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Crash Cart Readiness and its Impact on Cardiopulmonary Resuscitation Efficiency and Patient Safety in Hospital Emergency Settings .

Ammar Ali Yahya Asiri¹, Hassan Mohammed Ghazwani², Rayan Abdulrahman Hafiz³, Samirah Yahya Majhali⁴, Amal Yahya Mohammed⁵, Ali Abdullah Salawi⁶, Suhail Saeed Alghamaz⁷, Hassan Qasem Almalki⁸

¹ Pharmacist, Najran Prison Health Center, Najran, ammarasiri97@gmail.com

² Emergency Medical Services Specialist, Najran Prison Health Center, Najran, hghazwani00@gmail.com

³ Nursing Specialist, Najran Prison Health Center, Najran, ra89338@gmail.com

⁴ RGN, Armed Forces Hospital, South Region, Khamis Mushait, sam551xxq@gmail.com

⁵ RGN, Armed Forces Hospital South Region, Khamis Mushait, Amalyahyamajhali@gmail.com

⁶ Consultant, Armed Forces Hospital of Southern Region, Abha, Ali-Salawi1414@hotmail.com

⁷ Pharmacy Technician, Armed Forces Hospital, Khamis Mushait, Saudi Arabia, Suhail.alghamaz@gmail.com

⁸ Pharmacy Technician, Armed Forces Hospital - Southern Region, Khamis Mushait, uw7hassan@gmail.com

ABSTRACT: Cardiac arrest inside a hospital or medical center is an event in which delays that appear minor under ordinary circumstances can become clinically important. Although considerable attention is appropriately given to CPR technique, early defibrillation, and advanced life-support algorithms, the practical readiness of the equipment used by the resuscitation team receives comparatively less attention. The crash cart is at the center of this process. Its usefulness depends not simply on whether a cart is available, but on whether the required medications and equipment are present, functional, clearly organized, and immediately familiar to the staff using them.

This narrative review discusses crash cart readiness as a practical component of resuscitation quality and patient safety. Particular attention is given to medication management, equipment availability, standardization of cart layout, routine inspection, restocking after use, staff training, simulation, and multidisciplinary responsibility. The roles of physicians, nurses, pharmacists, emergency personnel, respiratory therapists, biomedical engineering, and patient-safety teams are considered within the same emergency-response system.

Across the literature and current resuscitation practice, a recurring principle is that preparedness reduces avoidable complexity during an already complex clinical event. Standardized cart organization can make medications and equipment easier to locate, while regular checks can identify expired drugs, missing supplies, and equipment problems before they affect an actual patient. Simulation exercises add another layer of value

because they reveal practical problems that may not be apparent from a completed checklist.

Crash cart readiness should therefore be viewed as part of the hospital's resuscitation system rather than as a routine stocking responsibility. Combining standardization, multidisciplinary oversight, medication-safety practices, staff education, and continuous auditing may improve the reliability of emergency response and reduce preventable risks during CPR.

1. INTRODUCTION

When cardiac arrest occurs in a hospital, the clinical team has very little time to organize itself. Several activities begin almost simultaneously: chest compressions are initiated, the cardiac rhythm is assessed, a defibrillator is prepared, vascular access is obtained, ventilation is supported, medications are requested, and somebody must document what is happening. In this environment, the organization of emergency equipment is not a minor logistical issue. It can directly influence how smoothly the team works.

The crash cart was developed for this reason. It places the medications, equipment, and supplies most likely to be required during resuscitation in one accessible location. Yet having a crash cart positioned on a ward does not necessarily mean that the ward is prepared for an emergency. A cart containing an expired medication, a missing airway device, an unfamiliar drawer arrangement, or a defibrillator that has not been appropriately checked may create problems at exactly the moment when clinicians have the least capacity to manage them.

This distinction between the **presence** of a crash cart and its actual **readiness** is important.

In everyday hospital practice, responsibility for the cart is often shared. Nurses may perform routine readiness checks and are commonly among the first professionals to use the cart. Pharmacists are involved in the selection, storage, labeling, replacement, and safety of emergency medications. Physicians and emergency teams depend on immediate access to these resources while making time-sensitive treatment decisions. Respiratory therapists may be heavily involved in airway and ventilation management, while biomedical engineering supports the reliability of devices such as defibrillators.

