 to 1.00, and the S-CVI was 0.904. Five items were deleted as their I-CVI was <0.80. Even though the rest of the 29 items had I-CVI values of >0.80, the content experts suggested that the items be reviewed for similar meaning and clarity in the item statements. A further eight items were removed: four items were removed because of duplicity with other items, and other four items were removed because of inconsistencies. A total of 18 items were reconstructed for the following reasons: better choice of words, clearer meaning and improved comprehensibility (Supplementary File 2 in Appendix S1). In additional, four items were added on the basis of recommendations of the experts, resulting in 25 items for the second round of the content validity assessment.

In the second round, the I-CVI ranged from 0.79 to 1.00, and the S-CVI was 0.944. The only one item with I-CVI < 0.80 was removed, and minor fine-tuning was made to five items for clarity. Finally, these 24 items composed the preliminary version of ATREND scale with an adequate content validity (S-CVI = 0.95).

The pilot testing of the 24-item ATREND scale among 17 ward RNs led to the rewording of one item for improved clarity. No further comments were made to revise or delete any of the items. Thus, the revised 24-item ATREND scale was determined as the version for psychometric testing.

TABLE 1 Sample characteristics (*n* = 434)

Characteristics	*n* (%)
Age (years)	
20–29	210 (48.4)
30–39	174 (40.1)
40–49	41 (9.4)
50 and above	9 (2.1)
Years of nursing experience	
2 and below	84 (19.3)
3–5	112 (25.8)
6–10	125 (28.8)
11–15	81 (18.7)
More than 15	32 (7.4)
Nursing job grade	
Staff nurse	233 (53.7)
Senior staff nurse	175 (40.3)
Assistant nurse clinician	26 (6.0)
Highest nursing educational qualification	
Basic nursing training certificate/Diploma in Nursing	159 (36.6)
Advanced diploma in nursing	22 (5.1)
Degree in nursing	250 (57.6)
Post-graduate degree	3 (0.7)
Area of practice	
Cardiology	15 (3.4)
General/internal medicine/acute medical	156 (35.9)
General surgery/orthopaedic surgery	91 (21.0)
Geriatric medicine	25 (5.8)
Isolation/infectious disease	23 (5.3)
Obstetrics and Gynaecology	25 (5.8)
Neurology/Neurosurgery	56 (12.9)
Others[a]	43 (9.9)

[a]Includes cardiothoracic and vascular surgery, inpatient dialysis unit, haematology and oncology, and psychiatric medicine.

4.2 | Psychometric testing of the ATREND scale

4.2.1 | Participant characteristics

Table 1 presents the demographic characteristics of the participants. The majority of the nurses had between 3 and 10 years of nursing experience (54.6%), had attained a degree in nursing education

(57.6%), held a job grade of staff nurse (53.7%) and were working in either a medical or surgical ward setting (56.9%).

4.2.2 | Item reduction

The corrected item-total correlation coefficients of the 24 items ranged from −0.100 to 0.548. Twelve items with a corrected item-total correlation of <0.30 were removed; thus, 12 items were retained for further psychometric testing.

4.2.3 | Structural validity

In this study, the Kaiser–Meyer–Olkin measure of sampling adequacy (0.765) and Bartlett sphericity test ($\chi^2 = 1213.4$, $df = 66$, $p < .001$) results implied that the data were appropriate for an EFA. The scale's structural validity was first tested with EFA using PCA. Cattel's scree test (Cattell, 1966), Kaiser criterion of all factors with eigenvalues-greater-than-one rule (Kaiser, 1960) and Horn's parallel analysis (Horn, 1965) were used to determine the scale's factor structure. The results indicated that the scale had a three-factor structure.

After varimax rotation, one item with a factor loading <0.40 was removed. A rerun of the PCA was performed on the remaining 11 items. A three-dimensional, 11-item ATREND scale was presented in the final EFA. The rotated factor loadings of the 11 items ranged from 0.480 to 0.848 (Table 2). The three factors were named: (1) beliefs about importance of patient observation, (2) use of broader patient assessment skills and (3) confidence in recognising clinical deterioration, together explaining 56.30% of the total variance.

