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Innovations in Blood Pressure Monitoring

By Nancy T. Artinian, PhD, RN,BC, FAHA

New, automated devices provide in-home or around-the-clock readings.

Although the virtual hypertension clinic does not yet exist, technology has been changing the way blood pressure is monitored. The traditional method—sphygmomanometer readings conducted in a clinical setting—requires patients to return to the office when closer monitoring is advisable or necessary. But today a patient with hypertension may receive a home monitor for self-measurement or an ambulatory monitor that records around-the-clock readings for a day or longer. That patient may also enroll in a telemonitoring service that transmits stored readings and offers analytic reports to a provider and keeps the patient informed of average waking blood pressures.

The convenience of these methods could make a crucial difference to the 50 million Americans with hypertension: nearly a third (30%) aren't aware they have it and only 34% of those who are aware they are hypertensive are controlling it—a percentage still well below the Healthy People 2000 goal of 50%.[1,2] Some of the reasons for uncontrolled blood pressure include a lack of health care access and nonadherence to treatment. A recent metaanalysis of randomized trials in which patients self-monitored their blood pressure found "improved control of hypertension."[3]

It's true that both ambulatory monitoring and self-monitoring offer more than convenience and the possibility of better control; they may also provide more accurate readings.[3] The use of a sphygmomanometer and stethoscope to listen for Korotkoff sounds can be compro-

Monitor courtesy of Omron Healthcare, Inc.

Omron Healthcare, Inc. makes several upper-arm self–blood pressure monitors.

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mised by noisy environments, equipment failure (such as a leaky bulb), a clinician's hearing impairment, or soft Korotkoff sounds.[4] And the phenomenon known as "white-coat hypertension," the tendency for blood pressure to rise when one is visiting a provider, can also result in imprecise readings. Around-the-clock ambulatory monitoring, in which 50 to 100 readings are taken in 24 hours outside of a clinical setting, has revealed this effect more fully.[4] And the slow phasing out of mercury from medical equipment such as the sphygmomanometer has fueled the need for new methods (the toxic substance will likely be banned from clinical use in coming years).[5]

Because self-monitoring and ambulatory monitoring involve many readings over time, they permit more accurate diagnoses than sphygmomanometry.[6] Studies have shown that ambulatory monitoring and self-monitoring are better predictors of hypertensive target-organ damage and death from cardiovascular disease and other causes than conventional office monitoring.[5, 6]

Using a monitor that has been validated for accuracy is important; unfortunately, many devices on the market don't fulfill the requirements of current validation protocols. The Association for the Advancement of Medical Instrumentation (AAMI) and the British Hypertension Society (BHS) have each published protocols for the evaluation of blood pressure monitors. According to these protocols, readings using either an ambulatory or a self-monitoring device and a sphygmomanometer must be made in normo- and hypertensive subjects in various age groups.[7, 8] As noted by Gerin and colleagues, "both protocols require an assessment based on 85 subjects, with three blood pressure measurements recorded for each person, for a total of 255 measurements."[9] On the basis of these results, only devices that achieve a high grade of accuracy for both systolic and diastolic readings are to be recommended. (Some consider these protocols difficult to meet because of the number of subjects and amount of time required. The European Society of Hypertension [ESH] recently developed a simpler validation protocol that requires fewer subjects and less time to complete. For more information see www.eshonline.org/documents/International_PS_2002.04.29.pdf.)

Unfortunately, manufacturers aren't obligated to guarantee their products' accuracy. See *Upper-Arm Self–Blood Pressure Monitors Validated by AAMI or BHS Protocols*, page 55, for sources of recommended devices.