For this reason, crash cart readiness is better understood as a multidisciplinary system rather than the responsibility of one department.

This narrative review examines crash cart readiness from that broader perspective. It considers how cart organization, emergency medication management, equipment reliability, routine inspection, staff familiarity, simulation training, and multidisciplinary coordination can influence the efficiency and safety of hospital resuscitation. It also discusses practical weaknesses in current crash-cart processes and opportunities for hospitals to improve them.

2. WHY CRASH CART READINESS MATTERS DURING RESUSCITATION

A cardiac arrest is different from most clinical situations because the team cannot simply stop and reorganize when something is missing. The resuscitation continues while the problem is being solved.

Consider a simple example. A physician requests an emergency medication, but the nurse opening the cart cannot immediately locate it because the drawer arrangement differs from the carts used elsewhere in the hospital. The medication may be available, but several seconds are lost searching for it. In another situation, the correct drug is found immediately but is available in an unfamiliar concentration. The team must then verify the product before preparation. Neither problem necessarily results in patient harm, but both introduce unnecessary difficulty into a situation that is already demanding.

This illustrates why readiness involves more than inventory.

A useful crash cart should allow staff to anticipate where an item will be found. Medications should be clearly identifiable, equipment should work when required, and supplies should be appropriate for the patient population served by the clinical area.

The aim is not merely to make the cart tidy. The aim is to remove avoidable obstacles from resuscitation.

3. STANDARDIZATION: MAKING THE CART PREDICTABLE

One of the most practical ways of improving crash cart usability is standardization.

Healthcare professionals frequently move between departments. A nurse may be reassigned to another ward, a physician may respond to cardiac arrests throughout the hospital, and members of a rapid-response or code team may attend emergencies in clinical areas they rarely visit.

If every unit organizes its crash cart differently, these professionals must repeatedly adapt to unfamiliar layouts.

For this reason, hospitals should aim for the same basic organization wherever clinically possible. The first drawer should not contain medications in one unit and airway equipment in another without a strong clinical justification. Labels, medication locations, equipment categories, and stocking quantities should follow a recognizable institutional system.

Some variation will always be necessary. A pediatric unit, for example, has different requirements from a general adult ward. An operating room may also require resources that are unnecessary elsewhere. Nevertheless, the underlying organizational logic can remain consistent.

Standardization therefore serves an important human-factors function: it reduces the amount of searching and remembering required from staff during an emergency.

4. THE MEDICATION COMPONENT OF THE CRASH CART

Emergency medications deserve particular attention because medication errors during resuscitation can have immediate consequences.

The crash cart may contain medications used during cardiac arrest as well as drugs required for arrhythmias, severe allergic reactions, hypoglycemia, seizures, and other acute conditions. The exact list should be determined locally according to the patient population, institutional protocols, and current clinical guidance.

Problems can arise even when the correct medication is technically present. Similar packaging, different concentrations, poorly positioned products, expired stock, or unfamiliar substitutions can all increase the chance of error.

This is an area where pharmacy involvement becomes particularly valuable.

The pharmacist's contribution should extend beyond checking expiration dates. Pharmacists can review which medications genuinely need to be stored in the cart, determine appropriate quantities and concentrations, improve labeling, identify look-alike products, and assess how medications are physically arranged.

Unnecessary medications should also be questioned. Adding more products may appear to improve preparedness, but an overcrowded medication drawer can make essential drugs more difficult to identify. The most useful crash cart is not necessarily the one containing the greatest number of items; it is the one containing the right items in an arrangement that allows them to be used safely.

5. NURSING AND DAY-TO-DAY READINESS

In many hospitals, nurses have the closest day-to-day relationship with the crash cart. This places nursing practice at the center of maintaining operational readiness.

Routine checks commonly include confirming that the cart is in its designated location, examining the integrity of the security seal, checking the defibrillator, and ensuring that external equipment is available. The exact process varies according to institutional policy.

The quality of these checks matters more than simply recording that they occurred.

A checklist can easily become a routine documentation exercise if staff do not understand why each component is being checked. Training should therefore connect the inspection process with real clinical consequences. A missing defibrillation pad or inaccessible suction device is not merely a failed checklist item; it represents a potential problem during the next emergency.

