

FALLS PREVENTION

Measurement of lying and standing blood pressure in hospital

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Shelagh O'Riordan

Falls workstream clinical lead,
Royal College of Physicians,
London, England

Naomi Vasilakis

Project manager, Royal College
of Physicians, London, England

Labib Hussain

Phase 3 medical student,
King's College London,
England

Rowena Schoo

Falls and fracture liaison
service database project
co-ordinator, Royal College of
Physicians, London, England

Julie Whitney

NIHR/HEE clinical lecturer,
King's College London,
England

Julie Windsor

Patient safety lead older
people, NHS Improvement,
London, England

Khim Horton

Independent researcher/
consultant and independent
adviser - service user
engagement, Age UK, Surrey,
England

Finbarr Martin

Falls and Fragility Fracture
Audit Programme chair and
clinical lead, Royal College of
Physicians, London, England

Correspondence

naomi.vasilakis@rcplondon.
ac.uk

Abstract

Measuring lying and standing blood pressure (BP) is an important clinical observation in older hospital inpatients. This is because a drop in BP on standing, known as orthostatic hypotension (OH) is common in older people and in acute illness and, therefore, in hospital patients. OH increases the risk of a fall in hospital. Simple measures such as changes in medication or rehydration can reduce this drop in BP and reduce the risk of falls.

In a recent snapshot audit in England and Wales of 179 acute hospitals and 4,846 patients aged 65 years and over admitted with an acute illness, only 16% had a lying and standing BP recorded within 48 hours.

A review of the literature showed that existing advice on how to measure and interpret lying and standing BP was often not appropriate for use on the ward with frail and unwell inpatients. An online survey of 275 clinicians' usual practice highlighted variation and the need for clarity and pragmatism. In the light of the survey findings, a clinical guide has been developed on when to measure lying and standing BP, how to measure it and what is considered a significant result.

Keywords

audit, falls, lying and standing blood pressure, older people, orthostatic hypotension, patient safety

THE WORK discussed in this article is part of the Falls and Fragility Fracture Audit Programme (FFFAP) commissioned by the Healthcare Quality Improvement Partnership and managed by the Royal College of Physicians (RCP). The FFFAP aims to improve the delivery of care for patients who have falls or sustain fractures through effective measurement against standards and feedback to providers.

The central strand of this programme is a national audit of the assessments and preventive actions taken by clinical staff in the first few days of a patient's hospital admission. It is based predominantly on National Institute for Health and Care Excellence (NICE) (2013, 2015) guidance on falls assessment and prevention and National Patient Safety Agency (2007a, 2007b, 2009, 2011) guidance on preventing falls in hospital.

The 2015 audit of 179 acute hospitals in England and Wales and 4,846 patients over 65 years admitted with an acute illness, found that only 16% had a lying and standing blood pressure (BP) recorded (RCP 2015a). Patients whose measurement could not be recorded, such as those who were bedbound, were excluded from the denominator. In 2010 the

National Audit of Falls and Bone Health in Older People reported that 15% of non-hip fracture patients and 38% of hip fracture patients had a documented lying and standing BP recorded, or it was documented that the patient was unable to stand (RCP 2011).

These results highlighted that, despite the availability of consensus guidance, low numbers of patients had a lying and standing BP recorded. A survey was conducted to establish practice, with the objective of using the findings in conjunction with guidance and published articles to develop standardised, pragmatic advice on how to measure patients' lying and standing BP on hospital wards. The aim is to promote the increased measurement of orthostatic BP and more consistency in how it is measured, therefore improving routine clinical practice.

Orthostatic hypotension

Orthostatic hypotension (OH), a drop in BP on standing, is a contributing factor to falls (Ooi et al 2000, Lahrmann et al 2011). A change in position from lying to sitting, or from lying or sitting to standing causes a reduction in the volume of blood returning to the heart and blood to pool in the extremities.

An inadequate physiological response to such postural changes can result in an abnormally large drop in BP, which is common in older people (Lowry et al 2016). This may be due to impaired homeostatic mechanisms; inadequate hydration, for example, because of anorexia, drowsiness, delirium and dementia; antihypertensive medication; or prolonged bedrest (Feldstein and Weder 2012). Acute causes of OH include dehydration or deconditioning, but chronic OH may be caused by neurodegenerative disorders such as Parkinson's disease or autonomic failure. OH can cause people to feel dizzy, lightheaded and have blurred vision and blackouts, but some people with OH have few symptoms and cognitive impairment may affect their ability to report symptoms (Passant et al 1996, Arbogast et al 2009). OH in such patients who experience few symptoms may still contribute to the risk of falling.