Patient Education: Self–Blood Pressure Measurement

Tell patients who will measure their own blood pressure at home the following:

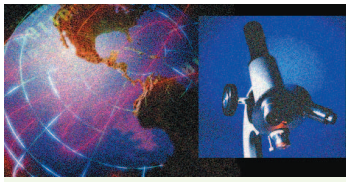
- Sit in a chair with back support, with feet flat on the floor and arms bared and supported at heart level. Sit next to a table and rest one arm on its surface during measurement. A lack of back and foot support can cause a transient rise in diastolic blood pressure (of, on average, 5 mmHg).
- Rest for at least five minutes before beginning blood pressure measurement. This helps eliminate activity-related factors that can cause elevation in blood pressure.
- It's important to refrain from smoking or ingesting products containing caffeine (such as coffee or tea) for 30 minutes before measurement. Smoking and caffeine ingestion can cause a transient rise in blood pressure.
- Wrap the cuff smoothly and snugly around the upper arm, with the center of the bladder placed directly over the bend in the elbow and the cuff's lower edge placed 2.5 cm (about two finger-widths) above the bend of the elbow. Incorrect cuff placement will yield inaccurate readings.
- Take two or more readings and record the data in a notebook if the monitor isn't memory equipped or linked to a telephone transmission system. Blood pressure changes from one minute to the next; averaging two or more readings taken from the same arm improves the reliability of the data. Frequency of readings will vary according to the severity of the hypertension and the need to monitor or adjust medication dosage.
- Make sure the cuff is sized appropriately. Measure upper-arm circumference before buying a monitor. Using the wrong cuff size results in inaccurate readings.

Asmar R, Zanchetti A. *J Hypertens* 2000;18(5):493-508; Grim CM, Grim CE. In: Izzo J, et al., editors. *Hypertension primer: the essentials of high blood pressure*. 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 1998. p. 295-8.

AMBULATORY MONITORING

Ambulatory devices employ a standard arm cuff that's inflated automatically by a small pump at preset intervals, typically every 15 to 30 minutes during waking hours and every 30 to 60 minutes during sleep over a 24-hour period.[10] Readings are stored in the unit the patient wears and then uploaded to the manufacturer's computers, which print information such as waking and sleeping systolic and diastolic pressures, pulse pressure, heart rate, and the blood pressure load (the percentage of readings above a fixed threshold, typically higher than 135/85 mmHg when awake and 125/75 mmHg when asleep).[10]

Both the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC) and the World Health Organization–International Society of Hypertension have endorsed the use of ambulatory monitor-



RELATED RESEARCH

Prognostic Value of At-Home Blood Pressure Measurements

They may be more accurate than those taken in the office.

A new study suggests that among elderly patients being treated for hypertension, blood pressure measurements taken at home may more accurately predict cardiovascular events than those taken in a clinician's office.

Researchers compared the efficacy of home and office blood pressure measurements in predicting cardiovascular "events," such as cardiovascular mortality, myocardial infarction, stroke, angioplasty, and coronary artery bypass graft surgery, in 4,939 patients (mean age, 70 years) being treated for hypertension by general practitioners in Europe. The mean values of six valid measurements taken during two office visits and six valid measurements taken at home (three in the morning and three in the evening), along with other pertinent information such as cardiac risk factors, were established as baseline readings.

After a mean follow-up period of 3.2 years, 205 patients (4.16%) had died, 85 of them (1.72%) of cardiovascular causes; and 324 patients (6.57%) had suffered at least one cardiovascular event. After adjusting for various cardiac risk factors, an analysis using the home blood pressure measurements showed that the risk of a cardiovascular event increased by 17.2% for every 10-mmHg increase in systolic blood pressure and by 11.7% for every 5-mmHg increase in diastolic blood pressure, a pattern that wasn't evident when office blood pressure measurements were used. And in comparison with patients with controlled hypertension (defined as normal home and office blood pressure readings), patients with uncontrolled hypertension (defined as in-office blood pressure readings of at least 140/90 mmHg and home readings of at least 135/85 mmHg) had nearly double the risk of a cardiovascular event; those with elevated home but normal office measurements had more than double that risk. Patients with elevated office but normal home measurements showed no difference in risk.

