

**Behavioral links and reminders.** The pairing of adherence behavior with daily habits—for example, linking pill taking with brushing teeth or shaving—avoids missed medication doses. Reminders by telephone, mail, or electronic aids enhance memory and appropriate behavior. Compliance packaging, such as blister packaging, help patients remember when to take their medication and notice if they have forgotten. One of the most successful strategies in many practices is the use of “pill boxes” with individual bins for each day of the week. Multiple dose pill boxes are also available.

## Multilevel Approach to Improve Care Delivery

A multilevel approach is needed with patients, providers, and health care organizations taking action to increase compliance. The delivery of care needs to be organized to address potential and real problems with adherence at all levels simultaneously. Table C131.3 presents the actions and strategies encouraged by the American Heart Association for patients, providers, and health care organizations to increase compliance with prevention and treatment recommendations. It is important to work with individual patients to assure that they understand what is necessary to achieve treatment goals and that they participate in treatment decisions. Joint problem solving to prevent or minimize barriers to care and treatment is valuable. Provider responsiveness to patient concerns as well as reinforcement and support are also necessary. Provision of reminders, outreach, and follow-up services are bene-

cial. The use of a pharmacy to fill prescriptions improves surveillance, counseling, identification of drug-drug interactions, and monitoring of timely refilling of prescriptions. Integrated systems approaches with continuous quality improvement enhance the training and practice of providers and patient outcomes.

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## Chapter C132

# Hypertension Recordkeeping and Electronic Management Systems

Mary K. Goldstein, MD, MS; Brian B. Hoffman, MD

## KEY POINTS

- Flowsheets and patient summary of hypertension-related clinical information facilitate treatment of hypertensive patients.
- Graphic displays can communicate quantitative information rapidly.
- Guideline-based decision support systems, individualized for the patient being seen, are being developed that can be presented to clinicians at the time of medical decision making in outpatient clinics.

See also Chapters B105, C127, C131, and C136

## Rationale for Improved Recordkeeping Systems

Despite comprehensive, evidence-based, national guidelines for management of hypertension [e.g., Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC VI)], clinical management of hypertension often falls short of concordance with

guideline goals for adequate control of blood pressure (BP) and optimal choices of drugs. To manage hypertension effectively over time, physicians and other health care professionals need rapid access to accurate medical record information about the patient's previous BPs and antihypertensive regimens. Such information can be difficult for the physician to extract from

clinic charts unless they are structured to collect and display this specific information.

The increasing availability of electronic medical records offers an opportunity for improving the display of relevant clinical information. Electronic medical records, viewed at the time of clinic visits, can be used to present guideline-based recommendations about management of hypertension to physicians and other health care providers when medical decisions are actually being made.

### Traditional Data Organization: A Barrier to Blood Pressure Control

Medical information in traditional clinical charts is often so extensive that it overwhelms the physician's capacity to evaluate it in the time available for most clinic visits. Prioritization of information value also does not occur. Presentation of information in graphic format can vastly improve the recipient's perception of important patterns. An early example of the power of graphic display of information is the famous dot map of Dr. John Snow, the physician who identified the Broad Street Water pump as the source of the cholera epidemic in London in 1854 by plotting the location of deaths. Clinical information intended to help physicians provide care for hypertensives may most effectively take the form of flowsheets and summaries.