Interventions to address OH in hospital include adjusting medication, treating dehydration or using compression stockings. Some cases of OH are difficult to treat especially in the context of congestive cardiac failure. However, all staff should know if a patient has OH as they may need to mitigate risk by encouraging the patient to stand in stages and with close supervision (Windsor et al 2016).

Assessment of OH is usually indicated for any patient presenting with a history of falls; unexplained syncope or pre-syncope; visual disturbances; dizziness; general weakness; fatigue; cognitive slowdown; leg buckling; and 'coat-hanger' ache, that is, in the shoulders and neck. These symptoms are more commonly found in older people. Additionally, the European Society of Cardiology lists six main classifications of OH, three of which – classical autonomic failure, progressive OH and progressive OH with reflex syncope – are more common in older age (Moya et al 2009).

There are many reasons why lying and standing BP is not measured in hospital inpatients, despite clinical guidance suggesting that it should be. Reasons for non-implementation of clinical guidance include (Grimshaw et al 2004):

- » Factors associated with the guidance itself – provenance, clarity and applicability.
- » Individual professional factors – knowledge, routines or attitudes.
- » Organisational and cultural factors that act as enablers or barriers.

Reasons for non-implementation of guidance on measurement of lying and standing BP may relate to: clarity of the guidance; uncertainties

about roles and responsibilities; inadequate knowledge, skills or understanding to enable interpretation of findings; perceived importance of the test; or the availability of time or tools to undertake the observation in a clinical setting (Gagliardi et al 2011).

Aim

To promote the increased measurement of orthostatic BP and more consistency in how it is measured, thus improving routine clinical practice.

Methods

Literature review

Relevant guidelines and published articles on OH by authoritative sources were searched, which included reference to:

- » Measurement of lying and standing BP to diagnose OH, specifically to identify the suggested technique and timing.
- » The BP measuring device to be used.
- » The interpretation of findings.

Investigation of practice

An online survey of clinical staff involved in falls and bone health programmes was undertaken by the RCP's FFFAP team. The aim of the survey was to determine common practice across the UK. Based on advice from the falls audit network on the healthcare professionals most commonly involved with BP measurement and falls risks assessments on acute wards, invitations to participate were sent to the following email groups:

- » RCP FFFAP clinical contacts: doctors, nurses and allied health professionals (AHPs) responsible in their respective hospitals for coordinating the audit of falls risk assessments.
- » British Geriatrics Society falls and bone health contacts: doctors and AHPs.
- » English regional falls network contacts: mostly nurses.
- » AGILE contacts: chartered physiotherapists working with older people.

The use of intermittent BP measurement methods was the focus as these are most often used on wards. Ambulatory devices, bedside vital signs monitors or devices using 'beat-to-beat' methods that continuously monitor BP such as tilt-table tests in outpatient syncope clinics, were not included. The survey focused on the specifics and interpretation of lying and standing BP recordings in hospital and closed responses were sought for each of the following questions:

- » Do you measure lying and standing BP in your clinical practice?

Conflict of interest

None declared

Peer review

This article has been subject to external double-blind peer review and checked for plagiarism using automated software

- » In practice, how many lying and standing BP measurements do you take?
- » In practice, how long do you ask patients to lie down for before taking the first BP reading?
- » In practice, when do you take the first standing BP?
- » In practice, if you take a third BP reading (second BP recorded when standing), how long after standing do you take it?
- » What type of sphygmomanometer do you most often use?
- » What do you consider is a significant drop in systolic BP?
- » What do you consider is a significant drop in diastolic BP?

There was also an option for free-text responses at the end of the survey. Simple descriptive statistics were used to analyse the data.

Results

Literature review

A review of guidelines and articles showed there was agreement in how OH is defined: a reduction in systolic BP of at least 20mmHg and/or diastolic BP of at least 10mmHg (Table 1). However, most guidelines and articles referred to measurement in specialist settings such as syncope clinics and did not mention how these complex diagnostic procedures should be translated into pragmatic guidance for use on general wards.

Of these sources, not all defined OH and only four described a procedure for measuring lying and standing BP (Table 2). Where these were defined, they were broadly consistent.