The 11-item and three-factor structure found with EFA was tested with CFA. The fit indices were all acceptable and demonstrated a good fit of the three-factor structure: $\chi^2/df = 1.516$, AGFI = 0.956, GFI = 0.973, CFI = 0.973, IFI = 0.973, NFI = 0.925, RMSEA = 0.035, SRMSR = 0.058 and TLI = 0.963.

4.2.4 | Convergent validity

Convergent validity was satisfactory, considering that the ATREND scale had significant and positive correlation with all the subscales and the overall V-scale. Specifically, higher total scores of V-scale were associated with higher scores of *beliefs about importance of patient observation* ($r = 0.31$, $p < .001$), *use of broader patient assessment skills* ($r = 0.46$, $p < .001$), *confidence in recognising clinical deterioration* ($r = 0.50$, $p < .001$) and overall ATREND scale ($r = 0.55$; $p < .001$).

4.2.5 | Descriptive statistics and reliability

The mean scores, floor and ceiling effects, and scale reliability results are presented in Table 3. "Beliefs about importance of patient observation" was scored the highest, while "use of broad patient assessment skills" was scored the lowest. The correlations between subscales ranged from 0.213 ("use of broader patient assessment skills" and "confidence in recognising clinical deterioration") to 0.431 ("beliefs about importance of patient observation" and "confidence in recognising clinical deterioration").

Except for item 14 that has a floor effect of 27.9%, no floor effect was seen in other items (0.2%–10.8%). Ceiling effects were observed in all the 6 items in factor 1 (beliefs about importance of patient observation), with a range of 18.7% to 34.6%. No ceiling effects were seen in factor 2 and 3.

Cronbach's alpha for the 11-item ATREND scale and its three subscales indicated an acceptable internal consistency, with Cronbach's alpha ranging from 0.637 to 0.763 for each subscale and Cronbach's alpha of 0.745 for the total scale. The corrected item-total correlation of all the 11 items exceeded 0.30.

The test–retest method was used to assess the temporal stability of the scale. The paired samples *t*-test showed no significant difference between the measurements (*t* statistics = 0.982, $df = 99$, $p = .328$). The average measure of ICC of the total scale was 0.825 (95% CI [0.740, 0.882], $p < .001$).

4.2.6 | Final instrument

The ATREND scale consists of 11 items and three subscales: (1) beliefs about importance of patient observation (six items), (2) use of broader patient assessment skills (two items) and (3) confidence in recognising clinical deterioration (three items). The first subscale (beliefs about importance of patient observation) encompasses nurses' awareness about the importance of patient observation to detect early signs of clinical deterioration and their attitudes towards their role in patient observations and delegation of vital signs monitoring. The second subscale (use of broader patient assessment skills) is a proxy of RNs' use of patient assessment skills that extends beyond measuring vital signs to detect early signs of clinical deterioration. The third subscale (confidence in recognising clinical deterioration) relates to RNs' confidence in recognising clinically deteriorating patients. All items were rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) that evaluates the attitudes of general ward nurses towards early recognition of clinical deterioration. Items 13, 14 and 24 were negatively worded and were required to be reverse coded before inclusion in data analysis.

4.2.7 | Associations between sample characteristics and attitudes towards recognising clinical deterioration

As shown in Table 4, total attitude scores towards early recognition of clinical deterioration were observed to be significantly higher among nurses with more than 10 years of clinical nursing experience, nurses with a job grade of assistant nurse clinician and nurses who had attained a degree or a higher degree in nursing. No significant

TABLE 2 Rotated factor loadings of the 11-item Attitudes Towards Recognising Early and Noticeable Deterioration (ATREND) Scale ($n = 434$)

