


# Do Vestibular Physiotherapy and a Clinical Pathway in the Emergency Department Improve Management of Vertigo?

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## Abstract

**Objective.** Determine the effects of a vertigo/dizziness emergency department (ED) clinical pathway incorporating vestibular physiotherapy on quality and efficiency of care.

**Study Design.** A multisite retrospective study investigated differences between cohorts before and after a vertigo clinical pathway and cohorts who did and did not receive vestibular physiotherapy assessment.

**Setting.** Adults presenting to 2 Australian EDs with symptoms clinically consistent with vestibular disorder were captured via ED diagnostic code screening and subsequent medical record review.

**Methods.** Medical record audits obtained quality of care indicators: diagnosis, HINTS (head impulse–nystagmus–test of skew), and vestibular physiotherapy management. Linked hospital administrative data sets provided efficiency measures: time from ED presentation to assessments, hospital admission rates, and ED and total hospital length of stay.

**Results.** Postpathway cohorts (n = 329) showed greater use of HINTS (by 27%; 95% CI, 21%–33%), more frequent vestibular physiotherapy assessment (by 27%; 95% CI, 20%–33%), reduced wait time to assessment (25.0 to 4.6 hours; 95% CI, –27.1 to –14.1), and reduced ED length of stay (3.9 to 3.2 hours; 95% CI, –0.3 to –1.0) as compared with prepathway cohorts (n = 214). When compared with those not receiving vestibular physiotherapy assessment, patients assessed by a vestibular physiotherapist (n = 150) received a specific diagnosis more frequently (65% vs 34%; 95% CI, 22%–40%) but were admitted more often (79% vs 49%; 95% CI, 22%–38%) with longer total hospital length of stay (13.0 vs 5.0 hours; 95% CI, 6.1–10.6).

**Conclusion.** An ED vertigo clinical pathway was associated with improved quality and efficiency of care, including reduced ED time. Vestibular physiotherapist assessment was associated with greater diagnostic specificity but higher hospital admissions.

## Keywords

vestibular, vertigo, dizziness, emergency department, efficiency, physiotherapy

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Vertigo and dizziness are common presentations to emergency departments (EDs)<sup>1</sup> but are often not managed optimally. Vertigo presentations are frequently related to peripheral vestibular disorders,<sup>2</sup> such as benign paroxysmal positional vertigo (BPPV) and vestibular neuritis, often requiring treatment to alleviate symptoms.<sup>3</sup> Although the majority of presentations are for non-life-threatening disorders, vertigo and vestibular disorders are associated with substantial health care costs,<sup>4</sup> and ongoing vestibular dysfunction has a significant impact on patients' health and quality of life.<sup>5</sup>

Demands on EDs throughout Australia are increasing.<sup>6</sup> Time targets in EDs have been introduced to address the increased demand on EDs and the larger health system. Concerns have been raised that time pressure can lead to inappropriate discharges or unnecessary hospital admissions, compromise clinicians' ability to care for patients, and place

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demands on staff to make decisions without sufficient time to create a management plan.<sup>7</sup> Acute vertigo diagnosis is complex, and skilled professionals are often not available to undertake specific vestibular assessment and management.<sup>1</sup> Consequently, adverse outcomes in the management of acute vertigo may increase, such as misdiagnosis, inferior management, overprescribing of medications,<sup>1</sup> and patient readmission rates to the ED.

Moreover, it is critical to identify life-threatening conditions, such as posterior circulation stroke, to provide early treatment.<sup>8</sup> Clinical assessments by skilled clinicians have shown to have greater sensitivity for the diagnosis of stroke in patients presenting with acute vestibular syndrome than brain magnetic resonance imaging obtained within the first 48 hours of symptoms onset.<sup>9</sup> Despite this, there is an overuse of computerized tomography imaging in the ED in presentations of dizziness/vertigo,<sup>1</sup> which has very low sensitivity (<16%) in detecting early posterior circulation stroke despite high specificity (98%).<sup>10</sup> Bedside neurologic examination, the HINTS test (head impulse–nystagmus–test of skew), is highly accurate in differentiating whether the acute vestibular syndrome is of peripheral vestibular or central origin.<sup>11</sup> HINTS appears more sensitive for ruling out stroke than early magnetic resonance imaging in acute vestibular syndrome.<sup>9</sup> Early vestibular physiotherapy assessment with evidence-based assessment tools may improve diagnosis accuracy as compared with no vestibular physiotherapy assessment<sup>12</sup> in the ED.<sup>4</sup> Furthermore, vestibular physiotherapy has excellent outcomes regarding treatment for peripheral vestibular disorders in the hospital setting<sup>13</sup> but has been underutilized in the ED.<sup>14</sup> The negative consequences of inappropriately managed vestibular disorders can be devastating on individuals and society.<sup>4</sup>

Given the high prevalence of vertigo and dizziness<sup>2</sup> and the high costs associated with diagnosis and management in the hospital,<sup>4</sup> improved quality of care is increasingly important to patients, clinicians, and organizations.