Investigation of practice

The survey was circulated in December 2015 to January 2016 and 316 responses were

TABLE 1. Definition of orthostatic hypotension in literature

Literature	Definition of orthostatic hypotension (OH)
National Institute for Health and Care Excellence (NICE) (2013) clinical guideline 161 on assessment and prevention of falls in older people	None given
NICE (2010) clinical guideline 109 on transient loss of consciousness (TLoC)	'Condition in which a marked fall in blood pressure is provoked by a change in posture from lying to sitting, or from lying or sitting to standing. This may cause light headedness (dizziness), a fall or TLoC.'
Consensus statement on the definition of OH, neurally mediated syncope and the postural tachycardia syndrome (Freeman et al 2011)	'A sustained reduction of systolic blood pressure (BP) of at least 20mmHg or diastolic BP of 10mmHg within 3 minutes of standing.'
Consensus statement on the definition of OH, pure autonomic failure, and multiple system atrophy (Consensus Committee of the American Autonomic Society and the American Academy of Neurology 1996)	'A reduction in systolic BP of at least 20mmHg and/or diastolic BP of at least 10mmHg within three minutes of standing.'
Guidelines for the diagnosis and management of syncope (version 2009) (Moya et al 2009)	'An abnormal decrease in systolic BP upon standing.' "Classical OH" is a physical sign defined as a decrease in systolic BP \geq 20mmHg and in diastolic BP \geq 10mmHg within 3 minutes of standing.'
New concepts in the assessment of syncope (Brignole and Hamdan 2012)	'...a decrease in systolic BP \geq 20mmHg or a decrease of systolic BP to <90mmHg associated with syncope or pre-syncope (a fall >30mmHg is needed in hypertensive subjects).'
Postural hypotension (Sathyapalan et al 2011)	'An abnormal fall in BP—of at least 20mmHg systolic and 10mmHg diastolic—within three minutes of standing upright.'
Evaluation and management of OH (Lanier et al 2011)	'A decrease in systolic BP of 20mmHg or a decrease in diastolic BP of 10mmHg within three minutes of standing when compared with BP from the sitting or supine position.'
Preventing Falls in Hospitals two modules aimed at hospital-based nurses and foundation level 1 and 2 doctors (Royal College of Physicians 2015b)	'A >20mmHg fall in systolic BP and/or a >10mmHg fall in diastolic BP within three minutes of standing with symptoms.'

received. An overall response rate is not possible as multiple group emails were used from different sources but with considerable overlap and some clinicians will have received the questionnaire from more than one source. There were 277 respondents who confirmed their job role. These included doctors ($n=114$), nurses ($n=88$), physiotherapists ($n=55$) and occupational therapists ($n=2$). The 'others' ($n=18$) included two associate practitioners, three specialist nurses and three technical instructors.

Of the total respondents, 275 (87%) measured lying and standing BP in their clinical practice and answered the remaining questions.

The first five questions explored the procedure used to measure lying and standing BP (Tables 3 and 4). The final two questions focused on the importance of BP measurement findings (Table 5).

Many respondents stated that a drop from a lower BP was more significant than a similar drop from a higher BP. Furthermore, many considered a drop to a BP $<100\text{mmHg}$ clinically significant even if $<20\text{mmHg}$. Many also stated that a drop in diastolic BP was clinically less significant than a drop in systolic BP.

Free-text responses

The free-text responses showed some evidence of unusual practice. For example, one respondent reported they took at least seven BP recordings every time and often more, and

another indicated that they asked inpatients and outpatients to lie down for 30 minutes between readings.

Discussion

There was reasonable consistency in the literature on how to record lying and standing BP, the definition of a positive result and whether symptoms were required as well as a drop in BP. However, the literature was biased towards specialist clinical assessments of transient loss of consciousness or syncope with specialist equipment including tilt tables and omitted pragmatic advice for routine ward measurements.

A large number of health professionals caring for older people in hospitals were surveyed on how they recorded lying and standing BP. The findings identified that lying and standing BP measurement was a multidisciplinary task with a range of professionals involved.

Although there was some variance, responses concerning time supine and time to first and second measurements were in line with the guideline recommendations. The way the options were presented may have influenced these responses: allowing for a continuum of responses on times may have provided more nuanced information. Just over a third of respondents reported performing more than three measurements in total.