In light of these results and the fact that office measurements failed to identify a significant proportion of patients with elevated blood pressure levels, the researchers suggested that home measurements should be part of the management of hypertension.—*Julie J. Chu, MSN, CRNP*

Bobrie G, et al. Cardiovascular prognosis of "masked hypertension" detected by blood pressure self-measurement in elderly treated hypertensive patients. *JAMA* 2004;291(11);1342-9.

ing.[2,11] According to the *JNC 7 Express*, the seventh report of the *JNC*, ambulatory monitoring is most commonly used in and most clinically helpful to patients who have white-coat hypertension.[2] It's also beneficial in cases of apparent drug resistance, hypotensive response to antihypertensives, episodic hypertension, or autonomic dysfunction.[12]

Ambulatory readings in patients with normal blood pressure (generally defined as below 135/85 mmHg when awake and below 120/70 mmHg when asleep) are often lower than clinic readings using sphygmomanometry.[2] In most people, blood pressure drops during sleep, a phenomenon called "dipping." "Nondipping" refers to awake-to-asleep systolic or diastolic pressure dropping by less than 10%.[13] Evidence has shown that nondipping may have prognostic significance: nondippers appear to have greater target-organ damage and a higher incidence of cardiovascular comorbidity such as stroke than do dippers.[6] Ambulatory monitoring permits better assessment of dipping, as well as of daytime variability, including morning surge (a sharp increase in blood pressure upon getting out of bed).

Ambulatory monitoring is one of the best ways to confirm a diagnosis of white-coat hypertension[14]—defined as an in-office blood pressure higher than 140/90 mmHg and out-of-office blood pressure below 135/85 mmHg. Studies suggest that it occurs in about 20% of the hypertensive population, with risk factors including being female and older and having less severe hypertension according to office measurement and less frequent clinic visits and measurements.[15] The Centers for Medicare and Medicaid Services recently approved for reimbursement the use of ambulatory monitoring in patients with suspected white-coat hypertension, when the data thus obtained are necessary for treating the condition.[16]

Nursing care for patients undergoing ambulatory monitoring usually includes checking cuff size, teaching patients to use the monitor, and telling them which activities to avoid during the 24-hour monitoring period (which may vary because different institutions have different policies).

Accurate readings depend on the cuff fitting properly, with the inner bladder encircling at least 80% of the upper arm. Cuff size (child, small adult, adult, large adult, or extra-large adult) is determined by measuring upper-arm circumference at the midpoint, between the olecranon and acromion processes.[17]

The cuff should be worn on the nondominant arm, to minimize interference from movement. The tube leading from the cuff to the monitor should emerge at the top of the cuff rather than the bottom.[18] It's best to place the cuff directly on the skin; a spokesperson for one manufacturer (Spacelabs Medical, Issaquah, Washington) said that readings may also be taken through a lightweight shirtsleeve. The cuff should be wrapped smoothly and snugly around the upper arm with the bladder centered over the brachial artery and the lower edge of the cuff 2.5 cm above the antecubital fossa.[17]

A typical ambulatory monitor weighs less than 1 lb.; the patient carries it in a pouch attached to a shoulder strap or waist belt. During sleep the pouch can be placed under a pillow or hung from a bedpost.

Some institutions require that patients not remove the cuff during 24-hour monitoring unless they can't tolerate or complete the procedure; others permit patients who must shower to remove it briefly. In any case, the monitor should not be immersed in water. If the cuff is to be removed, the shower should be taken between cuff inflations; the patient should slip the cuff off immediately after a reading ends, shower, and slip the cuff on before the next inflation begins. Alternatively, the patient can simply turn the monitor off before showering and turn it on afterward without losing data.

Ambulatory monitors vary by manufacturer. Usually, only the first few readings are visible when the monitor is first put on; the patient should know that readings won't be visible during most of the monitoring period. Patients should also expect to hear certain sounds from the monitor; for example, a tone may signal the beginning of cuff inflation, which lets the patient know to straighten the arm and keep it straight until the cuff deflates. (In most models, this feature can be turned off.) Some problems, such as a loose or improperly positioned cuff, a pinched air hose, or excessive patient movement, will trigger alarms. In some models, a marked rise or fall in blood pressure from one reading to the next may trigger an alarm. It's important that patients know what each sound means and how to get help when necessary.

Patients should also know how often the cuff will inflate throughout the day and night. The patient is interviewed (by a nurse or an ambulatory monitor technician, depending on the facility) about daily schedule, and usual waking and bed times are programmed into the monitor. Once the times are set, the patient can't reprogram the monitor. Physical activities that patients are likely to engage in during the 24-hour monitoring period are discussed. The patient should be told that when he feels the cuff begin to inflate, he should stop what he's doing and let the cuffed arm hang at his side. If he's driving, he should take the cuffed hand off the steering wheel and rest it in his lap during inflation and deflation.

