



**Empress  
Embedded Database**

**for**

**Medical Systems**



## 1. Introduction

From patient primary care information system to medical imaging system to life-critical equipment, Empress Embedded Database has been used in a variety of medical and life-science applications. Medical application developers count on Empress reliability, low cost and speed performance.

For medical application developers and device vendors, accelerating time-to-market produces rapid recovery of development cost and increased revenue generation. One technique for faster time to market is to use component-based design for product development. Reusable modules and commercial off-the-shelf components like the highly modular Empress Embedded Database are ready to be embedded as part of feature rich products. By using modular commercial components, valuable human resources are not wasted in reinventing and maintaining the same component functionality. Building intelligent devices becomes an easier and more straightforward task.

### **Reasons why Empress Embedded Database is utilized in medical and life-science applications:**

- Rich toolset, rich data types and rich functionality for rapid, modular development
- Flexible and configurable for application optimization
- Small footprint ideal for size constrained environments
- Predictable performance
- High reliability and consistency of data
- Embeddable as a single unified program that is robust and efficient
- Easy, straightforward and cost effective runtime licensing
- Continuous product development, deployment and life cycle support

## 2. Empress Embedded Database Functionality

Empress Embedded Database, with its small footprint, delivers an unmatched combination of rich features, rich tools, rich data types and high performance that are well suited to the Medical and Life-Science industry:

### **Rich toolset, rich data types and rich functionality for rapid development**

- **TOOLSET API's:**
  - DSQL and ESQL
  - Interactive SQL
  - Java SQL
  - C and C++
  - JDBC
  - ODBC
  - Report writer
  - Third party product interfaces
- **Empress Data Types:**
  - Character
  - Text
  - National Language Support
  - Byte Stream
  - Date and Time
  - Microsecond Timestamp
  - Decimal
  - Dollar
  - Real
  - Float and Double
  - Integer - 8, 16, 32 & 64-bit
  - Sequence

- **Empress Functionality:**
  - SQL support
  - Kernel level C API
  - Transactions
  - Locking
  - Indexing
  - Time series Indexing
  - Hierarchical Join
  - Cascade Delete
  - Persistent Stored Modules
  - Triggers and Stored Procedures
  - Referential Constraints
  - Range Checks
  - MicroSecond Time Stamp
  - On-Line Backup and Recovery
  - Replication
  - Audit trail Logging
  - Unicode support
  - User Defined Functions
  - Integrity Check
  - Import and Export
  - Shared Memory
  - Batch Commands
  - Encryption

### **Flexible and Configurable for application optimization**

- Stand-alone, client/server and distributed modes
- On-disk and in-memory capability
- Layered architecture accessible at 4 levels allows optimization and rapid prototyping
- Over 170 system variables for configuration, tuning and optimizing
- Customizable product footprint

### **Small footprint for constrained environments**

- Minimum resource consumption for high functionality
- Small disk size that is customizable
- Small memory usage with usage limits

### **Predictable performance**

- Fast database engine
- Minimum overhead
- Kernel level control and speed
- Direct access to database structures
- Deterministic response

### **High reliability and consistency of data**

- 24x7 unattended operation
- Data integrity maintained
- Minimum storage/disk fragmentation

### **Embeddable as a single unified program that is robust and efficient**

- Empress can be linked with an application in a single address space
- Empress installation is embeddable into application installation procedure

### **Easy, straightforward and cost effective runtime licensing**

- Choose from:
  - royalty based
  - one-time fee
  - yearly subscription

### **Continuous product development, deployment and life cycle support**

- Empress Software technical support team of knowledgeable database experts deliver high quality, timely support

### **3. Empress in the Primary Care Information System**

#### **Overview:**

The Primary Care Information System is a clinical management system. The system is used in several of the large academic health science centers. This system utilizes various aspects of Empress Embedded Database to facilitate the functionality it delivers to its users.

At its lowest level it utilizes the Empress mr routines embedded in the C programming language for high-performance modules that are used for either interfacing with government or maintaining various tables.

A web-based interface has been used to develop a high-performance transaction based interface for the operational aspects of the system. This includes booking of appointments, registering patients and creating billing transactions that are sent to the government-run medical insurance agency. This interface is used to provide access to clinical patient records, which includes a full cumulative patient profile, as well as domain specific information related to lab results and disease specific information. It also allows viewing of diagnostic images such as MRI and CAT scans.

Medical data can be exported either internally or transmitted to other hospital-based systems for processing.

Handheld and portable devices are supported where they can be used to good advantage.

#### **Functionality:**

The primary care information system provides operational, clinical, and research capabilities for physicians and staff who utilize the system.

Operationally, it provides registration, appointment booking, billing, consultant referrals, and various reporting functions.

Clinically, it provides a full cumulative patient profile, which includes ongoing conditions, treatment regimen, history, allergies, consultant lists, personal and family data, pediatric prevention, adult prevention, lab results, and disease specific modules. In addition, it provides prescription ordering and can identify drug/drug interactions in real-time based on all drugs prescribed and the patient treatment regimen. For improved recordkeeping, the physician can provide hand written or dictated progress notes directly into the Empress Embedded Database patient records.

On the research side, the system allows for aggregate and specific analysis of all operational and clinical data to satisfy the needs of the physicians in question such as tracking treatments for diabetics and hypertensive patients. Again, this is done by means of Empress.

**Operations:**

Most clinical units, which depend on the Primary Care Information System, operate six days a week using a 12 hour day. However, the Primary Care Information Systems run 24 X 7 X 365 for maximal availability. Most systems have been running for years without requiring a reboot. In those cases where systems have been rebooted, it has been a case of hardware failure or hardware upgrade, but never a failure associated with Empress Embedded Database and the applications which rely on Empress.

## 4. Empress in Medical Imaging System

Empress Embedded Database is used to develop state-of-the-art digital imaging technology for general radiography and mammography applications. The system is used for osteoporosis assessment, mammography and breast biopsy, direct-to-digital X-ray for general radiography applications and mini C-arm imaging for orthopedic applications.



## 5. Empress in Life-Critical Equipment

Empress Embedded Database is used in life-critical equipment, such as infusion pumps. An infusion pump infuses fluids, medication or nutrients into a patient's circulatory system. Infusion pumps can administer fluids in ways that would be impractically expensive or unreliable if performed manually by nursing staff.

Empress is used to store data collected from up to 16 pump modules on a regular basis or asynchronously. Data is also written to an Empress database in Flash memory to assure continuity in a power failure situation.

Empress Databases are accessible from a web browser for data retrieval, database configuration and update. The browser can be on a registered laptop or a desktop PC. The infusion pump system can handle up to 50 simultaneous connections.



Infusion pump data is stored in RAM, FLASH or both at the same time. The data can reside in one or multiple Empress databases.

Power down recovery is a must-have requirement for life-critical equipment. Empress provides a power down recovery utility that checks databases and performs any necessary recovery operations rapidly on power-up.



## 6. SUMMARY

Empress Embedded Database delivers an unmatched combination of rich features, rich tools, rich data types and high performance that are well suited to the Medical and Life-Science industry.

### **Reasons why Empress Embedded Database is utilized in medical and life-science applications:**

- Rich toolset, rich data types and rich functionality for rapid development
- Fast medical data ingest rate
- Flexible and configurable for application optimization
- Small footprint ideal for size constrained environments
- Predictable performance
- High reliability and consistency of data
- Embeddable as a single unified program that is robust and efficient
- Easy, straightforward and cost effective runtime licensing
- Power down recovery
- Continuous product development, deployment and life cycle support