



*The tabletop remote care system for the elderly and chronically ill, asks a series of questions about sleep, eating habits and medication use, which are evaluated remotely by a health care professional. Source: Health Hero Network.*

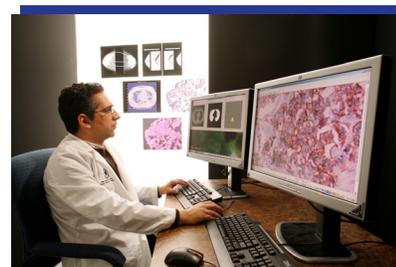
### What is telehealth?

Telehealth is broadly defined as the use of communications technologies to provide and support health care at a distance. Telehealth has become a valuable tool for improved health thanks to combined advances in a number of areas including communications, computer science, informatics, and medical technologies.

Telehealth can be as simple as two doctors talking on the phone about a patient's care or as complex as the use of robotic technology to perform surgery from a remote site. Today, telehealth is often associated with remote monitoring of a patient's condition; for instance, blood pressure, heart rate, and other measurements of health status can be obtained by a device worn by the patient and electronically sent to medical personnel.

### What types of telehealth technologies are there and how are they improving medical care?

**Teleconsultations** allow a physician in a rural area to receive advice from a specialist who may be in a distant location, about patients with special or complex conditions. Such consultations can be as simple as a phone call. Increasingly, they involve more sophisticated sharing of medical information such as CT or ultrasound scans. These images can be taken by the local physician, incorporated into an electronic medical record and sent to the specialist for diagnosis and treatment recommendations.



*Images of patient tissue samples can be sent from remote sites for analysis by experts.*

**Remote patient monitoring (RPM)** is a technology enabling patients to be monitored outside of conventional clinical settings, such as in the home. RPM requires sensors on a device that wirelessly transmits or stores physiological data for review by a health professional. Incorporating RPM in chronic disease measurement can significantly improve an individual's quality of life, particularly when patients are managing complex processes, such as home hemodialysis. For example, in diabetes management, the real-time transmission of blood glucose and blood pressure readings enables immediate alerts for patients and healthcare providers to intervene when needed.

**Intraoperative monitoring (IOM)** is a technique that allows a surgeon to perform continuous checking, recording, and testing during a difficult surgical procedure. In neurological surgeries, IOM is used to detect potentially damaging changes in brain, spinal cord, and peripheral nerve function prior to irreversible damage. Staff in rural hospitals rarely have the expertise to perform this type of monitoring. Remote IOM uses systems to transmit data, voice, and images over the Internet to a site for monitoring by an expert. The expert can then let the on-site surgeons know if any problems arise as the surgery progresses.



*The patient breathes into the wireless capnograph, which sends breath patterns to the user's phone where they are transmitted from home to a health care professional for evaluation. Source: Erica Forzani, Arizona State University*

**Telehomecare (THC)** provides the remote care and reassurance needed to allow people with chronic conditions, dementia or those at high risk of falling to remain living in their own homes. The approach focuses on reacting to emergency events and raising a help response quickly. Deterioration can be spotted at an early stage before an accident occurs.

Advanced systems use sensors to monitor serious changes in chronic conditions as well as other health risks including floods, fires and gas leaks. Such sensors can also alert caregivers if a person with dementia leaves the house. When a sensor is activated a radio signal is sent to a central unit in the user's home, which automatically calls a monitoring center where appropriate action can be taken such as contacting a caregiver, family member or doctor, as appropriate, or sending emergency services.

**Medical diagnosis and treatment at the “point-of-care”** refers to the ability to test and treat patients rapidly at sites close to where they live, rather than coming to the doctor or hospital for tests, waiting days or weeks for results, and then returning to the doctor for treatment. Point-of-care medicine is particularly useful for communities with limited access to large healthcare facilities, such as rural or low-resource areas.

Point-of-care medicine relies on portable diagnostic and monitoring devices that can be delivered to remote areas, combined with telehealth technologies. Such systems allow health care workers in remote areas to test patients and instantly send the results to experts to make a diagnosis and send back instructions for proper care. Portable devices have been developed that can measure blood gases, electrolytes, blood chemistries, and glucose levels. This capability greatly enhances health care for patients in remote and underserved areas.

## What are NIBIB-funded researchers developing in the area of telehealth to improve biomedical research and medical care?

### ***Ambulatory cardiac monitor to address heart disease in American Indians.***

There are many barriers that can prevent American Indians and Alaska Natives living on reservations from receiving adequate health care. Remote diagnostic tools equipped with telehealth monitoring systems can help remove some of these barriers. For instance, NIBIB-funded researchers are developing an ultra-low-power wireless electrocardiograph sensor for use in ambulatory electrocardiographs (ECGs). Ambulatory ECG devices include cardiac arrhythmia recorders, and cardiac monitors that use cell phones to transfer data to monitoring facilities. The devices use ultra-miniature long-life sensors with batteries that last for 10 years or more, resulting in more efficient, and comfortable wearable devices that do not require frequent battery replacement.



*This low-cost, disposable cartridge system is used by minimally trained health workers in the field to simultaneously test blood samples for multiple infections. Results can then be interpreted, remotely, by health care experts.  
Source: Michael Lockhead, mBioDiagnostics*

### ***Testing how mobile technologies empower families and reduce home healthcare problems.***

Many patients have chronic conditions that prevent normal eating. Such patients can only receive nutrition through the infusion of a nutrient solution directly into the major veins. Patients at home who use this method are at a high risk for serious blood infections related to the chronic insertion of the feeding line into the vein. Investigators are testing real-time home observation of these patients for early detection of serious bloodstream infections. The researchers are using a built-in camera, computer tablet and a smart phone for simultaneous monitoring of these individuals by family members and health professionals at home.

This study tests if mobile computer tablets and phone information can successfully assist in preventing infections and improve patient access to health professionals. It will also evaluate how well patients use internet websites for problem solving. The goal is to reduce home health-care costs and complications and improve support for caregivers and patients.

### ***Smart technologies allow aging population to remain safely at home.***

The prevalence of chronic illness is a challenge that must be addressed as the world’s population ages. NIBIB-funded investigators are designing remote monitoring or “smart” environment technologies to allow adults to function independently in their homes. This project studies older adults performing daily activities in their homes. Intelligent software identifies acute health changes such as infection and injury as well as slower progressive decline such as dementia. Prompt interventions support independence and promote healthy lifestyle behaviors (e.g., social contact, exercise, regular sleep). Developing automated technologies to help identify early indicators of changes in health status will extend the amount of time individuals can live independently in their own homes.

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