## Objectives

The objective of this study was to determine the effects of a vertigo/dizziness ED clinical pathway incorporating vestibular physiotherapy on the quality and efficiency of care. The term *physiotherapy* refers to providers and care that are commonly termed *physical therapy*. Specific research questions were as follows:

- Does an ED vertigo clinical pathway improve quality of care?
- Does an ED vertigo clinical pathway improve efficiency of care?
- Does a vestibular physiotherapy assessment completed acutely have an effect on quality and efficiency of care?

## Methods

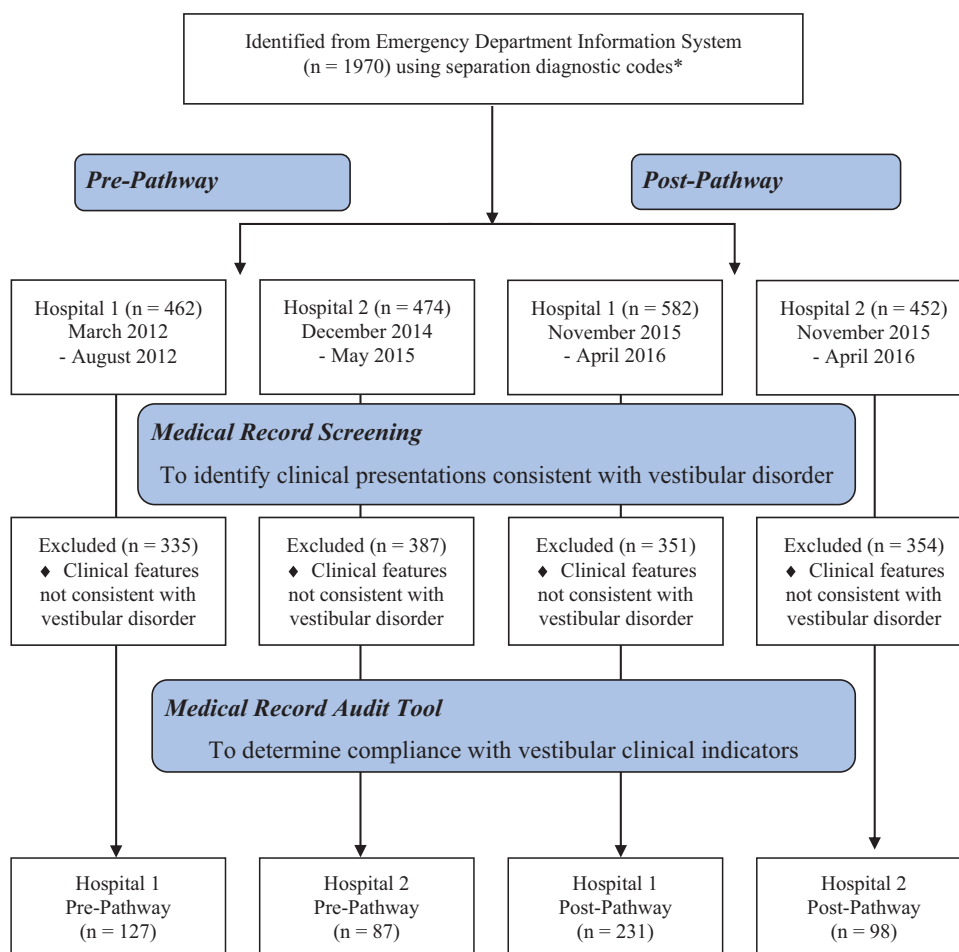
### Design

A multisite retrospective cohort study comprising pre- and postpathway phases (**Figure 1**) utilized the STROBE reporting guideline. The prepathway phase occurred during an emergency physician–led model with on-call stroke and otolaryngology physicians and physiotherapy for mobility assessments. The Prince Charles Hospital Human Ethics Research Committee (HREC/14/QPCH/34) approved this study

A vertigo clinical pathway (**Figure 2**) for use in the ED was developed in 2015 that aimed to streamline assessment and redirect care from admitted to ambulatory. Pathway development was based on clinical literature by a multidisciplinary group (stroke consultant, 2 vestibular physiotherapists, stroke physiotherapist, vestibular audiologist, 2 neurootologists, neurologist, otolaryngologist, and 3 ED consultants) and included diagnostic prompts, simple risk stratification processes, and red flags. A clinical decision support page (Supplemental Figure S1, available online) assisted clinicians with interpretation. During a 6-month implementation phase, the pathway for each hospital was adapted according to feedback and integrated into clinical practice. The 6-month postpathway phase immediately followed the implementation phase.