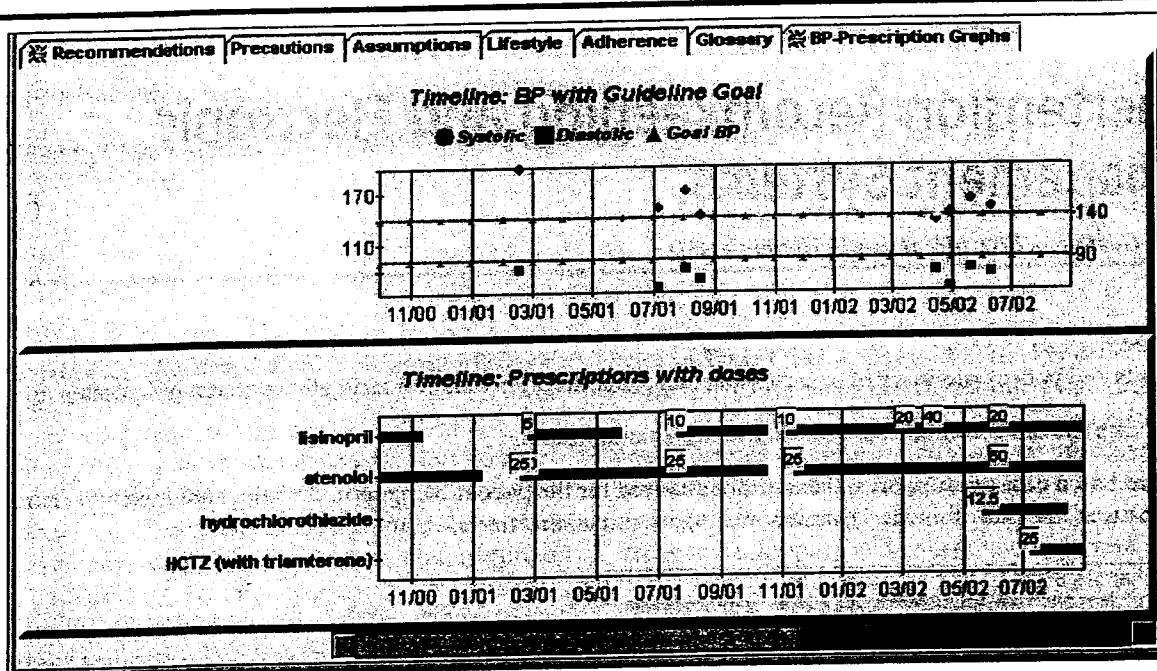
### Improved Information Systems

**Flowsheets.** Flowsheets aimed at providing important information for the management of hypertension, on paper or in

electronic format, should present BPs and doses of antihypertensive medications over time. Flowsheets should provide detail in a time frame relevant to the clinical setting. For example, intensive care unit flowsheets may show minute-to-minute changes in BP, whereas outpatient primary hypertension flowsheets typically show more isolated values over weeks, months, and years. Flowsheets and graphs have been used routinely in paper charts for outpatients in many clinical domains—for example, growth charts and immunization records for children, fundal height and other parameters in prenatal care, and hematologic and renal parameters together with drug doses in chemotherapy protocols. Despite the fact that these are easy to maintain, hypertension flowsheets have not been widely used.

**Patient summaries.** Periodic summaries from a paper chart aid in making the particular clinical decision at hand. However, summaries from paper charts are extremely labor intensive. In contrast, an electronic record lends itself readily to automating the rapid extraction and display of patient data important to a particular clinical domain. Patient summaries from the electronic patient data may be presented in text format or, with the more recent wide availability of graphic user interfaces, in user-friendly visual displays.

**Graphic displays.** Many electronic medical record systems include graphing capabilities for display of single parameters. For example, the Computerized Patient Record System-



**Figure C132.1.** Blood pressures (BP) and antihypertensive medications on the same time line. This figure shows 1 tab, the BP-Prescription Graphs tab, from a hypertension advisory program, Automated Treatment of Hypertension Evaluator and Advisor (ATHENA) Decision Support System, built using EON technology for developing decision support systems for guideline-based care. This tab displays a time line with the patient's BP measurements (top graph) and antihypertensive drugs, including drug dose (bottom graph), on the same time line. The patient's goal BP (in this case 140/90) is shown as a gray line on the top graph so that it is readily apparent when the blood pressure is higher than the target pressure. The drug display shows how many days of prescription drug the patient had available; gaps in the line are a clue to the possibility of the patient not refilling prescriptions in a timely manner. In this case, the patient's prescription for hydrochlorothiazide (HCTZ) was changed to a prescription for combination HCTZ/triamterene, with the newer prescription entered (appropriately) before the patient had run out of the previous one.

Vitals		
Name	Value	Date
Systolic Blood Pressure	157	2-1-2002
Diastolic Blood Pressure	74	2-1-2002
pulse	81	2-1-2002

ADRs / Allergies	
Substance	Reaction
ASPIRIN	OTHER REACTION

Active Antihypertensives	
Name	Dose/Dosage
lisinopril	40.0

Lab Tests		
Name	Value	Date
CREATININE	1.1	11-29-2001
SODIUM	140	11-29-2001
POTASSIUM	4.6	11-29-2001

Blood Pressure	
Conditions	BP (mmHg)
Late effects of CVA	438.9
Coronary Artery Disease	414.9
Hypertension	401.1, 401.9

ICD-9-CM	
Code	Description
477.9	ALLERGIC RHINITIS, CAUSE UNSPECIFIED
530.81	ESOPHAGEAL REFLUX

Update Advisory

**Figure C132.2.** Summary of patient's hypertension-related information. The most recent patient data relevant to treatment of hypertension are pulled from various locations in the electronic medical record and summarized in this window. Information in the window can be changed, using the + and - buttons. For example, new diagnoses can be added to the list from a drop-down menu, or present diagnoses can be deleted. Recommendations made by the program can be updated with the new information by clicking the Update Advisory button at the bottom of the screen. The recommendations of the program (for a different patient) are shown in Figure C132.3. ADRs, adverse drug reactions; CVA, cardiovascular accident.

Graphical User Interface used nationally by the Department of Veterans Affairs in its hospitals and clinics includes a feature to display graphs of a single parameter in each instance for a time window selected by the user. This feature can be used to display every BP entered into the patient's electronic record.