Many providers ask patients to keep an activity diary while wearing the monitor. This can help with data interpretation at the end of monitoring. Patients can record physical activities or emotional states; any symptoms of hypertension (such as headache, chest pain, palpitations, fatigue or muscle weakness, nosebleed, or dizziness); and times that blood pressure medications (and any drug that might affect blood pressure) are taken and meals are eaten, as well as waking and sleeping times.[12, 18]

SELF-MONITORING

As the cost of automated self–blood pressure monitors has dropped, their use has become more widespread; many people buy them without a provider's encouragement.[19] Ideally, patients should consult a provider before buying a monitor to ensure that they purchase one that meets validation standards. Currently insurance companies don't reimburse patients for self-monitoring devices, which can cost from about $25 for a manual model to over $100 for one with memory and printing capabilities.

Types of monitors available for home use include aneroid ("dial type") manometers, mercury-column sphygmomanometers, and semiautomatic electronic monitors that use an oscillometric method of measurement (this method measures the movement of blood through an artery, usually the brachial artery).[20] Because of its ease of use, the oscillometric method is the one most often used for self-monitoring. The device records small oscillations in arterial pressure and uses them to determine mean systolic and diastolic pressures; this method is susceptible to patient movement. Oscillometric monitors can't measure blood pressure in some patients, especially those with arrhythmias such as rapid atrial fibrillation.[21]

In comparison with ambulatory monitoring, self-monitoring is inexpensive and, if performed correctly, offers several of the same advantages.[6] It permits more readings than clinic visits can; because readings are taken at home or in another nonclinical setting, white-coat hypertension is avoided. In a study by Yarows and colleagues, average blood pressure readings obtained through self-monitoring at home and those recorded by ambulatory monitoring during patients' awake time were very close, and both were lower than measurements in clinical settings.[19] Like ambulatory monitoring, self-monitoring can help providers to distinguish sustained hypertension

Upper-Arm Self–Blood Pressure Monitors Validated by AAMI or BHS Protocols

At this writing, two companies make monitors for home use that meet validation criteria according to either the Association for the Advancement of Medical Instrumentation, the British Hypertension Society, or both. Specific models vary by features such as cuff size, cuff contour, whether cuff inflates automatically, memory, and printing capability. Details are available at the manufacturers' Web sites. (Ambulatory blood pressure monitors aren't listed here because patients don't purchase them.)

A&D Medical
1555 McCandless Drive
Milpitas, CA 95035
(408) 263-5333
www.lifesourceonline.com/products/BPMonHome.cfm

Omron Healthcare, Inc.
300 Lakeview Parkway
Vernon Hills, IL 60061
(847) 680-6200; (877) 216-1333
www.omronhealthcare.com

Two Approaches to Telemonitoring

At least two national companies currently provide blood pressure telemonitoring services.

LifeLink Monitoring, Inc.
751 Grant Avenue
Lake Katrine, NY 12449
(888) 595-8080
www.llmi.com

This company supplies patients with a self–blood pressure monitor for home use and sets up an automated monitor–telephone connection. No equipment purchase is required. The monitor inflates the cuff automatically, deflates it, displays blood pressure and pulse readings, and stores them, along with time and date, in its memory. At regular intervals (as ordered by the patient's primary care provider, typically daily or weekly), the monitor sends the stored readings to the monitoring facility through a small interface device plugged into the patient's telephone line. The patient then picks up the telephone receiver and an interactive voice response system provides her with an average level for the readings just sent and congratulates her if she's at goal. The system can also ask patients questions about their symptoms and medication compliance.

The entire procedure requires the patient to press just one button and takes less than two minutes. Graphic and tabular reports of monitor data and patient responses to questions are almost immediately available to providers and patients on a secure Web site that is compliant with the Health Insurance Portability and Accountability Act of 1996. Data can also be delivered to a patient's electronic medical record. The service costs the patient about $50 to $60 per month (depending on volume), plus a one-time shipping and set-up fee of about $40. These fees cover outbound and return shipping to the patient, equipment usage, toll-free telephone service, live-agent customer service for patients and clinicians, and reports to clinicians. There are no other licensing or user fees.