When history or clinical examination indicated central neurologic signs, a thorough neurologic examination was prompted, including testing of cranial nerves, visual fields, gait, headaches, and HINTS.<sup>9</sup> When examination revealed the presence of possible central pathology, urgent computerized tomography brain and continuation on the local established stroke pathway were recommended. The absence of central neurologic signs prompted the vestibular screening test.<sup>15</sup> A score  $\geq 4$  or strong clinical suspicion of a peripheral vestibular disorder prompted the request for an assessment of vestibular physiotherapy and mobility. The vestibular screening test is a reliable and valid tool for use in the acute hospital setting (83% sensitivity and 84% specificity) for people with dizziness.<sup>15</sup> Signs of peripheral vestibular dysfunction on vestibular assessment prompted commencement of immediate treatment when appropriate and redirected care to an ambulatory setting and specialist reviews depending on diagnosis.

The implementation phase was supported with staff education, equipment purchase (video Frenzel goggles), and high visibility of clinical pathway advertisements. Additional financial resources were not available to support the pathway; however, hospital 1 had a vestibular physiotherapy service from 2014 for ED, hospital, and outpatient clinics with accessibility on weekends. Hospital 2 has acute care physiotherapists with an on-call service to the ED. Extra training was provided to physiotherapists at both sites with pathway implementation. The barriers for implementing the pathway included informing a large group of rotating ED staff, change



**Figure 1.** Flow of participants. \*Separation diagnostic codes: vertigo, dizziness, vestibular neuronitis, labyrinthitis, Ménière's disease, vertebro-basilar insufficiency, cerebral infarction–unspecified, intracerebral hemorrhage–atraumatic, transient ischemic attack.

of clinical routine practice, and access to vestibular physiotherapy with limited resources. There was minimal or no access to otolaryngology and neurology specialists acutely at both hospitals.

Medical records of patients were audited by trained physiotherapists using a medical record audit tool (Supplemental Figure S2, available online) to collect data regarding clinical assessment, process of care, and final diagnosis. Only the first presentation to the ED was included for any individual patient with subsequent presentations treated as re-presentations. Administrative data sets for the ED and hospital admissions were linked across the health service district to obtain length of stay (LOS), ED re-presentations, readmission, and diagnostic codes.

Descriptive statistics were used to describe the patient cohort with frequencies for binomial data, mean with standard deviation for normally distributed data, and median with interquartile range for nonnormally distributed data. Normality was determined by visual inspection of histograms and the Shapiro-Wilk test. Effects of the clinical pathway were examined by comparing outcomes before and after pathway implementation and cohorts receiving and not receiving vestibular physiotherapy assessment. Differences in frequency

