APPLICATIONS OF MEDICAL INFORMATICS IN
ANTIBIOTIC THERAPY

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INTRODUCTION

Effective antibiotic therapy is an essential part of hospital care. Studies show that patients with rapidly fatal and ultimately fatal underlying diseases have improved chances for survival with appropriate antimicrobial therapy. However, several studies show that there is considerable overuse and misuse of antibiotics. Up to two thirds of hospitalized patients who receive antibiotics have no evidence of infection. The major cause for antibiotic overuse results from unnecessary or prolonged surgical prophylaxis. Studies also show that antibiotic prophylaxis should be initiated before the operation to be beneficial. Yet, many patients who would benefit from antibiotic prophylaxis do not receive the antibiotics until after the start of the operation. The selection of therapeutic antibiotics has been found to be inconsistent with microbiology data. This usually results from physicians being unaware of relevant susceptibility results. One study found that the selection of empiric antibiotics was unacceptable 34 percent of the time. The physicians were misinformed about likely pathogens and/or antibiotic susceptibilities. Organisms that were susceptible to antibiotics only a few years ago are now resistant. Antimicrobial resistance is spawned by the overuse and misuse of antibiotics.

The selection of appropriate antibiotics is becoming more difficult due to the introduction of new antibiotics, the change of bacterial pathogens, and antibiotic resistance. Adverse drug events can complicate up to 20 percent of drug therapy in hospitalized patients. In addition, physicians are being pressured to take an active role to reduce the cost of health care. The amount of medical information available to physicians is growing each year. It has been shown that information overload can lead to judgement error. Computerized reminders have been shown to improve physician compliance with predefined care protocols.

Medical Informatics is the rapidly developing scientific field that deals with the storage, retrieval and optimal use of biomedical information, and knowledge for computer-
based decision support\textsuperscript{20}. Every medical decision is based on information that must be properly recorded and communicated. Medical informatics uses modern computer technology to improve the availability and use of medical information. This paper describes some of the different ways medical informatics has been used to improve the use of antibiotics.

Hospital Information Systems

A hospital information system is a computer system that collects and stores patient information in a database. The information can be reviewed by medical personnel through computer terminals located throughout the hospital including the bedside. A knowledge base containing programmed medical logic can be used to monitor the patient information as it is stored and provide computer-based decision support. The system can automatically identify patient situations that need physician or nurse attention. Hospital information systems also provide automatic patient billing and other financial functions.

The HELP (Health Evaluation through Logical Processing) Hospital Information System has been under development at the LDS Hospital and the University of Utah for 20 years.\textsuperscript{21,22} This hospital information system is clinically operational at the LDS Hospital in Salt Lake City, Utah. LDS Hospital is a 500 bed, private, tertiary care hospital and a major teaching center for the University of Utah School of Medicine. One of the key features of the HELP system is the integrated database which contains patient information from most clinical areas. The system was designed to provide a medical decision-making capability that could be used to help improve patient care.

Therapeutic Antibiotic Alerts

Microbiology culture and susceptibility results are entered into the laboratory computer by the technologist. Test results entered into the laboratory computer system are automatically sent to the HELP system where they are translated and stored in the patient's computerized medical record. All patient information that is stored in the computerized medical record is screened by a program on the HELP system called the "data driver." The data driver will activate or "drive" certain modules of the knowledge base depending on the type of patient information being stored. If the patient information contains antibiotic susceptibility data, the knowledge base will identify patients who are not receiving antibiotics to which their pathogens are susceptible (Figure 1). Each day a clinical pharmacist contacts the physicians of patients identified by the computer to see if they are aware of the potential problem. During a one year study, the computer system monitored 30,000 microbiology cultures of which 2,157 (7\%) contained susceptibility results.\textsuperscript{14} The knowledge base generated an "antibiotic alert" for 696 (32\%) of the susceptibility results. The physicians were receptive to the pharmacist interaction and willing to discuss the situation. The physicians either changed or initiated antibiotic therapy during the pharmacist contact for 125 of the computer alerts. Another 34 alerts resulted in antibiotic changes within the following 24 hours. The reasons physicians did not change antibiotic therapy for the other computer alerts were: 1) the patient was clinically responding to the prescribed antibiotics, 2) the patient was receiving an antibiotic that was not included on the \textit{in vitro} antibiotic panels, 3) the physician felt the organism(s) isolated from the microbiology culture was either due to contamination or colonization, or 4) the