No.	Item	Factor loading		
		Factor 1: Beliefs about importance of patient observation	Factor 2: Use of broader patient assessment	Factor 3: Confidence in recognising clinical deterioration
2	I believe that most cardiopulmonary resuscitation events can be avoided with recognition and response to early signs of clinical deterioration	**0.495**	0.028	0.209
3	I believe that most episodes of clinical deterioration are detected when the patients develop early signs and symptoms of deterioration	**0.480**	0.007	0.221
10	I tend to recognise signs of clinical deterioration through both vital signs assessment and other patient assessment	**0.698**	0.157	0.043
11	I believe ongoing patient assessment that goes beyond vital signs monitoring is necessary to detect early signs of clinical deterioration	**0.769**	0.198	0.064
20	When I have delegated the task of vital signs monitoring to other nursing staff, I check over the recorded vital signs to ensure that there are no abnormalities that have been missed or not reported to me	**0.676**	0.117	0.071
21	I believe that nursing staff delegated to the task of vital signs monitoring are responsible for reporting any abnormality to me	**0.545**	−0.080	0.228
13	Other than vital signs assessment, I rarely perform other patient assessment to assess for early signs of clinical deterioration[a]	0.053	**0.874**	0.059
14	Other than vital signs assessment, I do not see the need to perform other patient assessment to detect early signs of clinical deterioration[a]	0.239	**0.848**	−0.026
22	I am confident in recognising early signs of clinical deterioration	0.372	−0.034	**0.762**
23	I am confident in performing patient assessment using a structured approach (e.g. ABCDE approach: Airway, Breathing, Circulation, Disability, Expose) to assess for clinical deterioration	0.328	−0.091	**0.764**
24	I lack confidence in recognising early signs of clinical deterioration that may not be reflected in a patient's vital signs[a]	−0.090	0.457	**0.679**
Eigenvalues		3.409	1.605	1.179
% variance explained		31.0%	14.6%	10.7%
Total % variance explained		56.30%		

Note: Bold characters indicate significant correlations between items and corresponding factors (factor loadings ≥ 0.40).

[a]Indicates a negatively worded item that was reversely coded before inclusion in the analysis.

TABLE 3 Internal consistency reliability of the 11-item Attitudes Towards Recognising Early and Noticeable Deterioration (ATREND) Scale ($n = 434$)

No.	Item	Mean (SD)	% floor effects	% ceiling effects	Corrected item-total correlation	Cronbach's α	α if item is deleted
Factor 1: Beliefs about importance of patient observation		4.17 (0.41)				0.704	
2	I believe that most cardiopulmonary resuscitation events can be avoided with recognition and response to early signs of clinical deterioration	4.12 (0.79)	1.4	31.3	0.348		0.733
3	I believe that most episodes of clinical deterioration are detected when the patients develop early signs and symptoms of deterioration	4.06 (0.62)	0.9	18.7	0.342		0.733
10	I tend to recognise signs of clinical deterioration through both vital signs assessment and other patient assessment	4.21 (0.65)	0.7	30.2	0.449		0.721
11	I believe ongoing patient assessment that goes beyond vital signs monitoring is necessary to detect early signs of clinical deterioration	4.20 (0.56)	0.5	26.3	0.545		0.713
20	When I have delegated the task of vital signs monitoring to other nursing staff, I check over the recorded vital signs to ensure that there are no abnormalities that have been missed or not reported to me	4.27 (0.62)	0.5	34.6	0.451		0.721
21	I believe that nursing staff delegated to the task of vital signs monitoring are responsible for reporting any abnormality to me	4.17 (0.65)	0.5	28.3	0.343		0.733
Factor 2: Use of broader patient assessment skills		3.66 (0.92)[a]			0.763		
13	Other than vital signs assessment, I rarely perform other patient assessment to assess for early signs of clinical deterioration[b]	2.59 (1.05)	10.8	3.7	0.340		0.742
14	Other than vital signs assessment, I do not see the need to perform other patient assessment to detect early signs of clinical deterioration[b]	2.10 (1.0)	27.9	1.8	0.427		0.724
Factor 3: Confidence in recognising clinical deterioration		3.75 (0.53)[a]			0.637		
22	I am confident in recognising early signs of clinical deterioration	3.97 (0.60)	0.2	14.5	0.479		0.719
23	I am confident in performing patient assessment using a structured approach (e.g. ABCDE approach: Airway, Breathing, Circulation, Disability, Expose) to assess for clinical deterioration	3.93 (0.61)	0.2	12.4	0.425		0.724
24	I lack confidence in recognising early signs of clinical deterioration that may not be reflected in a patient's vital signs[b]	2.65 (0.85)	6.5	1.2	0.351		0.734
Total scale: Attitudes Towards Recognising Early and Noticeable Deterioration (ATREND) Scale		43.61 (4.35)			0.745		