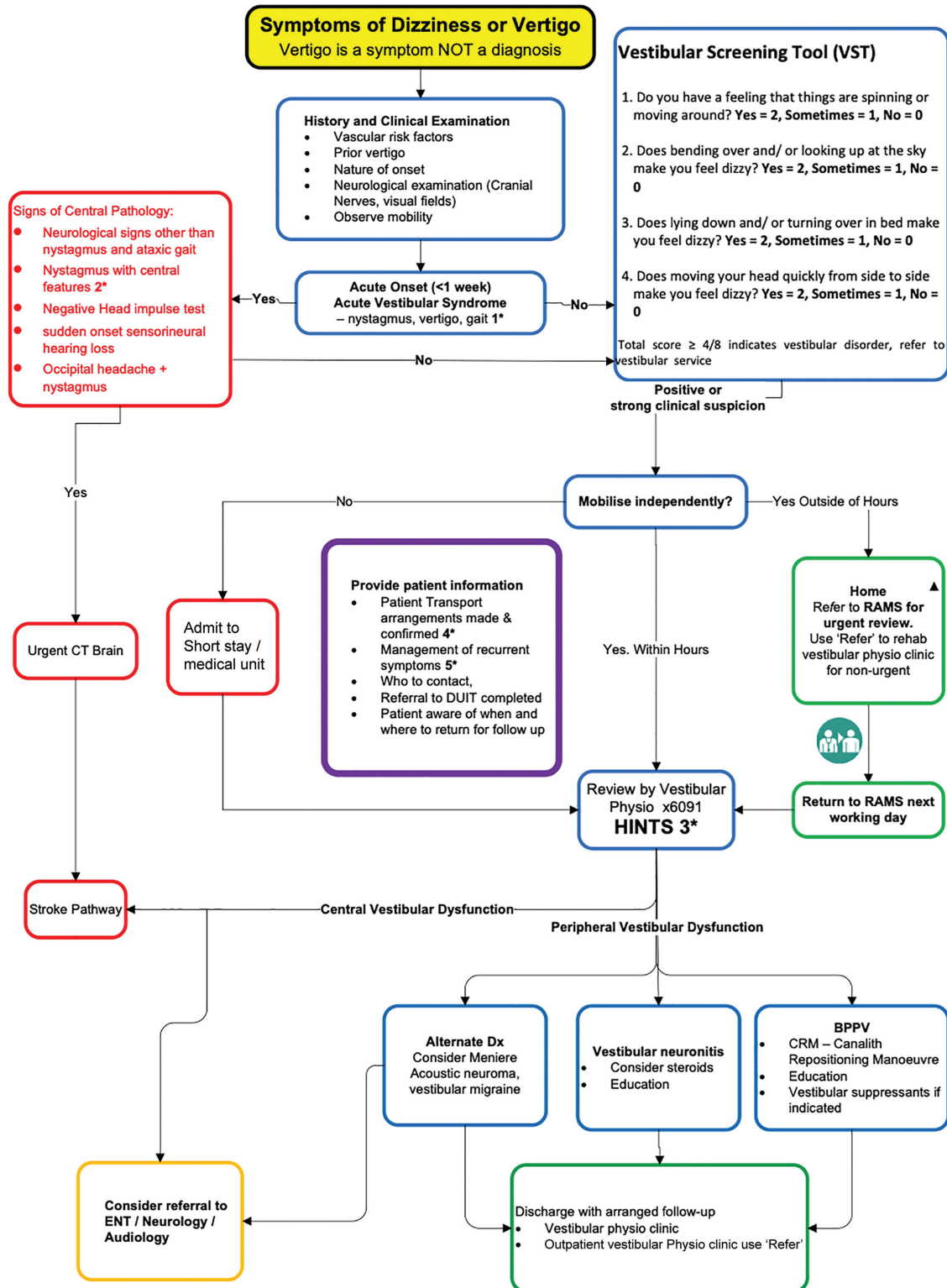
of binomial outcomes were calculated with 95% CIs, supplemented with the Pearson chi-square test. Differences in time-based outcomes were compared through median (quartile) regression.<sup>16</sup> A 2-tailed 5% level of statistical significance was assumed.

### Settings

The study was conducted at 2 hospitals. The first was a 600-bed major tertiary-level cardiothoracic referral hospital for Queensland, which at the time of study completion had limited hours of a visiting neurologist and no on-site access to otolaryngologists. The second was a regional hospital with 371 beds with limited access to neurology and no on-site access to otolaryngologists.

### Participants

The study population comprised all people aged  $\geq 18$  years presenting to the ED with clinical presentation consistent with vestibular disorder (vertigo/dizziness). People were identified by an electronic search on the Emergency Department Information System with separation diagnostic codes consistent with possible vestibular disorders (vertigo, dizziness, vestibular neuronitis, labyrinthitis, Ménière's disease, vertebrobasilar



**Figure 2.** Vertigo clinical pathway. BPPV, benign paroxysmal positional vertigo; CT, computerized tomography; DUIT, day unit investigation therapy; Dx, diagnosis; ENT, ear, nose, throat; HINTS, head impulse–nystagmus–test of skew; RAMS, rapid access medical service.

insufficiency, cerebral infarction–unspecified, intracerebral hemorrhage–atraumatic, transient ischemic attack). The medical records were screened by trained physiotherapists, using a

diagnostic decision guide to identify the final cohort of patients with clinical presentation consistent with vestibular disorder (**Figure 1**).

**Table 1.** Demographic and Clinical Characteristics of Participants Pre- and Postpathway for Hospitals 1 and 2.<sup>a</sup>

