

CHAPTER 11

MONITORING AND ANESTHESIA INFORMATION MANAGEMENT SYSTEMS

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Checklist

1. Are the number and capabilities of the anesthesia workstations (i.e., anesthesia gas delivery system, ventilator, intravenous (IV) delivery system, patient monitor, and drug cart) adequate for the procedures that will be performed in the facility? Have backup and emergency needs been considered?
2. Do all anesthesia workstations meet the standard of care (i.e., American Society of Anesthesiologists [ASA] monitoring standards, ongoing service plan, not obsolete, etc.)?
3. Is special equipment organized and available for managing cardiac arrest, difficult airway, or malignant hyperthermia and for performing regional anesthesia?
4. Does the facility provide the infrastructure for perioperative data management, including anesthesia information management systems (AIMS)?
5. Is there a well-organized team approach to choosing, installing, and maintaining the perioperative data management system?

Introduction

This chapter will focus on equipment to be considered for a new operating room (OR) suite, as well as an addition or alteration to an existing one. Personal preferences, cost considerations, mandated requirements, and type of practice will all influence the specific devices chosen.¹ Many of the details that a user might wish to consider in selecting equipment are discussed in three recently published textbooks:

- Ehrenwerth J, Eisenkraft JB, eds. *Anesthesia Equipment: Principles and Applications*. St. Louis, MO: Mosby; 1993.
- Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment, Construction, Care and Complications*. 3rd ed. Baltimore, MD: Williams & Wilkins; 1994.
- Saidman LJ, Smith NT, eds. *Monitoring in Anesthesia*. 3rd ed. Boston, MA: Butterworth-Heinemann; 1993.

Other excellent sources of information are *Medical Instrumentation* (the journal of the Association for the Advancement of Medical Instrumentation) and *Health Devices* (a publication of the Emergency Care Research Institute).

Anesthesia Machines^{2,3}

While there are currently only a small number of companies producing anesthesia machines for sale in the United States, there are some options available. United States standards for anesthesia machines were published in 1979 and 1988.^{4,5} When purchasing a machine, be sure to choose one that meets the 1988 standard. Used machines are sold by a few companies, and it is important to make certain that such a machine can be serviced. Some models are no longer serviced by the manufacturer, or the original manufacturer is no longer in business. In these cases, parts may no longer be available. Considerations in evaluating a new machine include service, cost, size, and desired features. The need for good service should be obvious, as all equipment fails at some time and under some conditions. It is a good idea to discuss the quality and promptness of a manufacturer's service with other anesthesiology departments in your area. Depending on the size of the department, having one or two spare machines is useful. Spare machines will permit routine preventive maintenance to occur without affecting patient care.

Many departments prefer to have machines from only one company or even only one model, as there may be less chance for errors or misuse if all machines are the same. However, this may place unacceptable limits on the practice. For small rooms, such as cystoscopy, endoscopy, and minor procedure rooms, a smaller machine may be preferable. Machines that have only two gases and two vaporizers can be made smaller than can those with three or four gases and three vaporizers, but this may be unacceptable in certain practices. A small machine may also be more suitable if it is to be moved from room to room or taken out of the OR suite to a remote anesthetizing location.

Anesthesia machines come with a variety of features. Most have basic monitors, such as airway pressure and respiratory volumes, and may also have gas and physiological monitors. Which model is best for a particular practice depends on the needs of the practice and the monitors already present in the department. Magnetic resonance imaging (MRI)-compatible machines are now available with ventilators, oxygen analyzers, and airway pressure monitors. Where these machines can be placed in the MRI suite to avoid artifact on scans is dependent on the machine and magnetic shielding. Prior to patient use, test scans should be performed to determine the best position for the machine. Special gas cylinders made of aluminum must be used. Many newer anesthesia machines are equipped with ventilators that are capable of ventilating small neonates and infants unless lung pathology is significant. In departments where premature and neonatal patients are frequently anesthetized, consideration should be given to purchasing a ventilator specifically designed for these patients. However, it may be difficult for anesthesia personnel who do not use this equipment on a regular basis to maintain familiarity with it. When faced with a neonate with significant lung pathology, hand ventilation and using a standard neonatal ventilator with a neonatologist or respiratory therapist present to assist are options.