[a]When computing the mean subscale scores, the negatively worded items (item 13, 14 & 24) were reversed scored.

[b]Indicates a negatively worded item that was reversely coded before inclusion in the analysis.

TABLE 4 Differences in attitudes towards recognising clinical deterioration among different group of nurses ($n = 434$)

Characteristics	*n*	Total ATREND score (Range: 1–55) Mean (SD)	Beliefs about importance of patient observation (Range: 1–30) Mean (SD)	Use of broader patient assessment (Range: 1–10) Mean (SD)	Confidence in recognising clinical deterioration (Range: 1–15) Mean (SD)
Years of nursing experience[a]					
5 and below	196	42.43 (4.21)	24.63 (2.51)	7.13 (1.79)	10.67 (1.54)
6–10	125	44.23 (4.13)	25.20 (2.40)	7.51 (1.87)	11.52 (1.51)
More than 10	113	44.96 (4.31)	25.55 (2.42)	7.42 (1.89)	11.99 (1.37)
F-value (*p*-value)		14.75 (<0.001)	5.39 (0.005)	1.91 (0.15)	30.74 (<0.001)
Nursing job grade					
Staff nurse	233	42.62 (4.38)	24.69 (2.58)	7.11 (1.84)	10.82 (1.59)
Senior staff nurse	175	44.66 (3.91)	25.44 (2.30)	7.55 (1.82)	11.77 (1.43)
Assistant nurse clinician	26	45.38 (4.73)			
F-value/ *t*-value (*p*-value)		14.18 (<0.001)[a]	−3.18 (0.002)[c]	−2.47 (0.014)[c]	−6.52 (<0.001)[c]
Highest nursing educational qualification[a]					
Basic nursing training certificate/Diploma in Nursing	159	42.54 (3.93)	24.61 (2.14)	6.90 (1.92)	11.03 (1.54)
Advanced diploma in nursing	22	43.82 (4.37)	24.73 (2.07)	7.59 (1.92)	11.50 (1.50)
Degree in nursing and above	253	44.26 (4.48)	25.33 (2.67)	7.55 (1.74)	11.60 (1.62)
F-value (*p*-value)		7.92 (<0.001)	4.34 (0.014)	6.50 (0.002)	2.88 (0.049)

[a] One-way ANOVA test.

[b]Independent sample *t*-test.

[c]Independent sample *t*-test: staff nurse compared with senior staff nurse/assistant nurse clinician.

associations were found between area of practice and total attitude scores.

A further analysis was performed to examine sample characteristics and subscales of the ATREND scale. Having more than 10 years of nursing experience was associated with more positive attitudes towards beliefs about the importance of patient observation ($F(2, 431) = 5.39$, $p = .005$) and higher confidence in recognising early signs of clinical deterioration ($F(2, 431) = 30.74$, $p < .001$). No significant differences in the use of a broader set of physical assessment skills were observed among nurses regardless of their years of nursing experience. Nurses who attained a degree or a higher degree in nursing were associated with more positive attitudes towards beliefs about the importance of patient observation ($F(2, 431) = 4.34$, $p = .014$) and more likely to endorse the use of a broader set of physical assessment skills ($F(2, 431) = 6.50$, $p = .002$). Compared with RNs with job grades of senior staff nurse and assistant nurse clinician, staff nurses scored lower on their beliefs about the importance of patient observation ($t(432) = -3.18$, $p = .002$), the use of a broader set of patient assessment skills ($t(432) = -2.47$, $p = .014$) and their confidence in recognising early signs of clinical deterioration ($t(432) = -6.52$, $p < .001$).