Characteristic	Total		Hospital 1		Hospital 2	
	Prepathway (n = 214)	Postpathway (n = 329)	Prepathway (n = 127)	Postpathway (n = 231)	Prepathway (n = 87)	Postpathway (n = 98)
Age, y, mean ± SD (range)	62 ± 17 (18-97)	57 ± 18 (18-97)	60 ± 18 (20-95)	55 ± 19 (18-97)	65 ± 17 (20-95)	62 ± 16 (18-94)
Female	132 (61.7)	202 (61.4)	79 (62.2)	142 (61.5)	53 (60.9)	60 (61.2)
ATSI	2 (0.9)	3 (0.9)	2 (1.6)	3 (1.3)	0	0
First episode <sup>b</sup>	112 (59.3)	193 (66.5)	88 (69.8)	178 (77.1)	24 (61.9)	15 (74.6)
Final diagnosis						
Vestibular neuritis	23 (10.8)	42 (12.8)	13 (10.2)	25 (10.8)	10 (11.5)	17 (17.3)
BPPV	40 (18.7)	87 (26.4)	26 (20.5)	57 (24.7)	14 (16.1)	30 (30.6)
Ménière's disease	8 (3.7)	10 (3.0)	5 (3.9)	8 (3.5)	3 (3.5)	2 (2.0)
Vestibular migraine	0	7 (2.1)	0	5 (2.2)	0	2 (2.0)
Acoustic neuroma	0	1 (0.3)	0	1 (0.4)	0	0
Stroke	2 (0.9)	7 (2.1)	0	2 (0.9)	2 (2.3)	5 (5.1)
Other <sup>c</sup>	3 (1.4)	2 (0.6)	1 (0.8)	2 (0.9)	2 (2.3)	0
No specific diagnosis	138 (64.5)	173 (52.6)	82 (64.6)	131 (56.7)	56 (64.4)	42 (42.9)

Abbreviations: ATSI, Aboriginal and Torres Strait Islander; BPPV, benign paroxysmal positional vertigo.

<sup>a</sup>Values are presented as No. (%) unless noted otherwise.

<sup>b</sup>Missing data: n = 64.

<sup>c</sup>Mitochondrial disease, medication side effects, chronic cerebrovascular disease, anxiety.

## Main Outcome Measures

Quality of care is defined as adherence to the pathway. Quality of care outcomes included the frequency of demonstrated compliance with key evidence-based vestibular clinical indicators of the clinical pathway: vestibular physiotherapy assessment, HINTS examination, positional tests for BPPV, balance assessment, formal mobility assessment, particle repositioning maneuver for BPPV, prescription of vestibular suppressant, and vestibular physiotherapy follow-up postassessment. Time to complete assessments from presentation to the ED in hours was also reported.

Efficiency-of-care measures were as follows: frequency of admissions and overnight admissions, ED LOS, total hospital LOS (combined ED and admitted LOS) in hours, representation rates to ED within 30 days of discharge from initial hospital presentation, 30-day hospital admission rates, and frequency of adverse events. Adverse events were collected from separation coding in the linked administrative data sets from subsequent ED re-presentations and readmissions.

## Results

### Flow of Participants

A total of 1970 people were identified by the initial diagnostic code search, and 543 participants were identified by medical records review as being consistent with vestibular dysfunction and included in the medical record audit. **Figure 1** presents the flow of participants through the study.

### Characteristics of Participants

Participants' demographics and clinical characteristics are detailed in **Table 1**. The most common diagnosis made in the

ED was BPPV, followed by vestibular neuritis. In most presentations, no specific diagnosis was documented, even after pathway implementation for 173 (53%) participants. There were no significant differences in demographics between the study sites and between pre- and postpathway subjects.

### Effect of ED Vertigo Clinical Pathway on Quality of Care

Compliance with vestibular clinical indicators to measure quality of care before and after pathway implementation is presented in **Table 2**. Following implementation of the ED vertigo clinical pathway, there were higher rates of performed vestibular physiotherapy assessment and increased compliance with evidence-based vestibular management.

### Effect of ED Vertigo Clinical Pathway on Efficiency of Care

The effect of the vertigo clinical pathway on efficiency-of-care outcomes comparing pre- and postimplementation is presented in **Table 3**. Introduction of the clinical pathway was associated with significantly reduced LOS in the ED, without a significant change in total hospital time or admission rate. The waiting time for a vestibular physiotherapist assessment was significantly reduced.

### Effect of Vestibular Physiotherapy Assessment on Quality and Efficacy of Care

The effect of the vestibular physiotherapy assessment component of an ED vertigo clinical pathway on quality of care is detailed in **Table 4**. Vestibular physiotherapy assessments were associated with increased compliance with vestibular clinical indicators, and participants more likely received a specific diagnosis.