Nurses should also have a straightforward mechanism for reporting deficiencies and obtaining replacements. Discovering a problem is of limited value if correcting it requires a complicated administrative process.

6. THE PHYSICIAN AND EMERGENCY TEAM PERSPECTIVE

During resuscitation, the physician leading the response is usually focused on the patient rather than on the contents of the cart. This is precisely why crash cart organization matters.

When the team leader requests a medication, airway device, or defibrillation intervention, the surrounding system should make execution of that decision as straightforward as possible. The resuscitation leader should not need to troubleshoot supply problems while simultaneously interpreting the rhythm, considering reversible causes, and assessing the response to treatment.

Physicians and emergency clinicians should therefore be involved in crash cart design and review. Their experience during actual resuscitations can identify problems that may not be obvious to those responsible for routine stocking.

Post-resuscitation debriefing provides an especially useful opportunity. If staff had difficulty locating a drug or piece of equipment, that observation should not disappear when the emergency ends. It should become information for improving the system.

7. AIRWAY AND RESPIRATORY READINESS

Airway and ventilation equipment represents another important part of emergency preparedness.

Depending on the clinical environment, this may include bag-mask ventilation equipment, airway adjuncts, oxygen-delivery devices, suction equipment, and supplies used for advanced airway management.

Respiratory therapists, emergency clinicians, anesthesiology staff, and nurses are particularly well positioned to evaluate whether these resources are practical and appropriately organized.

As with medications, familiarity matters. A technically complete airway drawer may still be difficult to use if equipment is poorly arranged or staff members cannot quickly distinguish between sizes.

For areas treating both adults and children, clear separation and labeling of equipment becomes even more important.

8. DEFIBRILLATOR READINESS

A defibrillator that is physically present but not ready for immediate use provides false reassurance.

Hospitals therefore need a reliable process for checking defibrillator status. Battery condition, pads or electrodes, cables, device indicators, and other required accessories should be evaluated according to local procedures and manufacturer recommendations.

Responsibilities must also be clear. Nursing staff may perform routine operational checks, while biomedical engineering manages preventive maintenance and technical servicing.

When a malfunction occurs, there should be an established pathway for removing the device from service and providing an immediate replacement.

9. WHAT HAPPENS AFTER THE CART IS USED?

The period immediately after a resuscitation deserves almost as much attention as routine inspection.

Once a crash cart has been opened, it may contain partially used medication boxes, missing syringes, opened airway equipment, displaced supplies, or damaged packaging. Returning such a cart to its usual location without complete replenishment creates a risk for the next patient.

The hospital should therefore define exactly what happens after use.

A practical system identifies who notifies pharmacy, who replaces medications, who replenishes non-medication supplies, who performs the final verification, and who authorizes the cart to return to service.

The process should also be fast. In departments with frequent emergencies, a replacement cart may be preferable to waiting for the original cart to be completely restocked.

10. Learning Through Simulation

Routine inspections tell us whether the required items appear to be present. Simulation tells us whether the system actually works.

This distinction is important.

During a mock cardiac arrest, staff may discover that an emergency medication takes too long to locate, that equipment packaging is difficult to open, or that several people assume somebody else is responsible for bringing the defibrillator.

These are system weaknesses that may never appear on a standard inspection form.

Simulation can therefore be used not only to assess CPR skills but also to test the crash cart itself. Hospitals can deliberately measure how long it takes staff to locate selected medications or equipment and observe where confusion occurs.

Repeated problems should lead to redesign rather than simply additional reminders to staff.

11. A MULTIDISCIPLINARY MODEL

Crash cart readiness works best when responsibilities are shared but clearly defined.

Professional group	Practical role in crash cart readiness	Main safety contribution
Physicians/Emergency Physicians	Clinical resuscitation leadership and review of required emergency resources	Ensures the cart supports actual clinical decision-making
Pharmacists	Medication selection, storage, labeling, standardization and expiration management	Reduces medication-related risk
Nurses	Routine checks, bedside use, medication administration and reporting deficiencies	Maintains day-to-day operational readiness
Emergency Staff	Rapid stabilization and frequent use of emergency equipment	Identifies practical workflow problems
Respiratory Therapists	Airway, ventilation and oxygen-related equipment	Supports rapid respiratory intervention
Biomedical Engineering	Device inspection and preventive maintenance	Reduces equipment-related failure
Quality and Patient Safety Teams	Auditing, incident review and performance monitoring	Converts recurring problems into improvement actions

No single profession can adequately cover all of these functions. The multidisciplinary approach is therefore not simply collaborative in principle; it reflects the practical reality of resuscitation.