Monitors

Instruments that measure blood pressure (invasive and noninvasive), electrocardiogram (ECG), oxygen saturation, central venous pressure, pulmonary artery pressure, temperature, electroencephalogram, cardiac output, and respiratory and anesthetic gas concentrations should be considered. These should be capable of interfacing with the electronic record, if one is planned. The choice of appropriate monitoring instruments depends on the type of cases to be performed in a particular room. If cardiac surgery is to be performed, a monitor that includes most of the above parameters is desirable. If patients are relatively healthy and/or procedures of low intensity are to be performed, ECG, noninvasive blood pressure, pulse oximetry, inspired oxygen, and capnometry will probably be adequate. It may be desirable to have monitors in the OR that are compatible with those in other areas of the facility, such as the critical care unit or the postanesthesia care unit (PACU). This will facilitate transfer of information between monitors, and sensors applied in the OR can follow the patient to other areas. Having all monitors from the same manufacturer may lead to economy in parts and better servicing. Modular monitors may be advantageous. With this type of device, a set of modules, such as blood pressure, ECG, and pulse oximetry, is available for each room. Other modules (e.g., invasive pressure and cardiac output) can be added as the situation warrants. Modular equipment may have significant financial advantages, despite higher initial cost, because upgrading can be performed without retiring the entire unit, and modules can be swapped without taking the whole unit out of service. Some monitoring instruments are now being built into anesthesia machines. This usually results in economy of space and integration of machine and monitor information and alarms. A disadvantage is that the built-in monitors may not meet all the needs of the user and may be different from monitors in other ORs. Also, the entire anesthesia machine may need to be removed if the monitoring instrument needs repair.

Electrocardiogram^{6,7}

The ASA Standards for Basic Anesthetic Monitoring require that every patient receiving anesthesia have the ECG continuously displayed from the beginning of anesthesia until preparing to leave the anesthetizing location.⁸ If a strip chart recorder is not available, it should be possible to freeze the display. Use of monitors that can detect ST-T segment changes may result in increased detection of ischemia. Some of the newer monitors can automatically recognize deviations from sinus rhythm and display them on the screen to be reviewed.

Noninvasive Blood Pressure Monitors^{7,9}

The ASA Standards for Basic Anesthetic Monitoring require that every patient receiving anesthesia shall have arterial blood pressure and heart rate determined at least every 5 minutes.⁸ A noninvasive blood pressure monitor may be part of a multivariable monitor, an anesthesia machine, or a separate console.

Invasive Pressure Monitors⁹

Invasive (e.g., arterial, central venous, and pulmonary artery) pressure monitoring is frequently employed in patients who are very ill and those in whom tight control of pressures is necessary. Most invasive pressure monitors are part of a multivariable monitor.

Pulse Oximetry^{10,11}

The ASA Standards for Basic Anesthetic Monitoring require that a quantitative method of assessing oxygenation, such as pulse oximetry, be employed during all anesthetics.⁸ Pulse oximetry may be incorporated into a multivariable monitor or the anesthesia machine, or a dedicated pulse oximeter may be used.

Temperature Monitors^{12,13}

The ASA Standards for Basic Anesthetic Monitoring require that a means to measure the patient's temperature be readily available. The temperature should be measured when changes in body temperature are intended, anticipated, or suspected.⁸ A temperature monitor may be part of a multivariable monitor or a small, inexpensive, stand-alone device.

Neuromuscular Transmission Monitors

A variety of neuromuscular transmission monitors are available,^{14,15} and it is recommended that there be one in every OR. Patterns of stimulation should include twitch, tetanus, train-of-four, and double-burst, and there should be a variable output in milliamperes. As yet, these devices are not part of anesthesia machines or multivariable monitors but may be in the future. More complex neuromuscular transmission monitors include the accelerometer and the electromyogram, which are more expensive but have desirable features, including the ability to accurately determine the train-of-four ratio. They can be used in cases in which the arm is tucked beside the patient.

Airway Pressure Monitors¹⁶

Most anesthesia machines and some multivariable monitors have airway pressure monitoring. Dedicated airway pressure monitors are also available. The pressure may be displayed as a numerical and/or wave form. One of the newer developments is pressure-volume loops.

Respirometers¹⁷

Respirometers may be analog or electronic. Electronic versions may have associated alarms. Some display flow-volume loops that relate the flow of gas to tidal volume. Respirometers are incorporated into all new anesthesia machines but may also be part of a multivariable monitor or a separate dedicated monitor.