Health Hero Network, Inc.
2570 West El Camino Real, Suite 111
Mountain View, CA 94040
(650) 559-1000
www.healthhero.com

This company's system consists of Web-based software used by the care provider and a home messaging appliance, called the "Health Buddy," used by the patient. The patient supplies the blood pressure monitor. Providers can use the desktop software to develop queries, reminders, and tips tailored for various groups of patients, including patients with hypertension. Patients enrolled in the company's network service receive a messaging appliance, which plugs into an existing telephone line and, if the patient's monitor has digital output, into the monitor. The appliance prompts the patient to take a blood pressure reading and then transmits the data to the provider's computer terminal. Patients can view information and respond to questions from their providers on the appliance screen using four buttons. Blood pressure data can be analyzed and reported to providers in various forms, including bar graphs and tables. Patients receive scripted messages, such as reminders about actions they can take to control blood pressure and instructions on what to do if it rises out of range.

Participating institutions and provider practices pay a one-time licensing fee. The patient pays an undisclosed monthly fee for use of the messaging appliance and network service.

from the white-coat variety, assess response to antihypertensives, and improve treatment adherence.[2]

Unless they have conditions such as cognitive impairment, partial or total upper-extremity paralysis, blindness, or cardiac arrhythmias, most adults can self-monitor. Patients with conditions such as arthritis may find it difficult to use devices that require manual cuff inflation.

Broege and colleagues found that home monitoring alone could be as useful as clinic monitoring when making treatment decisions for adults 65 years old and older.[22] They randomized 40 men and women (average age, 73 years) to one of two treatment groups; treatment decisions for the "home" group were based on self-monitored readings, and those for the "clinic" group were based on readings taken by a nurse in a clinic. Accuracy of the home group's self-measurement was evaluated using blood pressure averages taken by ambulatory monitoring in a 24-hour period. Over three months, average waking and sleeping values either fell or didn't change, regardless of whether treatment was based on readings obtained by a clinic nurse or a patient at home.

Several types of automated self–blood pressure monitors are currently available for home use: finger, wrist, and upper-arm devices.

Finger devices are not recommended. Inaccuracies result from measurement distortion caused by peripheral vasoconstriction, a more distal site, and the effect of hand position or placement on blood pressure.[21]

Wrist devices are more accurate than finger devices but also are subject to inaccuracies associated with a distal site and the effect of arm position on blood pressure.[21,23] A major disadvantage of wrist devices is that the patient's wrist must be held at heart level during every blood pressure measurement,[24] because substantial error may result from incorrect wrist placement.[25] Error may also result from wrist flexion or extension at the time of measurement.[24] Kikuya and colleagues found that under stringently controlled conditions wrist devices produced blood pressure values markedly different (more than plus-or-minus 10 mmHg systolic and plus-or-minus 5 mmHg diastolic) from auscultation.[26] They also found that readings obtained in palmar flexion were significantly higher, and those obtained in palmar dorsiflexion were significantly lower, than those obtained in palmar extension.

Upper-arm devices are thus recommended over finger and wrist devices for home monitoring.[21] But regardless of the device used, there are caveats. Patients may decide to report only some of their blood pressure readings to providers. And self-measured readings aren't always accurate. Campbell and colleagues compared self-measured readings with nurse-measured readings in a sample of 69

