

*Current technology review*

## **An automatic data acquisition system for ventilator patients**

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**Key words:** data acquisition, patient monitoring systems, real-time data capture, respiratory care, ventilator data

### **Abstract**

Computerized patient charting and trended data acquisition are becoming important elements of respiratory and intensive care. Continuous, remote monitoring of a patient's respiratory functions is now accessible with automated data acquisition systems. The system described in this article features real-time data collection from up to eight ventilators, automated patient charting, graphic trending, and configurable modes for viewing graphic trends. These features provide practitioners with continuous graphic presentations of ventilator data, which allows for better recording and understanding of each patient's respiratory progress.

### **Introduction**

In recent years, automated patient charting and trended data acquisition have become technically and economically feasible. High-performance personal computers can be used to provide physicians, respiratory care practitioners, and nurses with ventilator and patient data in formats that allow them to more easily assess their patients' medical progress. These automated data acquisition systems allow users to graphically trend ventilator and patient data from several ventilators. By displaying such trended data in both graphic and text formats, users can make cause and effect inferences about a patient's condition (for example, the effect of ventilator settings on oxygen saturation). In addition, automated data acquisition systems provide output of trended information onto hard-copy reports and in some cases allow for the possible replacement of manual charting associated with ventilator flow sheets.

### **System description**

An automated patient data acquisition system, QuickChart/RT<sup>®</sup>, has been developed to provide medical personnel with real-time data captured from up to eight Puritan-Bennett 7200<sup>®</sup>a Series Microprocessor Ventilators. The captured data is immediately available in graphic trend formats that can be viewed over selected time spans ranging from one to 96 hours. QuickChart/RT includes charting features for creating patient histories, respiratory assessments, limited lab profiles, physicians' orders, and practitioners' notes. The system also includes a report generator for hard-copy printouts from a laser printer.

QuickChart/RT runs on an IBM<sup>®</sup> PS/2<sup>®</sup> Model 80-071 personal computer, which comes standard with a 16 MHz 386 microprocessor and a 110 MB internal fixed disk drive. A line conditioner, internal modem, and mouse are included in the system hardware configuration.

Many of QuickChart/RT's 75 data management functions are specific to the graphics options in the



Fig. 1. QuickChart/RT.

system. These 75 functions are grouped into five areas of data management: entering and editing data (DATAMGR), trending data (TRENDS), selecting and printing patient reports (REPORTS), administrative functions, and support functions. Most system functions are accessed through function keys (F1–F10) on the IBM PS/2 keyboard. Some functions also permit, but do not require, the use of the mouse supplied with the system.

#### *Entering and editing data*

QuickChart/RT's DATAMGR function allows users to enter, edit, and review specific types of data in patient charts. Though DATAMGR data types are predefined, users can select parameters within those data types through an editing feature called CHOICES. The system data types accept most 7200a ventilator settings, including those from available ventilator options.

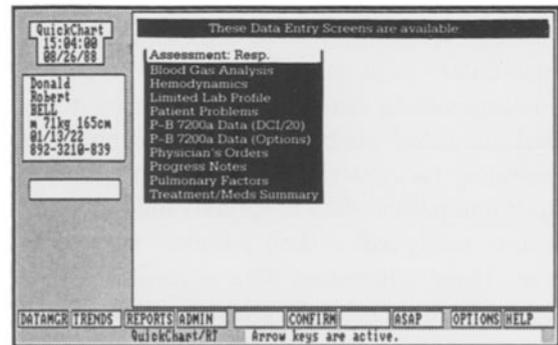


Fig. 2. DATAMGR data entry screen.

At present, the DATAMGR function accepts input for the following types of data:

- respiratory assessment
- blood gas analysis
- hemodynamics
- limited lab profile
- patient problems

- PB 7200a data (DCI/20)
- PB 7200a data (options)
- physician's orders
- progress notes
- pulmonary factors
- treatment and meds summary.

The system records all 7200a data via a communications link between the 7200a Digital Communications Interface (DCI) option and the PS/2.

### Trending data

QuickChart/RT's TRENDS function takes real-time data from the 7200a ventilator and plots trended curves for each selected data type over a specified timeline (1, 4, 8, 12, 48, 72, or 96 hours).

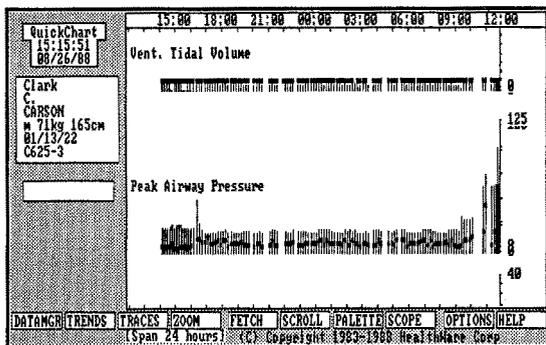


Fig. 3. Trended data from Puritan-Bennett 7200a Series Micro-processor Ventilator.

These trended curves (called traces) appear on the PS/2 monitor in different colors so they can be distinguished from one another. Traces can be viewed individually or overlapped for comparison. Traces that are not visible on the screen can be retrieved using a SCROLL feature. A FETCH feature brings a specific trace to the middle of the screen. A GOTO feature allows users to move immediately to a particular time and date in the patient's chart.