Anesthetic and Respiratory Gas Monitors^{18,19}

The ASA Standards for Basic Anesthetic Monitoring require that during administration of general anesthesia, the concentration of oxygen in the patient system be measured by an oxygen analyzer with a low oxygen concentration alarm.⁸ The standards also require that every patient receiving general anesthesia have the adequacy of ventilation continually evaluated. Quantitative monitoring of the CO₂ content is encouraged. When a tracheal tube or laryngeal mask is inserted, end-tidal CO₂ to verify correct positioning in the trachea is required, as is continual monitoring during the anesthetic when a tracheal tube or laryngeal mask airway is in use. Gas monitors may measure carbon dioxide, oxygen, helium, nitrogen, and/or anesthetic agents. A gas monitor may be a separate monitor or incorporated into an anesthesia machine or a multivariable monitor. All anesthesia machines are equipped with oxygen monitors.

Other Monitors

Other monitors include cardiac output, transesophageal echocardiography, and the electroencephalograph. The need for these will depend on the type of surgery to be performed in a particular facility.

Breathing Systems^{20,21}

The circle breathing system is the most popular in the United States for adult patients. Completely disposable circle systems (including CO₂ absorbent) are available. These may be especially useful for patients with malignant hyperthermia or a highly infectious disease, such as active pulmonary tuberculosis. Disposable breathing circuit tubes come in a variety of lengths, with and without bacterial filters, and as stretchable or coaxial. There are a variety of Y-piece configurations. Most disposable breathing tubes are clean but not sterile. If tubes are to be added to the surgical field, sterile ones should be available.

Systems other than the circle, such as one of the Mapleson systems, may be used. They may be useful for transport, resuscitation, application of continuous positive airway pressure, and pediatric patients. These are not commonly used for general anesthesia for adults because the gas flow required for adequate ventilation makes them uneconomical.

Humidification Devices^{22,23}

Disposable heat and moisture exchangers, especially those that also filter viral and bacterial particles, have become popular. Use of heated humidifiers has decreased with the increased use of heat and moisture exchangers, low fresh-gas flows, and forced-air warming machines.

Warming Devices

Forced-air warming machines maintain intraoperative normothermia better than do circulating-water mattresses²⁴ and are often used during prolonged cases. However, it is recommended that some circulating-water mattresses be kept for cases in which a forced-air machine cannot be used. For pediatric cases, radiant heat warmers may be desirable. Devices for warming fluids usually surround the IV tubing with a water bath or a heating element. These devices are useful if large volumes of cold blood or IV fluid are to be administered.

Airway Management Equipment^{25,26}

Tracheal Tubes

Tracheal tubes need to be stocked in sizes commensurate with the particular anesthesia practice. Laser tubes, molded tubes for head and neck surgery, double-lumen tubes, wire-spiral tubes, and tubes for bronchoscopy or laryngoscopy may be needed for special situations.

Double-Lumen Tubes and Blockers

Both right and left double-lumen bronchial tubes with appropriate suction catheters and stylets need to be available if thoracic surgery is to be performed. A means to apply continuous positive airway pressure should be available when a double-lumen tube is used. An alternative to a double-lumen tube is the Univent[®] tube, which has a bronchial blocker.

Airways

Oral and nasal airways should be available in a variety of sizes. Special airways for fiberoptic intubation should be available (see “Fiberoptic and Difficult Intubation Equipment” below).

Airway Accessories

Airway accessories, such as forceps, stylets, and adaptors, need to be available. The specific items depend on the user’s preferences and needs.

Laryngoscopes

The laryngoscopes that are needed will depend on the preferences of the user. Both straight and curved blades in a variety of sizes and at least two handles should be kept in each anesthesia cart.