5 | DISCUSSION

Recognising early signs of clinical deterioration is a key role of ward nursing staff because they have the most constant and prolonged patient contact compared with other healthcare professionals, which places them in an opportunistic position to recognise a change in the patient's condition. Therefore, a scale was developed to measure ward nurses' attitudes towards recognising early signs of clinical deterioration on general wards. The ATREND scale was developed using previous qualitative studies, a broad review of the literature and a panel of international experts' validations. Results of the psychometric properties testing of the scale have provided sufficient initial evidence of the ATREND scale as a valid and reliable scale, which has clinical and research applications to better understand ward nurses' attitudes and practices towards early recognition of clinical deterioration.

The structural validity of the ATREND scale was evaluated by performing an EFA, followed by a CFA. According to the final EFA results, the total variance explained by the three-factor structure was on the borderline of the recommended range for multidimensional scales (Hair et al., 2014). This indicates that the scale provides adequate coverage in evaluating nurses' attitudes and practices towards early recognition of clinical deterioration. At the same time, the CFA results demonstrated an acceptable fit of the model to the observed data, and the moderately strong positive correlation with the V-scale provides evidence supporting the convergent validity of the ATREND scale.

The three domains and each developed item were consistent with prior research in nurses' experiences in recognising clinically deteriorating ward patients. Factor 1 was labelled "beliefs about importance of patient observation" because it included items that reflect nurses' awareness about "early" clinical deterioration, which enlightens them about the importance of patient observation, and reflects their attitudes and practices in relation to patient observation and delegation of vital signs monitoring. Accounting for close to one-third (31.0%) of the variance explained, this factor echoes previous studies showing that having an awareness that a patient could be clinically deteriorating—exhibiting subtle or gradual changes in clinical conditions—before measurable clinical signs are evident is important for early recognition of clinical deterioration and raising the alarm not only when the patient has deteriorated catastrophically (Donohue & Endacott, 2010; Douw et al., 2017; Liaw et al., 2011). This would heighten nurses' vigilance about patient observation, undertaking both routine vital signs monitoring and other patient assessment to obtain a comprehensive view of a patient's clinical condition (Liaw et al., 2011; Massey et al., 2017). The literature has also described patient deterioration going unnoticed for a prolonged period when there is an over-reliance by RNs on enrolled nurses and healthcare assistants to perform and report vital signs abnormalities to the RNs, as well as when RNs do not periodically check the recorded vital signs or oversee the delegation of vital signs monitoring (Chua et al., 2019, 2022; Smith et al., 2021a, 2021b).

Factor 2 was labelled "use of broader patient assessment skills" because its items provided an assessment of ward nurses' attitudes and practices in using patient assessment skills that extend beyond vital signs assessment in picking up early signs of clinical deterioration. This factor is consistent with the theme of "primacy of vital signs" in nurses' patient assessment practice to pick up changes to patients' conditions, as recorded in Osborne et al. (2015) and Chua et al. (2019). The heavy reliance of vital signs abnormalities as the optimal cue for clinical deterioration risks devaluing the importance of recognising early and subtle cues of deterioration that may be observed through vigilant patient assessment and surveillance (Chua & Liaw, 2016; Osborne et al., 2015).

Factor 3 was labelled "confidence in recognising clinical deterioration" because it included items asking about ward nurses' confidence in recognising clinically deteriorating patients. This factor supports existing studies that show that a lack of clinical confidence often led to nurses' doubting their own assessment skills and clinical judgement to detect clinical deterioration, which could result in delay or failure in escalation of care (Chua et al., 2019; Massey et al., 2014; O'Neill et al., 2021).