Where there was no clear consensus, such as the number of measurements required or

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TABLE 2. Procedure for measuring lying and standing blood pressure

Literature	Procedure and actions
National Institute for Health and Care Excellence (2010) clinical guideline 109 on transient loss of consciousness	'Measure lying and standing blood pressure (BP) with repeated measurements while standing for 3 minutes... If orthostatic hypotension (OH) is confirmed, consider likely causes, including drug therapy, and manage appropriately.'
Preventing Falls in Hospitals two modules aimed at hospital-based nurses and foundation level 1 and 2 doctors (Royal College of Physicians 2015b)	Lying and standing BP should be taken with a manual sphygmomanometer to check for OH, and pulse taken by hand to check for arrhythmias. A related video also advises staff to: » Take the lying BP after the patient has been lying for at least five minutes. » Take the standing BP when the patient has been standing for about one minute and again, if possible, at three minutes.
Postural hypotension (Sathyapalan et al 2011)	'Measure BP and heart rate after ten minutes of supine rest, repeated at three minutes after standing.'
Orthostatic hypotension: framework of the syndrome (Naschitz and Rosner 2007)	'The mercury column sphygmomanometer is preferred... for routine clinical testing because of its reliability and simplicity.' 'BP is measured after 5-10 minutes of rest in the supine position; the patient arises and the measurements are then repeated while he stands motionless for 3-5 minutes with the cuffed arm supported at heart level.'

TABLE 3. Measuring lying and standing blood pressure

In practice, how many lying and standing blood pressure (BP) measurements do you take?

2	27% (73)
3	36% (100)
More than 3	36% (100)
Missing	1% (2)
Total	275

In practice, how long do you ask patients to lie down for before taking the first BP reading?

0-1 minute	6% (17)
2-3 minutes	13% (36)
4-5 minutes	38% (104)
6-10 minutes	21% (57)
More than 10 minutes	22% (61)
Total	275

In practice, when do you take the first standing BP?

0-1 minute	83% (227)
2-3 minutes	15% (40)
4-5 minutes	2% (5)
More than 5 minutes	1% (2)
Missing	1
Total	275

In practice, if you take a third BP reading (second BP recorded when standing), how long after standing do you take it?

1-2 minutes	32% (77)
3-4 minutes	52% (128)
5-6 minutes	12% (30)
More than 6 minutes	4% (9)
Total	244 *

*Only 100 respondents said they took more than 3 measurements but 244 answered this question.

the interpretation of a positive result, this may have been because these aspects required an element of clinical decision-making specific to each patient, that is, if BP was still low after two standing measurements, further monitoring might be required until BP was normalised.

Clearer wording of the survey, so that categorical answers were based on routine testing and having a free-text section to describe any deviations from routine, may have resulted in greater consensus.

There were some outliers in measurement technique, for example, one respondent required a patient to lie supine for 30 minutes before measurement, one measured seven or more times and another measured systolic pressure using a cuff and palpating the brachial pulse. The first two examples increase the time required for the procedure and render testing more impractical. The latter method may be more practical where a patient requires support to stand and help from other staff is limited. However, this method does not record diastolic pressure.

The answers about the type of device used deviated from guidance recommendations. It is suggested that staff use a manual sphygmomanometer (O'Brien et al 2003) but in this survey the highest proportion of respondents did not use a manual device. There are good clinical reasons why a manual device is advised. Automated sphygmomanometers often fail to record BP on standing and often fail to record at all if an arrhythmia is present.

In cases of large drops in pressure, an automated device may not detect a low pressure resulting in an error message. However, in this survey, health professionals reported limited access to manual machines on the wards and a lack of clarity on the respective merits of manual or automatic sphygmomanometers.

TABLE 4. Use of manual or automatic sphygmomanometer

What type of sphygmomanometer do you most often use?	
Manual	33% (90)
Automatic	47% (129)
Manual or automatic	18% (49)
Other	1% (2)
Missing	2% (5)
Total	275

Where possible, a manual machine should be used, but an automatic machine may suffice provided there is no evidence of arrhythmias and the user reverts to a manual sphygmomanometer if error messages occur.

There was no consensus on the importance of symptoms in determining a positive result with nearly half of respondents considering a drop in systolic BP of 20mmHg and symptoms as significant.

One of the arguments used to support the measurement of OH in hospital inpatients is that it is not always associated with symptoms, particularly in people with dementia or delirium (Passant et al 1996, Arbogast et al 2009). This was raised by respondents in free-text responses. Therefore, while symptoms are useful in supporting a diagnosis, it is important not to rule out a diagnosis based on lack of symptoms. Addressing this issue differently in the survey, for example, by separating a question about the numerical scale of the BP drop from the importance of symptoms, may have provided more useful information.

Important areas for improvements

Nurses have an important role in assessing patients at risk of falling and taking preventive measures. They need to have a clear understanding of the importance of underlying

symptoms of OH and the significance of any drop in BP. Accurate recording and reporting of this observation is essential in nursing practice.