**Table 2.** Quality-of-Care Outcomes Pre- and Postimplementation of an ED Vertigo Clinical Pathway.<sup>a</sup>

	Prepathway (n = 214)	Postpathway (n = 329)	Difference (95% CI)	P value <sup>b</sup>
Vestibular physiotherapy assessment	24 (11)	126 (38)	27 (20 to 33)	<.001
Time to assessment, h	25.0 (5.3-28.0)	4.6 (2.8-13.0)	-20.4 (-27.1 to -14.1)	<.001
HINTS <sup>c</sup>	11 (5)	105 (32)	27 (21 to 33)	<.001
Head impulse test	20 (9)	133 (40)	31 (24 to 38)	<.001
Nystagmus	83 (39)	160 (48)	10 (1 to 18)	.02
Test of skew	13 (6)	126 (38)	32 (26 to 38)	<.001
Positional tests	74 (35)	153 (47)	12 (4 to 20)	.006
Balance assessment	36 (17)	87 (26)	10 (3 to 17)	.009
Time to assessment, h	3.2 (1.5-11.0)	2.6 (1.0-5.6)	-0.6 (-2.6 to 1.6)	.60
Mobilized in ED	127 (59)	216 (66)	6 (-2 to 15)	.13
Time to mobilization, h	2.1 (0.7-5.0)	2.8 (1.2-5.6)	0.6 (-1.4 to 3.2)	.10
Particle repositioning maneuver	18 (8)	48 (15)	6 (0 to 12)	.03
Vestibular				
Suppressant	179 (84)	238 (72)	11 (4 to 18)	.002
Physiotherapy follow-up	25 (12)	85 (26)	14 (8 to 21)	<.001

Abbreviations: ED, emergency department; HINTS, head impulse–nystagmus–test of skew.

<sup>a</sup>Values are presented as No. (%) or median (interquartile range) unless noted otherwise.

<sup>b</sup>Chi-square for comparison of binomial outcomes, quartile regression for median comparison.

<sup>c</sup>Missing data: n = 4.

**Table 3.** Efficiency-of-Care Outcomes Pre- and Postimplementation of the Clinical Pathway.<sup>a</sup>

	Prepathway (n = 214)	Postpathway (n = 329)	Difference (95% CI)	P value <sup>b</sup>
Initial presentation				
ED LOS, h	3.9 (2.8-5.3)	3.2 (2.5-4.3)	-0.7 (-0.3 to -1.0)	<.001
Total hospital LOS, h	5.5 (3.7-12.0)	5.2 (3.5-12.2)	-0.3 (-1.1 to 0.5)	.50
Admission	118 (55)	195 (59)	4 (-4 to 13)	.34
Overnight admission	51 (24)	86 (26)	2 (-5 to 10)	.55
30-d outcomes				
ED LOS, h	4.1 (3.0-5.7)	3.3 (2.5-4.6)	-0.8 (-0.4 to -1.1)	<.001
Total hospital LOS, h	5.6 (3.8-13.0)	5.4 (3.6-13.0)	-0.2 (-1.1 to 0.7)	.70
ED re-presentations	18 (8)	17 (5)	-3.2 (-7.7 to 1.2)	.13
Related ED re-presentations <sup>c</sup>	10 (5)	8 (2)	-2 (-5 to 1)	—
Readmissions	11 (5)	9 (3)	-2 (-5 to 1)	—
Related readmissions <sup>c</sup>	4 (2)	6 (2)	0 (-2 to 2)	—
Major adverse event	2 (1)	3 (1)	0 (-2 to 2)	—
Death	0	0		—
Stroke	0	1 (0)		—
Fracture	2 (1)	2 (1)		—

Abbreviations: ED, emergency department; LOS, length of stay.

<sup>a</sup>Values are presented as No. (%) or median (interquartile range) unless noted otherwise.

<sup>b</sup>Chi-square for comparison of binomial outcomes, quartile regression for median comparison.

<sup>c</sup>Dizziness, vestibular disorder, collapse, minor injury, stroke, transient ischemic attack.

As compared with the cohort that did not receive vestibular physiotherapy assessment, the cohort that received it had significantly longer total hospital LOS and admission rates with no significant impact on ED LOS or adverse events (**Table 4**).

Differences in quality-of-care outcomes pre- and postimplementation of an ED vertigo clinical pathway comparing

hospitals 1 and 2 are presented in Supplemental Table S1 (available online).

## Discussion

This is the first study to investigate the impact of an ED vertigo clinical pathway on quality and efficiency-of-care outcomes. We found that a hospital-specific ED vertigo clinical

**Table 4.** Outcomes Comparison Between Patients Receiving and Not Receiving Vestibular Physiotherapy Assessment After ED Presentation.<sup>a</sup>