Fiberoptic and Difficult Intubation Equipment

The following equipment may be useful when a difficult intubation is anticipated or when fiberoptic intubation is planned: fiberoptic light source and fiberscope; defogging solution; swivel fiberoptic adaptors; local anesthetic spray; Patil-Syracuse endoscopic mask; fiberoptic intubating airways (e.g., Ovassapian, Patil-Syracuse, Williams, and Berman); fiberoptic stylet laryngoscope; lighted intubation stylet; Bullard laryngoscope; Wu scope; bougies; tracheal tube changers; laryngeal mask airways; cricothyrotomy device; jetting device or other transtracheal jet ventilation equipment; and combitubes. Arrangements of equipment for fiberoptic intubation are given in several publications.²⁷

Automatic Infusion Devices²⁸⁻³²

Automatic infusion pumps are used in the OR to administer IV fluids, anesthetics, analgesics, vasopressors, and epidural solutions. It is best to have the same type of IV fluid pump throughout the facility. Electronic syringe pumps have become increasingly popular. Often, standard disposable syringes already stocked by the facility can be used. A drawback to these devices is that the size of the reservoir is limited. The selection of a pump depends on several factors, including available features, cost of the pump, cost of the infusion sets, safety, ease of use, and required maintenance. The device should have a battery backup so that it will function during transport. If the infusion devices have data port outlets, infusions can be recorded on an automated anesthesia record.

Equipment for Regional Anesthesia

It may be convenient to keep equipment and supplies used for regional anesthesia on a separate cart. A variety of disposable trays are commercially available. It is good practice to keep extra needles on hand to replace ones that become contaminated or damaged rather than open another tray. A supply of extra-long needles should also be available. The following equipment should be considered for a regional anesthesia cart: B-bevel needles; marking pen; insulin syringe; tourniquet; prep pads, sticks, and solution; bactericidal ointment; double tourniquet for Bier block; spray adhesive; various types of tape; scissors; nerve finder and special insulated needles; sterile gloves; clear adhesive bandage; control syringes; temperature monitor; and intubation equipment. An ultrasound machine to assist with needle placement is a useful adjunct.

Resuscitation Equipment³³

Each OR suite should have at least one cart that contains the items needed to deal with a cardiac arrest. It is expected that laryngoscopes, stylets, forceps, airways, tracheal tubes, and other equipment commonly stocked on an anesthesia cart will be available in each OR and would not be needed on the resuscitation cart. This may not be the case for the holding area or the PACU, so a complete supply of drugs and equipment needed for emergencies should be

present. The following equipment should be considered for a resuscitation cart: spinal needles (18G, 19G, and 20G); labels; IV catheters; prep solutions, tourniquets, tape, and gloves; ECG pads and paper; defibrillator pads; blood pressure cuff; urinary catheterization kit; nasogastric tubes; wall suction setup, tubing, and suction catheters; monitor and defibrillator; external pacemaker; self-inflating resuscitation bag; and face masks.

Pediatric Equipment³⁴

While pediatric equipment may be readily available in a health care facility where pediatric surgery is routinely performed, it may be preferable to have pediatric equipment carts available in facilities where pediatric anesthetics are less often performed. A pediatric cart might contain the following: tracheal tubes in 0.5 mm sizes from 2.5 to 6.0 mm, both uncuffed and cuffed; laryngoscope handles and blades in pediatric sizes; pediatric suction catheters; pediatric breathing systems (e.g., Mapleson A, D, and F); pediatric ventilator bellows (if required by anesthesia machine); pediatric airways; precordial stethoscopes; pediatric masks; pediatric blood pressure cuffs in assorted sizes; Doppler ultrasound for blood pressure determinations; pediatric temperature probes; pediatric laryngeal mask airways; pediatric nasogastric tubes; pediatric urinary catheters; and a pediatric self-refilling bag-valve-mask unit.

Malignant Hyperthermia Cart

The following equipment should be considered for a malignant hyperthermia cart: malignant hyperthermia protocol and hot line number; chart for recording drugs, temperatures, and various interventions; syringes and needles; arterial blood gas (ABG) kits; arterial catheters; pressure transducers; Vacutainers® for laboratory tests; central venous and pulmonary artery catheters; pressure bags for IV infusions; temperature probes (e.g., esophageal, rectal, etc.), including pediatric sizes; nasogastric tubes, including pediatric sizes; urinary catheters, including pediatric sizes; cold packs; cold IV solutions; and 1,000-mL bags of sterile water for mixing dantrolene.

Trauma Cart

Many departments find it useful to keep a cart stocked and ready for handling major trauma cases. The following should be considered for inclusion on such a cart: drugs (e.g., albumin and hetastarch, Hep-Lock® solution, heparin, etc.); central venous and pulmonary artery catheters; central venous pressure manometer; pressure transducers; arterial catheters; ABG kits; Vacutainers for laboratory tests; blood filters and administration sets; IV solutions; fluid warmers; pressure bags for infusions; flexible oximeter sensors; and urinary catheters and urometers.