The health professionals invited to take part in the survey had an interest in falls and/or bone health. Although most respondents reported that they measured lying and standing BP in line with the guidance

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Figure 1. How to measure lying and standing blood pressure as part of a falls assessment



Royal College of Physicians

Falls and Fragility Fracture Audit Programme

How to measure a lying and standing blood pressure (BP) as part of a falls assessment

1. Identify if you are going to need assistance to stand the patient and simultaneously record a BP.
2. Use a manual sphygmomanometer if possible and definitely if the automatic machine fails to record.
3. Explain the procedure to the patient.

Lying

- 0 min**: Ask the patient to lie down for **at least five minutes**.
- 5 mins**: Measure the BP.

Standing

- 0 - 1 mins**: Ask the patient to stand up (assist if needed). Measure BP after standing in the **first minute**.
- 3 mins**: Measure BP again after patient has been standing for **three minutes**. Repeat recording if BP is still dropping. In the instance of positive results, repeat regularly until resolved. If symptoms change, repeat the test.

Notice and document **symptoms** of dizziness, light-headedness, vagueness, pallor, visual disturbance, feelings of weakness and palpitations.

Advise patient of results and if the result is positive:

- a. inform the medical and nursing team.
- b. take immediate actions to prevent falls and/or unsteadiness.

A positive result is:

- a. A drop in systolic BP of 20mmHg or more (with or without symptoms).
- b. A drop to below 90mmHg on standing even if the drop is less than 20mmHg (with or without symptoms).
- c. A drop in diastolic BP of 10mmHg with symptoms (although clinically less significant than a drop in systolic BP).

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TABLE 5. Importance of blood pressure measurement findings

What do you consider is a significant drop in systolic blood pressure (BP)?	
Drop in systolic BP of 20mmHg	46% (126)
Drop in systolic BP of 20mmHg and symptoms	47% (128)
Other	7% (18)
Missing	1% (3)
Total	275
What do you consider is a significant drop in diastolic BP?	
Drop in diastolic BP of 10mmHg	36% (99)
Drop in diastolic BP of 10mmHg and symptoms	52% (144)
Other	11% (30)
Missing	1% (2)
Total	275



Implications for practice

- » Orthostatic hypotension (OH) can be a cause of falls.
- » Measuring lying and standing blood pressure (BP) would identify OH, but the National Audit of Inpatient Falls (Royal College of Physicians (RCP) 2015a) shows only 16% of patients had this measured.
- » The RCP (2017) has produced standardised pragmatic guidance on measuring lying and standing BP to address this.

recommendations, a minority reported measuring it incorrectly. Most patients in the National Audit of Inpatient Falls (RCP 2015a) did not have a lying and standing BP measured, suggesting that practical implementation was lacking. Possible reasons for this may be because the ward-based clinical staff involved with the care of the patients audited were either not aware of the guidance or found its practical application challenging. Therefore, the objective of this work was to use the survey findings in conjunction with guidance to develop standardised, pragmatic advice on how to measure patients' lying and standing BP on hospital wards.

The aim is to promote the increased measurement of orthostatic BP and more consistency in how it is measured, thus improving routine clinical practice.

The guide produced (Figure 1) provides clarity and may prevent unnecessary and time-consuming practice, that is, supine lying for 30 minutes, or potentially ineffective assessment, that is, automatic sphygmomanometer measurement in the presence of cardiac arrhythmias. It also provides a clear rationale that can be explained to clinical staff during training and enables good practice to be embedded. It could be used in the education of students, clinical staff, hospital and community teams who look after older people at risk of falls.

Implications for nursing practice

Recording, interpreting and acting on the assessment of vital signs including temperature, pulse, respiration, blood pressure and pulse oximetry are fundamental clinical nursing skills. The correct assessment of OH will not only support diagnosis and treatment, but also allow opportunities for the safe management of mobility and prevention of falls.

Conclusion

Guidance states that measuring lying and standing BP in older people in hospital is good clinical practice and part of a multidisciplinary falls risk assessment. Current guidelines and published articles do not always define OH or describe how to measure lying and standing BP, but are broadly consistent where they do. Despite this a snapshot audit of nearly 5,000 acute inpatients aged over 65 years found that only 16% had a lying and standing BP recorded by the third day of their admission (RCP 2015a). The survey of health professionals reported in this article showed the need for clarity and pragmatism in the measurement of lying and standing BP. A new guide developed in the light of the survey results might give clinical staff the confidence to know they are measuring a vital sign in a sensible way and to determine a clinically significant result. Whether this aim is achieved will be evaluated in this year's national inpatient re-audit of falls prevention measures.

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