Characteristic	Vestibular physiotherapy assessment		Difference (95% CI)	P value <sup>b</sup>
	No (n = 393)	Yes (n = 150)		
Age, y, mean ± SD	58 ± 18	62 ± 17	4 (1 to 8)	.01
Female	250 (64)	84 (56)	8 (−2 to 17)	.1
First episode <sup>c</sup>	211 (62)	94 (68)	6 (−4 to 15)	.2
HINTS	11 (3)	105 (70.0)	67 (63 to 77)	<.001
Head impulse test	18 (5)	135 (90)	85 (80 to 91)	<.001
Nystagmus	122 (31)	121 (81)	50 (42 to 57)	<.001
Test of skew	17 (4)	122 (81)	77 (70 to 84)	<.001
Positional tests	107 (27)	120 (80)	53 (45 to 61)	<.001
Balance assessment	64 (16)	59 (39)	23 (14 to 32)	<.001
Time to assessment, h	1.8 (0.9-3.3)	4.5 (1.9-16)	2.7 (0.4 to 0.9)	<.001
Mobilized in ED	210 (53)	133 (89)	35 (28 to 42)	<.001
Time to mobilization, h	1.8 (0.8-3.8)	4.0 (2.0-8.4)	2.2 (1.3 to 3.0)	<.001
Particle repositioning maneuver	17 (4)	49 (33)	28 (20 to 36)	<.001
Vestibular				
Suppressant	303 (77)	114 (76)	−1 (−9 to 7)	.8
Physiotherapy follow-up	22 (6)	88 (59)	53 (45 to 61)	<.001
Received specific diagnosis	134 (34)	98 (65)	31 (22 to 40)	<.001
	No (n = 375)	Yes (n = 150)		
Initial presentation				
ED LOS, h	3.4 (2.6-4.5)	3.6 (2.6-5.4)	0.2 (−0.1 to 0.6)	.2
Total hospital LOS, h	4.7 (3.4-7.2)	13.0 (4.8-30.0)	8.3 (6.1 to 10.6)	<.001
Admission rate	194 (49)	119 (79)	30 (22 to 38)	<.001
Overnight admission	63 (16)	74 (49)	33 (25 to 42)	<.001
30-d outcomes				
ED, h	3.6 (2.6-5.0)	3.7 (2.6-5.7)	0.1 (−0.3 to 0.6)	.6
Total hospital LOS, h	5.0 (3.5-7.9)	13.0 (4.8-31.0)	8.1 (6.3 to 10.8)	<.001
ED re-presentations	30 (8)	5 (3)	−4 (−8 to 0)	.07
Related ED re-presentations <sup>d</sup>	15 (4)	3 (2)	−2 (−5 to 1)	—
Readmissions	17 (4)	3 (2)	2 (−1 to 5)	—
Related readmissions <sup>d</sup>	8 (2)	2 (1)	−1 (−2 to 3)	—
Major adverse event	4 (1)	1 (1)	0 (−2 to 1)	—
Death	0	0		—
Stroke	1 (0)	0		—
Fracture	3 (1)	1 (1)		—

Abbreviations: ED, emergency department; HINTS, head impulse–nystagmus–test of skew; LOS, length of stay.

<sup>a</sup>Values are presented as No. (%) or median (interquartile range) unless noted otherwise.

<sup>b</sup>Chi-square for comparison of binomial outcomes, quartile regression for median comparison.

<sup>c</sup>Missing data: n = 64.

<sup>d</sup>Dizziness, vestibular disorder, collapse, minor injury, stroke, transient ischemic attack.

pathway was associated with improved quality and efficiency of care. Importantly, following implementation of an ED vertigo pathway, ED LOS was reduced, without change to total hospital LOS, admission rates, or adverse events, including ED re-presentation or hospital readmission. Accordingly, implementation of a hospital-specific ED vertigo clinical pathway should be a highly recommended policy decision.

Multiple studies have reported insufficient use of vestibular diagnostic tests in the ED, such as underutilization of HINTS as compared with neuroimaging,<sup>17</sup> the head impulse test,<sup>18</sup> and BPPV positional tests.<sup>14</sup> Our study indicated that

implementation of a pathway—based on simple clinical diagnostic processes to support ED physicians and access to urgent vestibular physiotherapy assessment utilizing video Frenzel goggles—is an effective way to bridge these evidence-practice gaps.

Ozdemir et al evaluated the economic burden of vertigo on the health care system and found that mean duration of hospitalization of peripheral vertigo was 5.6 days with high associated costs, far greater than the 5.2-hour hospital LOS found in this study.<sup>19</sup> This study aimed to move patient care toward the ambulatory setting for diagnosed peripheral conditions, but

this aim was not achieved with the implemented vertigo clinical pathway, as recorded by the unchanged admission rates and total hospital LOS. A possible explanation is that the processes to move a patient to quick follow-up ambulatory care were too complex. In a complex environment such as an ED with fast flow processes, simple processes to ambulatory care are critical.

This study is the first to investigate the effect of vestibular physiotherapy assessment in the ED on LOS, admissions, and re-presentations. While our finding of a trend to reduced 30-day re-presentations is promising and warrants further research, the cohort that received vestibular physiotherapy assessment had greater LOS and higher admission rates, which differed from the overall effects of the pathway. Contributing factors may include that vestibular physiotherapy assessments were more likely to be requested for patients who had complex clinical presentations or were unable to mobilize in an ED without assistance. Another explanation is that the pathway precipitated admission to enable access to rapid vestibular physiotherapy assessment.