The TRENDS function allows for both comprehensive and specific viewing of patient data. A single traced curve showing all the data available

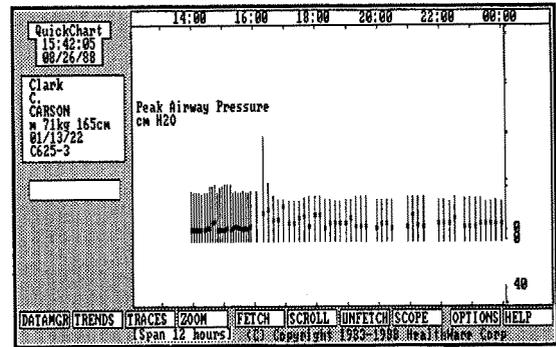


Fig. 4. Isolated portion of trended data from 7200a Series Micro-processor Ventilator.

for an individual data type can be created with a HISTOGRAM feature, while the exact numeric value, time, and date of a single data point within a trace can be isolated with a SCOPE feature.

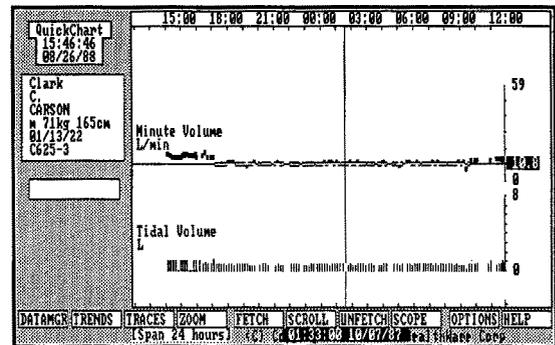


Fig. 5. Single data point isolated with SCOPE function.

### Reporting data

QuickChart/RT allows users to print three different types of hard-copy reports. The PATIENT REPORT FILE command provides printouts that list tabular numeric values for parameters selected by the user. The FLOWSHEET and FLOWSHEET REVISION HISTORY commands produce printouts of data displayed on the system screens. Both flowsheet printouts use text and graphic formats. The flowsheet revision history differs from the flowsheet by showing the changes made to the patient charts.

QuickChart		OPERATOR INFORMATION		3.09.A	
08:00:23 08/13/88				TIME STAMP 08:00:20 08/13/88	
Dixie		OPERATOR			
Billcox F 70kg 175cm 10/24/05 077-11-1234		Last: [CHOICES available ]		User ID: / /	
		First: [ / / ]		Creation Date: / /	
		Middle: [ / / ]		Time: / /	
		Screen Color: [ ] 01 - 15		Last Used: / /	
				Time: / /	
		READ/WRITE AUTHORITY		Type of Operator: [ ] 00 - 02	
		Write: [ ] Read: [ ]		00 non-medical	
		01 - 04 nursing access		01 RN	
		05 physician access		02 MD	
		06 administration access			
		07 software administration			
		Password: [ / / ]		] 5 chars minimum, no doubles	
		Salutation: T		] displayed with time/calendar	
DATAMGR   TRENDS MODIFY   ADMIN REVIEW   CHOICES PRINT   NEWFORM OPTIONS   HELP		QuickChart/RT (C) Copyright 1983-1988 HealthWare Corp.			

Fig. 6. Operator information data entry screen.

### Administrative functions

QuickChart/RT includes functions in the following areas of administration:

- operator information
- patient information
- data acquisition
- trace parameters.

The OPERATOR and PATIENT INFORMATION features allow users to create and modify administrative records for patients and system operators.

The patient information features include modifying entire patient databases (e.g., deleting all of a patient's records, or changing administrative patient information). Other patient information features allow recording or changing patient data, except for data entered via the DATAMGR function. The DATA ACQUISITION feature allows users to specify the sampling rates that data is acquired from the 7200a ventilator. Users can change parameters for the labels, units, and upper and lower limits of traces through the TRACE PARAMETERS feature.

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 Personal System/2 is a trademark of International Business Machines.  
 Quick Chart/RT is a trademark of Health Ware Corporation.

### Support functions

The system's SUPPORT functions include login and logoff, help, an on/off switch for the system's error alarm, an emergency patient data collector called ASAP, and a palette for selecting different colors for traces. These SUPPORT functions are available at any time – before logging in, or before and during data collection.

### System security

Various levels of password authorization, from normal user to system administrator, allow entry into different parts of the system.

### Benefits

QuickChart/RT may improve medical decision-making by providing physicians, respiratory care practitioners, and nurses with patient data that is readily available in well-organized and flexible formats. Trended patient data provides a graphic means of communicating ventilator and patient conditions from one shift to the next, and to physicians when they make their rounds.

As an automated charting system, this new product provides practitioners with the ability to simultaneously collect and trend real-time data for eight ventilators. The system also provides legible, thorough patient records that may be used to meet demands for increased quantity and quality of documentation.

### Future

Envisioned enhancements to QuickChart/RT include an alert capability for the 7200a Series Ventilator and an interface to respiratory care information management systems. A network version of this product is under development.