The reliability of the ATREND scale was evaluated with corrected item-total correlation coefficients, Cronbach's alpha coefficient and the test–retest method. The results of the corrected item-total correlation coefficients and Cronbach's alpha coefficient showed that the items in the ATREND scale are homogeneous and correlated with each other as a whole, thus exhibiting an acceptable internal consistency (Furr, 2018). The stability of the scale was acceptable with a high ICC value of 0.825 (Furr, 2018). However, the notable ceiling and floor effects in factor 1, beliefs about importance of patient observation and item 14, respectively, might suggest limitations in the items' sensitivity and ability to discriminate between

individuals at the maximal spectrum of endorsing positive awareness about the importance of patient observation and their roles in patient observations, as well as the need to perform patient assessments other than vital signs monitoring (i.e. individuals who rated "strongly agree" for these affected items; Uttl, 2005).

In this study, use of broader patient assessment skills was rated the lowest, and we also found no association between RNs' years of nursing experience and the use of broader patient assessment skills. This finding may well be due to a general receding physical assessment skill set used by nurses, with vital signs assessment as their core skill set in their daily nursing practice as reported in previous studies (Chua et al., 2019; Shi et al., 2019; Tan et al., 2021). In addition, the reliance on vital signs derangement as the optimal cue for patient deterioration, as dictated by the early warning scoring systems, could marginalise other patient assessment skills (Osborne et al., 2015). Consequently, this could lead to nurses not adequately using assessment skills relevant to their clinical work area and patient profile (Osborne et al., 2015). Nevertheless, similar to Cicolini et al. (2015), our data suggest that nurses with higher education levels (e.g. a bachelor's or a master's degree in nursing) were more likely than other nurses to assess beyond vital signs to detect patient deterioration. In part, this may be because of the greater emphasis given to the learning of physical assessment skills in the higher nursing education curriculum in order to develop nurses' higher thinking skills (Egilsdottir et al., 2019). On the whole, while vital signs changes are predictors for clinical deterioration, using other physical assessment skills, in combination with vital signs assessment in nurses' daily practice, is essential to detect patients at risk of clinical deterioration (Osborne et al., 2015; Tan et al., 2021).

It was also noted in this study that nurses with more than 10 years of nursing experience and those in more senior clinical positions held a positive attitude towards the domains, "beliefs about importance of patient observation" and "confidence in recognising clinical deterioration." This finding highlights the notion of "experience breeds confidence," as demonstrated in Hart et al. (2014), where years of clinical nursing experience was found to be a predictor of medical-surgical ward nurses' perceived self-confidence in recognising and managing acute patient deterioration. Similar to previous studies, experienced nurses who had more encounters and exposure to patient deterioration situations were reported to be more competent and confident in recognising clinical deterioration and the need for early care escalation (Chua et al., 2019; O'Neill et al., 2021; Odell et al., 2009). Aligned with experiential learning theory, simulation-based education is an effective educational strategy to develop nurses' and student nurses' knowledge, skills and confidence in the recognition and management of clinical deterioration (Liaw et al., 2015; Orique & Phillips, 2018; Stayt et al., 2015). However, the mixed results on the associations between self-rated confidence and objectively measured clinical competencies suggest that higher or improved self-confidence may not necessarily reflect acquisitions of clinical competencies and skills (Chen et al., 2017; Liaw et al., 2012; Massoth et al., 2019). Thus, more attention should be given to accurate assessment of nurses' clinical competencies and skills through evaluation of their clinical performance.

Earlier studies have also shown positive relationships between RNs' levels of confidence in delegating, length of clinical nursing experience and former training in delegation (Kærnested & Bragadóttir, 2012; Saccomano & Pinto-Zipp, 2011; Yoon et al., 2016), suggesting delegation as a skill set that requires practice for it to be perfected (Weydt, 2010). In a wider context, this underscores the significance of incorporating experiential learning in delegation and supervision in the educational preparation of RNs, and developing continuing education and training in the workplace to instil practising RNs with greater confidence and skills in delegation.

