**Clinical Chemistry**

**Computers in Clinical Chemistry**

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The analytical chemist’s relationship to clinical chemistry ranges from one of casual observation to enthusiastic participation. Clinical chemistry laboratories annually perform over **4.5** billion analytical determinations with direct bearing on the health of individuals. The analytical clinical chemist shares with his colleagues many unique and challenging problems. This article focuses on one-the utilization of computers in the clinical analytical laboratory. These laboratories, with their patient-oriented mission, have developed concepts and approaches to laboratory computer systems worthy of consideration by other laboratories. This article first compares the operational philosophy of clinical and general analytical laboratories. **A** discussion of computerization in clinical laboratories emphasizes those techniques of general interest. Part I1 describes basic operational areas in clinical laboratories in the context of the potential contribution of computerization.

Part I11 discusses significant computerization concepts developed for clinical laboratories, and Part IV briefly reviews some of the working systems. In Part V we have provided an annotated bibliography.

**Part I. Analytical Vs. Clinical Laboratories: Philosophy of Operation**

The analytical and clinical chemistry laboratories share a common objective to produce chemical determinations. The emphasis in clinical labs is the ultimate objective of the analysis the treatment and/or detection of disease. The clinical laboratory supplies the physician with data forming the basis of diagnosis and treatment. Since samples emanate from a hospital patient population, minimum turnaround time is emphasized. Benefits derived therefrom are obvious: effective therapy, reduced costs, minimum hospital . stay, and increased efficiency-all to

meet increased demands on the medical care facilities. These practical considerations give impetus to the development of clinical laboratory computers.

**Part II. Clinical (Hospital) Laboratory**

The present stage of development for clinical laboratory computer systems is as much a product of evolution as necessity. Its understanding requires some background in clinical laboratory operation. The eight elements below enumerate interrelated areas to which computer systems must address themselves.

**1.** Request/Samples. Requests to draw samples are received randomly by the laboratory (or its computer) and must be organized into a sequence of acquisitions (draw list). Technologists (often laboratory personnel)

are dispatched to obtain the specimens from the patients and check samples into the laboratory. Special provision must be made for emergency “STAT” requests and repeat or follow-up tests on the original

specimen.

**2.** Raw Data Acquisition. Primary data (sensor output), instrument readings (both analog and digital), and technologist observations and commentary on specimens constitute types of raw data. Information

must be assimilated, transformed into usable laboratory results, and matched to specimen identification.

**3.** Intermediate Reports /Editing. Primary test results are reviewed soon after analysis. Data are “edited,” that is, modified (adjective added), discarded for analyzer or sample inadequacy, corrected for dilutions, identified as to analyst, etc., and ultimately approved for temporary filing, prior to dispersal as a finished product.

**4.** Quality Control. Quality control is involved in every stage of the laboratory operation. It is critically needed at the intermediate stage where data are accepted or rejected on the basis of control data. Multiple

forms of quality control information are a necessary part of the laboratory’s operating records for internal, long-term, and proficiency licensure purposes. Efficient handling, storage.

***5.* Reports.** Reports in many different formats which reference the data in a variety of ways are needed for different purposes. Here, the computer must be able to respond to the unique needs of the institution. An intermediate report is required at the editing stage.

**Part III. Computerization Concepts in the Clinical Laboratory**

**Goals.** The goals of computerization in the clinical laboratory are obvious- to enable the laboratory to concentrate on producing high-quality analytical data within a time frame consistent with the ultimate use of the data.

**Approaches to Computerization.**

The approach of clinical and analytical laboratories has been remarkably similar. Early attempts to use large, remote, or timeshared systems were generally unsuccessful, largely because of the unpredictable, yet demanding use requirements of laboratory operation. Direct linkage with “outside” computers was abandoned in favor of producing data in an intermediate form which could be handled independent of laboratory operations. Card-oriented systems were by far the most common.

**User Control Programming** .

Clinical chemists, unlike other analytical counterparts, have virtually no standard methods or procedures. To illustrate user-controlled programming concepts, we will discuss the routine operation of the glucose Auto Analyzer