Diagnosis of dizziness/vertigo presentations in the ED is challenging, and ongoing assessment after hospital discharge is recommended.<sup>20</sup> This study showed that those receiving urgent vestibular physiotherapy assessment had higher-quality assessment and achieved comparable levels of specific diagnosis in a very short time frame with limited resources. Similar to our study, Lloyd et al demonstrated that ED vestibular physiotherapists adhere to evidence-based clinical practice completing assessment and treatment components without adverse effects.<sup>21</sup> However, 35% of patients were discharged without a specific diagnosis in the vestibular physiotherapy cohort of our study. Diagnosis of vestibular conditions often occurs after ED presentation in the outpatient setting, where multidisciplinary reviews (eg, audiology, physiotherapy, otolaryngology, and neurology) track symptoms over time.<sup>21</sup> This is in line with a study by Maihoub et al, who investigated vertiginous cases after hospital discharge and reported no eventual diagnosis in 24%.<sup>22</sup>

Future modifications of the clinical pathway could aim to bring about greater diagnostic yield by producing a pathway specific to acute vestibular syndrome and an episodic vestibular pathway to account for triggered and spontaneous recurrent vertigo episodes. Modifications of the pathway could utilize the recently developed diagnostic approach TiTrATE (timing, triggers, auditory, targeted assessment), which categorizes patients into groups based on symptom timing and triggers, guiding the differential diagnosis with targeted bedside assessment and recommendations for tests.<sup>23</sup> The TiTrATE approach aims to assist clinicians in diagnosis for the ED population presenting with dizziness, including differentiating benign peripheral vestibular conditions from dangerous posterior circulation strokes. This approach will assist in improving patient flow through the ED to the ambulatory care setting, while optimizing quality and efficiency of care. Specific modifications to the clinical pathway could include a

red flags section, directing referral to appropriate specialties, such as cardiology, otolaryngology, neurology, and stroke pathways. Further modifications to strengthen our clinical pathway may include subsequent ambulant dizzy clinics to access early specialist intervention, assist with hospital avoidance, and increase diagnosis provision for complex presentations. Ambulatory multidisciplinary dizziness clinics and rapid-access dizziness clinics, specializing in diagnosing and treating people with dizziness, are increasingly being employed internationally.<sup>24</sup>

### *Limitations and Areas for Future Research*

We used a retrospective design collecting data from medical records. Medical records rely on details recorded by staff who may not have specific vestibular competency to document vestibular symptoms and signs accurately, which may have resulted in reduced accuracy of compliance with vestibular clinical indicators. Furthermore, we were unable to provide detailed information on uptake of the pathway as no intervention fidelity measures were collected. It is therefore unclear if the implementation strategy, including education and marketing, was optimal for changing management in ED. As no additional funding was received for this study, a pragmatic approach was utilized. This study was conducted in an Australian health care system, and while principles used in pathway development and implementation are applicable to most systems, caution should be applied when extrapolating results. Another limitation is that participating sites had no acute access to formal audiovestibular testing, which assists in acute diagnosis, and minimal acute access to neurologists, which may mean that first-presentation vestibular migraine may be underrepresented. Future directions include whether a headache pro forma may assist in the acute differential diagnosis of vestibular migraine presenting as an acute vestibular syndrome.

The ED vertigo clinical pathway was associated with improved quality and efficiency of care, such as higher completion rates of vestibular assessments and reduced ED time. Vestibular physiotherapist management was associated with greater diagnostic specificity but higher hospital admissions. Future modifications to hospital-specific ED vertigo clinical pathways should consider inclusion of diagnostic approaches such as TiTrATE. It is recommended that vestibular physiotherapy is available in the ED/hospital setting to assist with diagnosis, ongoing assessment, and management post-discharge. Future studies may focus on the effect of moving subsequent evaluation of more complex cases without specific diagnosis to ambulant multidisciplinary acute dizziness clinics involving vestibular physiotherapists and audiologists, as well as otolaryngology, neurology, or stroke physicians.

### **Author Contributions**

**Vicky Stewart**, design, conduct, analysis, write-up; **Ingrid Rosbergen**, design, conduct, analysis, write-up; **Benjamin Tsang**, conduct, analysis, write-up; **Aliese Hoffman**, design, conduct,



write-up; **Shelly Kwan**, conduct, write-up; **Rohan Grimley**, design, conduct, analysis, write-up.

## Disclosures

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## Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## Supplemental Material

Additional supporting information is available at <http://journals.sagepub.com/doi/suppl/10.1177/2473974X221119163>

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