Anesthesia Information Management System Product Selection and Evaluation

Departmental and institutional goals will largely determine AIMS product selection. Obviously, a system comprising a full array of perioperative modules (i.e., surgery scheduling, preoperative, anesthesia, PACU, Nursing, and postoperative) is most desirable. The following should be considerations for goals: Electronic Medical Record [EMR]

- Business and efficiency enhancement tools
- Patient safety and quality improvement
- Areas of use (e.g., preoperative, intraoperative, postoperative, ORs, ICU, obstetrics [OB], etc.)
- Clinical work flow: Patient care protocols
- Drug tracking: Regulatory compliance
- Billing, coding, and charge capture
- Outcomes research: Return on investment considerations
- Data exchange: Links to an enterprise-wide clinical information system

Senior departmental and Information Systems IS leadership steer the selection and implementation of AIMS by setting performance standards and expectations. Issues to be considered before product evaluation include:

- Who is paying for the system? Rather than the “best” system, there may be institutional pressure to implement an AIMS by the same vendor used elsewhere in the hospital.
- Locations where AIMS will be used (OR, OB, MRI, Cardiac Catheterization labs, ICU)
- Information technology (IT) support needs to be addressed early:
 - Adequate support and staffing during implementation
 - Ongoing maintenance, including 24 hours/day-7 days/week coverage during the go-live phase
 - Plan for ongoing IT support, server structure, and software products
 - Wireless coverage
 - Interfaces with existing applications (e.g., admission, discharge, and transfer [ADT]; pharmacy; materials management; laboratory; billing; etc.)
 - Security considerations
- Functionality requirements should be considered. These include data capture from physiologic monitors and anesthesia machines, graphic anesthesia record display at each work station, automatic report generation for pharmacy, billing, materials management, hard copy printout, automatic data backup, electronic signatures for anesthesia providers, and special access privileges.

The leadership, along with an implementation team (see below), generates a detailed request for proposals (RFP). The vendors then provide information on costs for purchasing and licensing, upgrades, support, maintenance, and other requirements, like network specifications, work stations, servers, applications, interfaces needed, and hardware estimates. Adequate account should be made for hardware and other essentials. These include keyboards, computer

mice, cables, brackets, mounting arms and devices, network switches, uninterruptible power supplies, and mobile adjustable carts for workstations on wheels (WOWs). Computers with six data ports are usually well suited for connecting to physiologic monitors and anesthesia delivery systems. Monitor configuration and display is vendor dependent.

Important considerations in selecting a vendor include track record on AIMS implementation and performance at other sites; average time from contract signing to go-live date; company size and stability; business and service plans, including costs of software upgrades; system interfaces; compatibility of systems with standard commercial software and hardware; technical support; and minimal acceptable functional requirements. Other factors that determine the robustness of a vendor's AIMS include work station response to temporary power or network failure, system availability during software security patches and application updates, daylight savings time transitions, detection of real-time provider concurrency, visual and electronic alerts and prompts, and accommodation of unusual clinical scenarios (e.g., emergency case, death in the OR, discontinuous anesthesia times, patient identification errors, etc.).

The total cost of an AIMS is \$4,000.00-\$9,000.00 for each anesthetizing location. The WOWs cost approximately \$6,000.00-\$8,000.00. The timeline and target dates should be set in conjunction with vendors, depending on the departmental requirements and available resources. The implementation can take anywhere from 6 months to 2 years before a go-live date is achieved. The ongoing IT support cost and model needs to be incorporated into the proposals and accepted in the initial approval phases.