Figure 1. The Process of Telemonitoring

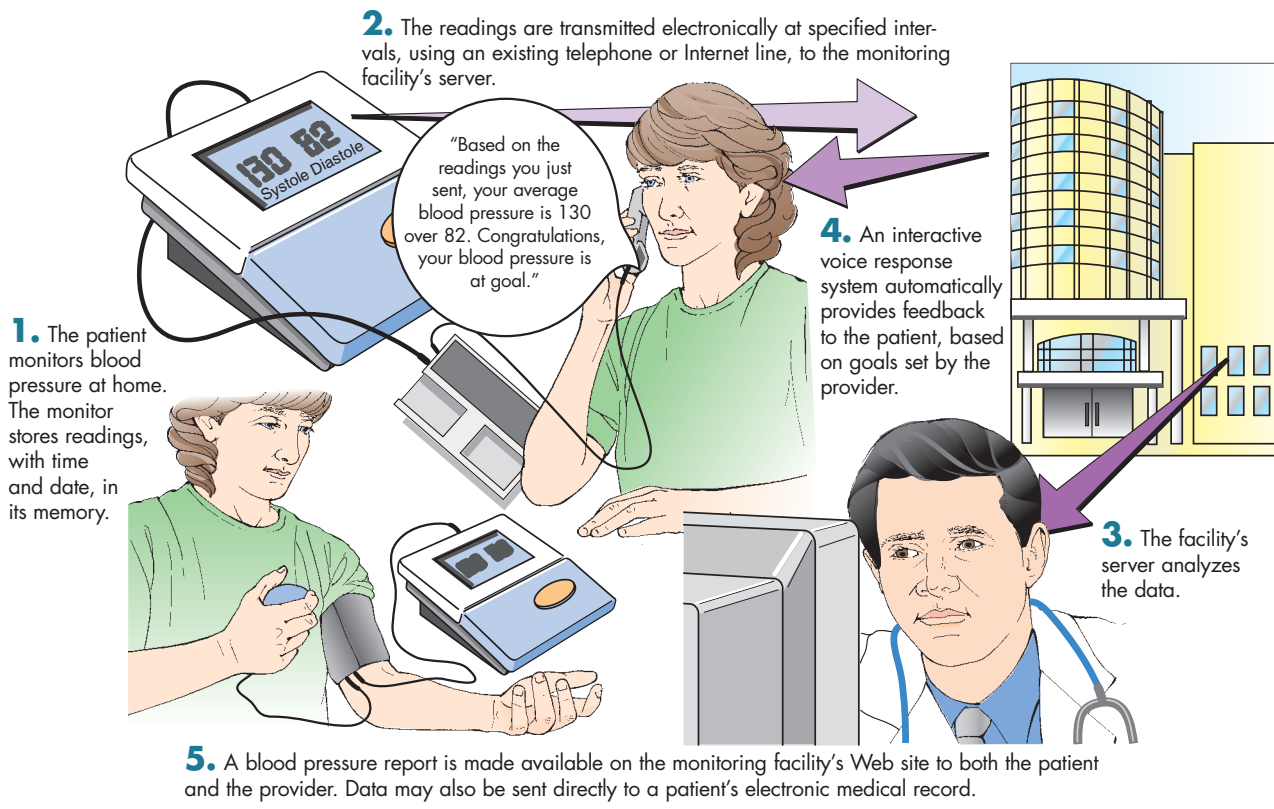


Illustration based on one supplied courtesy of LifeLink Monitoring, Lake Katrine, NY.

patients with hypertension (average age, 62 years) and found that inadequate knowledge and skill and inaccurate equipment were widespread.[27] Only about one-third of patients followed instructions for resting before measurement (36%) and applying the cuff properly (37%), and even fewer used a chair with back support during measurement (25%) or deflated the cuff at the recommended rate (4%), although most patients did apply the cuff to a bare arm (96%) and supported the arm during measurement (88%). Overall, 42% of the initial patient readings differed in classification of hypertension or normotension from those taken by the nurse.

A study by Merrick and colleagues showed similar findings; 31 of 91 patients (34%) obtained inaccurate readings when self-monitoring.[28] The reasons for the inaccuracies weren't identified. But the researchers found that although most participants (96%) had physicians, only 69% had brought their monitors to the office for comparison with a reading taken by the provider using a sphygmomanometer. And 53% of the participants had never received instruction in the use of their monitor.

Nursing care includes verifying the accuracy of patients' self-measured readings by checking their knowledge, technique, and equipment. And nurses should interpret the readings with caution. It's recommended that patients be trained in self-monitoring and reevaluated annually.[21] See *Patient Education: Self–Blood Pressure Measurement* on page 53 for techniques that nurses should teach patients.

How can providers ensure that patients who self-monitor are obtaining accurate readings? Nurses should check that patients

- position themselves and apply the cuff properly.
- perform a reading correctly.
- understand the result.
- know what actions, if any, should be taken.

Nurses should also determine whether a patient's readings match, or come close to matching, those obtained by the provider. This is especially important for patients whose monitors do not meet AAMI or BHS standards.[9] Patients should be advised to use the same monitor over time so that blood pressure changes are tracked with one device.