The ability to display a graph of a patient's BPs over time is quite useful. It is also clinically advantageous to know what antihypertensive drugs, and at what doses, the patient was taking at the time these BP measurements were made. **Figure C132.1** shows a graphic display of BPs and antihypertensive drugs on the same time line. **Figures C132.1 to C132.3** are from Automated Treatment of Hypertension Evaluator and Advisor Decision Support System (ATHENA DSS), an automated hypertension advisory system built using EON technology for developing decision-support systems for guideline-based care. The graph shows the target BPs for adequate control, individualized to take into account comorbidities such as diabetes. The dose of each antihypertensive drug is shown at the time the drug was introduced or changed. Gaps in availability of the drug—for example, due to the patient not refilling the prescription on time—suggest the need to ask the patient about barriers to medical refill or other potential medication adherence difficulties.

**Summary of hypertension-related information.** The electronic medical records can be organized to present a summary

of the patient's relevant clinical information (**Figure C132.2**). The summary shows the most recent vital signs, any known allergies or adverse reactions to drugs, the most recent relevant laboratory tests, a list of active antihypertensive medications, the diagnoses relevant to choice of antihypertensive medication, and other diagnoses.

**Management decision support for hypertension management.** The electronic medical record may be combined with hypertension guidelines to generate recommendations for management of each patient. A detailed description of the hypertension knowledge base for this program is beyond the scope of this chapter. These recommendations may be displayed visually. **Figure C132.3** shows one such display. In this case, the recommendations are shown with icons indicating the clinical significance of each recommendation (e.g., a compelling indication per JNC VI). Additional information triggered by the patient data is available by clicking the Info button next to the recommendation. The clinician can also provide feedback about the recommendation from a checklist of options by clicking the Feedback button.

### Testing of Records Systems

Automation provides many opportunities to improve medical care and patient safety through alerts, reminders, and other such systems. Studies of accidents, particularly in the

Guideline Goal: SBP < 140 and DBP < 90 [ absence of diabetes, heart failure, and renal insufficiency ]  
 BP apparently NOT UNDER CONTROL, based on most recent available BP.  
 ( Enter "Today's Decision Blood Pressure" and press "Update Advisory" for new recommendations. )

Recommendations Precautions Assumptions Lifestyle Adherence Glossary BP-Prescription Graphs

Consider **INTENSIFYING** drug treatment: BP **ELEVATED** based on most recent available BP.

Compelling Indication Relative Indication Strong Contraindication Relative Contraindication Adverse Events

Consider one of the following therapeutic possibilities	Click here for important ...	Reasons	Click here to provide ...
Increase dosage of atenolol	Info	Isolated Systolic Hypertension	Feedback
Add DHP Calcium Channel Blocker (felodipine, nifedipine)	Info	Isolated Systolic Hypertension	Feedback
Add Thiazide Diuretic (HCTZ)	Info	hyponatremia	Feedback

**Figure C132.3.** Display of guideline-based recommendations. The figure shows the mid-portion of screen displayed in a pop-up window in the electronic medical record. It includes goal blood pressure (BP) (<140/90); because this patient is above target, the information is displayed in red letters. A series of tabs give options for the clinician to select; the current screen shows the Recommendations tab, which is the default display when the window pops up. Because the BP is not adequately controlled, the primary recommendation is to intensify drug treatment.

The table shows recommended changes to drug treatment. Recognizing that drug choices must be individualized for the patient and that guideline-based recommendations may not apply to each individual patient, clinicians are asked to consider the possibilities. The first column in the table shows the specific drug recommendations for this patient, including an increase in the dose of a currently used drug, in this case atenolol, or the addition of a new drug. A variety of options are afforded in the boxes that prompt the user to make choices derived from guidelines and policies. DBP, diastolic blood pressure; DHP, dihydropyridine; HCTZ, hydrochlorothiazide; SBP, systolic blood pressure.

airline industry, have shown that the introduction of automated systems can also affect human problem solving in ways that can lead to unanticipated problems. New automated systems should be thoroughly tested in simulated clinical environments before they are deployed, and the systems should be monitored after deployment to detect and correct any problems that arise.

## Health Insurance Portability and Accountability Act

The Health Insurance Portability and Accountability Act (HIPAA) of 1996, Public Law 104-191, specifies a number of regulations that include standard transaction and code sets and the national provider identifier; security standards; and a privacy rule that goes into effect in April 2003. A description of HIPAA is beyond the scope of this chapter. Physicians and health care systems should be aware of important security and privacy provisions of HIPAA. Further information is available from many sources, including the following Centers for Medicare and Medicaid Services Web site: <http://cms.hhs.gov/hipaa/hipaa1/content/more.asp> and the following Department of Health and Human Services Web site: <http://www.hhs.gov/ocr/hipaa/assist.html>.

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