12. FROM PAPER CHECKLISTS TO DIGITAL MONITORING

Many hospitals continue to rely heavily on paper-based crash cart records. These systems can work, but they have limitations, particularly when an organization manages dozens or hundreds of carts.

Digital systems can provide better visibility.

Barcode-supported inventory, electronic inspection forms, automated expiration alerts, and centralized dashboards may help pharmacy and nursing departments identify upcoming medication expirations or incomplete inspections before they become problems.

However, digitalization should solve an existing problem rather than create an additional administrative burden. A sophisticated electronic system that takes substantially longer to complete than the clinical process it replaces may reduce staff engagement.

The objective should remain simple: make readiness easier to verify and deficiencies easier to correct.

13. MEASURING WHETHER THE SYSTEM WORKS

Hospitals should avoid judging crash cart performance solely by whether inspection forms are completed.

More meaningful measures can include the proportion of carts found fully compliant during unannounced audits, number of expired medications identified, frequency of missing items, defibrillator readiness, time required to replenish a cart after use, and medication or equipment problems identified during mock codes.

Retrieval time can also be informative.

For example, during simulation, staff can be asked to locate a specific emergency medication. If retrieval repeatedly takes longer in one cart design than another, the organization has identified a measurable opportunity for improvement.

These measures move crash cart management away from documentation compliance and toward actual emergency preparedness.

14. DISCUSSION

The literature surrounding resuscitation consistently emphasizes rapid intervention, coordinated teamwork, effective communication, and high-quality CPR. Crash cart readiness intersects with each of these areas.

What becomes apparent when examining the issue from a practical hospital perspective is that many potential failures are mundane. A missing item, expired medication, broken seal, unfamiliar drawer, or poorly positioned cart may appear insignificant during normal operations. During cardiac arrest, however, these small failures occur within a highly time-sensitive environment.

This is why crash cart readiness should be treated as a system issue.

Another important observation is that responsibility cannot reasonably be assigned to nursing alone. Nurses are often responsible for routine inspection, but medication safety requires pharmacy expertise, equipment reliability requires technical support, airway organization benefits from respiratory and emergency expertise, and the clinical suitability of the cart requires physician input.

There is also a strong argument for greater use of simulation when evaluating crash cart systems. A checklist answers the question, “Is the item there?” A simulation asks the more clinically relevant question, “Can the team find and use it quickly when the patient needs it?”

Future improvement efforts should increasingly focus on the second question.

15. FUTURE RESEARCH

Despite the obvious clinical importance of emergency preparedness, more research is needed to determine which crash cart interventions translate into measurable improvements in resuscitation performance.

Studies could compare standardized and non-standardized cart layouts using medication retrieval time, error rates, or interruption of chest compressions as outcomes. Digital inventory systems could be compared with conventional manual systems for expired-stock rates and staff workload.

Human-factors research may be particularly useful. Drawer arrangement, typography, labeling, packaging, lighting, and visual differentiation of medications can all influence how quickly clinicians identify an item under pressure.

Multicenter studies would also help determine whether standardized readiness indicators could be developed for broader hospital use.

16. CONCLUSION

The crash cart is easy to regard as a piece of hospital equipment. In practice, it is better understood as the physical endpoint of several interconnected safety processes.

Pharmacy must ensure that emergency medications are appropriate and safe. Nursing must maintain operational readiness. Physicians and emergency teams must ensure that the cart reflects real resuscitation needs. Respiratory professionals contribute to airway preparedness, biomedical teams maintain critical equipment, and quality departments help identify recurring system failures.

When these responsibilities are coordinated, the crash cart becomes more than a storage trolley. It becomes part of a reliable resuscitation system.

Hospitals should therefore focus not only on whether crash carts are available and checked, but on whether healthcare professionals can obtain the correct medication or equipment quickly, confidently, and safely during an actual emergency. Standardization, multidisciplinary oversight, simulation, thoughtful medication management, and continuous evaluation provide a practical framework for achieving this goal.

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