One review of the literature suggests that it's important to document environmental and behavioral factors that can affect blood pressure.[29] For example, blood pressure measured at work has been reported to be higher by an average of 5 mmHg than that measured at home. Blood pressure also varies greatly depending on whether one is resting or speaking. It's important that patients not talk during blood pressure measurement.

Gerin and colleagues recommend two levels—population and individual user—of blood pressure monitor validation.[9] Population validation means that a particular monitor meets criteria set by the AAMI or the BHS. Individual user validation means that the patient's monitor has been validated by a

person trained in blood pressure measurement. This entails comparing several readings taken by both the automated monitor and the provider at the same time in order to verify the monitor's accuracy.

TELEMONITORING

With telemonitoring, patients self-monitor blood pressure at home, then transmit the readings over existing telephone lines to a network server provided by a telemonitoring service. Because this technology is rather new, it's not known how many patients are using such services; nor do insurance companies typically cover the costs.

Providers instruct patients who enroll in scheduling readings and transmitting data to the network server. For example, my research team tells patients to send their readings once a week. The server in turn sends the patient an automated message that includes the average blood pressure level (the average of all blood pressure readings in that transmission) and congratulates them whenever blood pressure is at their target level. It also performs some data analysis and sends more detailed reports to providers, weekly or as often as a provider specifies. These reports usually contain information about the mean systolic pressure, mean diastolic pressure, and mean heart rate; some display readings on a graph by date. Figure 1 (page 57) diagrams the telemonitoring process.

There is evidence that telemonitoring may improve blood pressure control. In a pilot study of 26 African-American patients with hypertension, my colleagues and I found that those who used home telemonitoring had clinically and statistically significant ($p < 0.05$) reductions in both systolic and diastolic blood pressure levels at three months' follow-up.[30] In comparison, those who received usual care only had little change in systolic or diastolic blood pressure levels at three months' follow-up. (Usual care involved primary care visits scheduled at intervals requested by the provider and influenced by the participant's level of compliance. Each visit lasted 15 minutes; care typically included blood pressure measurement, performance of diagnostic tests, and recommendations, provided either verbally or in writing, about lifestyle modification.) In another study, Rogers and colleagues found that mean arterial pressure decreased by an average of 2.8 mmHg in patients using a home telemonitoring service but increased by an average of 1.3 mmHg in patients receiving usual care.[31] Other researchers have found that home telemonitoring helps patients control their blood pressure effectively.[32, 33]

Several companies provide telemonitoring equipment or services; the specific equipment and services, and therefore costs, vary somewhat. Companies may charge participating institutions or providers a licensing fee for customized services; patients also pay a monthly fee. For more information and some typical costs, see *Two Approaches to Telemonitoring*, page 56.

Nursing care for patients who self-monitor their blood pressure applies to those who telemonitor as well. Patients who will be telemonitoring need to know how to connect their monitor to the telephone and how to transmit the readings, as well as how to troubleshoot problems (such as a loose wire between the linking device and the monitor or telephone).

Nurses should note that, without careful planning, telemonitoring may increase their workload. It takes time to review a patient's readings, discuss them with the primary care provider, and contact the patient regarding any medication changes. Internet-based telemonitoring services require providers to spend some time at a computer terminal evaluating the patient's data (as opposed to receiving reports of analyzed data by e-mail, fax, or postal mail). Good time management is essential. ▼

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CE 2 HOURS
Continuing Education

GENERAL PURPOSE: To present registered professional nurses with a detailed review of blood pressure monitoring, including the advantages and disadvantages of various innovative monitoring methods as well as the implications for nursing.

LEARNING OBJECTIVES: After reading this article and taking the test on the next page, you will be able to

- discuss three ways that ongoing blood pressure monitoring is useful in treating patients with hypertension.
- compare and contrast the various methods of monitoring blood pressure.
- outline a teaching plan for patients who are or will be self-monitoring their blood pressure.

To earn continuing education (CE) credit, follow these instructions:

1. After reading this article, darken the appropriate boxes (numbers 1–14) on the answer card between pages 56 and 57 (or a photocopy). Each question has only one correct answer.

2. Complete the registration information (Box A) and help us evaluate this offering (Box C).*

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