Implementation Team

The implementation team typically consists of a core group of members from anesthesiology, perioperative services, biomedical engineering, and IS. Individuals from materials management, billing, compliance, pharmacy, and perioperative nursing may also play a role on the implementation team. The lead personnel on the implementation team include:

- Project manager, preferably a senior anesthesiologist familiar with IT, who oversees the project, including interface design, hardware purchase and installation, and daily progress of the project; escalates issues beyond the authority of the implementation team to appropriate levels; and determines go-live readiness
- Anesthesia clinical lead, who configures the software, confirms the completeness and accuracy of all the lists and verifies documentation, coordinates with Compliance and other committees to obtain approval of electronically generated medical records, and updates end users on new developments
- System administrator, who oversees day-to-day management after the go-live date, triages problems as they arise with a good working knowledge of the software, and generates reports for various departments and quality assurance

Configuration Setup

Software customization has to be balanced with end-user adaptation and work flow. Creating a standardized format for documentation can minimize free-text entries. These formats include action buttons, lists (for medication, drips, fluids, blood products, quality indicators, etc.), subspecialty templates (e.g., cardiac, pediatric, obstetrics, ambulatory, etc.), and drop-down menus (for procedures and other documentation). However, this software build has to be done cautiously so as not to compromise reliability, ease of upgrades, and user training.

Patient safety, compliance, and process improvement

Essential documentation of patient safety protocols, for example, preoperative anesthesia safety check, World Health Organization and The Joint Commission (formerly JCAHO)–recommended preprocedure verification, Universal Protocol- National Patient Safety Goals, patient reassessment, and presurgical “time out,” can be formatted for ease of documentation and auditing. Macros or templates can prompt the user to follow and document established patient care protocols and increase adherence with Physician Quality Reporting System (formerly PQRI). Visual alerts can further aid documentation, and decision support has the potential to improve medical care. The Anesthesia information database can also be used as a quality assurance tool. A comprehensive perioperative AIMS that interacts with the PACU nursing module can be used to identify patients at risk for postoperative complications (e.g., postoperative nausea and vomiting, pain control, respiratory depression, etc.) and close the loop on quality improvement. AIMS that interface with the OR scheduling software enable tracking of times to improve efficiency (standards defined in the Procedural Times Glossary by the Association of the Anesthesia Clinical Directors). Physician-specific reports produced from an AIMS database can also be used for education and improvement of quality of care and efficiency. Electronic signatures and special privileges for attending anesthesiologists must be delineated to fulfill attestations of medical direction and supervision in compliance with regulatory agencies. Electronic signatures must also be suitable for billing.

Interfacing

Proper configuration of the software can help minimize redundancy in data entry. AIMSs essentially interface with OR scheduling and ADT databases. Most will also interface with materials management, enabling charge capture, and with pharmacy, allowing charges for drugs and tracking of controlled substances. Real-time integration with perioperative nursing enables sharing of common data fields, for example, surgery start and stop times. Most AIMSs also communicate with the laboratory information system. Accuracy of data transfer must be verified before the go-live date. Most of the interfaces between clinical databases are on the HL7 Clinical data architecture format.

Training and Go Live

Thorough testing of network and server problems is essential before going live. Going live in a multiuser environment is never totally smooth. Education must be planned in close proximity to the go-live date so that the training is not forgotten. Classroom-style sessions with hands-on training of each trainee at a work station are most effective. Essential elements of training should include selecting the correct patient, filling a complete record, accurately entering drugs and controlled substances, closing the anesthesia record, and troubleshooting basic issues (e.g., making sure observations are turned on, checking connections, rebooting, etc.). The attending anesthesiologist's training should also include attestations for medical direction and supervision as required by regulatory agencies. "Drop-in" sessions, in which AIMS stations manned by a superuser are set up in close proximity to the OR suite, have also been described.

Go live can be done in a big-bang approach, in which all the work stations go live in a matter of few days to a week. Laminated cards or cheat sheets with essential instructions can be helpful. A call center should be established to receive calls regarding concerns or questions and to expeditiously deploy appropriate help. The number for the call center should be posted at every work station. Both the vendor and the institution must commit enough resources, including personnel support 24 hours a day for the first couple of weeks. All electronic records must be reviewed for errors before they become a permanent part of the patient record. Adequate resources are key to the success of go live; lack of adequate support may lead to staff frustration, poor documentation, and delays in patient care. An alternative approach to the big-bang rollout is the graded approach, which may be preferable in large institutions with few superusers and multiple clinical environments with different anesthesia machines and monitors, each of which require different interfaces. Sometimes, concurrent charting on paper records and electronic records for the first few days of going live allows checks for consistency and accuracy of electronically produced records.

Systems^{33,35,36}

An AIMS is more than just a record-keeping mechanism. If such a system is contemplated, each piece of equipment must have an interface port. It is important to have adequate wiring to interconnect the various components.

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