5.1 | Strengths and limitations

An important strength of the ATREND scale was the relatively short length of the scale which will be valuable for practical survey implementation. However, this study has a few limitations that warrant our attention. First, the participants in this study were recruited from only two acute care hospitals in Singapore and may not be representative of general ward nurses at large. The use of convenience sampling could further affect the generalisability of the study as it can lead to under-representation or over-representation of targeted groups within the sample. Second, two of the three subscales (with two to three items each) of the ATREND scale were narrowly expressed. As per recommendations by Hair et al. (2014), at least three items per subscale are required to ensure minimum coverage of each construct's theoretical domain. Additionally, while the factor loadings of items 10 and 11 loaded heavily on factor 1 (beliefs about importance of patient observation), they contain elements of patient assessment that seem to overlap with factor 2 (use of broader patient assessment). Ideally, an independent sample should be employed to undertake validation activities of the factor structure (DeVellis, 2017). Thus, further empirical evidence is needed to confirm the factor structure of the ATREND scale using another independent sample. Third, the Cronbach's alpha coefficient of factor 1 ($\alpha = 0.704$) was lower than the item-level Cronbach's alpha coefficient if the individual item was deleted from the scale ($\alpha = 0.713$–0.733), suggesting that some of the items in factor 1 might be redundant. The notable ceiling effects observed in items of factor 1 accentuate the need for further psychometric testing of the ATREND scale. Furthermore, given that the scale development is an incremental process, the criterion validity and known-group validity of the ATREND scale that has not been tested in this study can be examined in future studies.

6 | CONCLUSION

To the best of our knowledge, the ATREND scale is the first scale developed to assess nurses' attitudes and practices towards early recognition of clinical deterioration. The 11-item ATREND scale, which

consists of three domains, "beliefs about importance of patient observation" (six items), "use of broader patient assessment skills" (two items) and "confidence in recognising clinical deterioration" (three items), has demonstrated adequate initial evidence of content validity, structural validity, convergent validity, internal consistency and stability. Although the usability of the ATREND scale was supported by content experts from five countries, further testing of the scale's psychometric properties in other settings and countries is recommended.

7 | RELEVANCE TO CLINICAL PRACTICE

The ATREND scale provides a multidimensional assessment of ward nurses' attitudes and practices towards early recognition of clinical deterioration. Continuing education and training is needed to facilitate nursing students and nurses to acquire the necessary knowledge, skills and attitudes to recognise and respond promptly to acute clinical deterioration situations. This scale could provide insights into aspects of nurses' attitudes towards recognising early signs of clinical deterioration, which need to be improved, and to help nursing educators and researchers to better understand how to support general ward nurses in the early recognition of deteriorating patients. Consequently, this can lead to the development of focused interventions to enhance the competencies and behaviours of nursing students and ward nurses in the recognition of clinical deterioration. This research has also filled some of the gaps in the literature on nurses' recognition of clinically deteriorating ward patients. Educational and training provisions for nursing students and nurses should focus on (1) enhancing nurses' assessment skills that extend beyond vital signs assessment; (2) exposing nurses and student nurses to various acute clinical deterioration scenarios, through simulation training or clinical rotations to acute care settings, in order to build their clinical competence and confidence in recognising and responding to patient deterioration; and (3) experiential learning opportunities for application of delegation and supervision skills in RNs' prelicensure curricula and in workplace training programmes.

AUTHOR CONTRIBUTIONS

Conception and design: WLC, DS, SYL; acquisition of data: WLC, LPCW, KCT, MLKY, SYL; analysis and interpretation of data: WLC, DS, SYL; drafting and critical revision of manuscript: WLC; interpretation of data and critical revision of manuscript: DS, LPCW, KCT, MLKY, SZM, SYL. All the listed authors have given final approval of the version to be published.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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