Chapter 13

Strengthening Health Systems to Provide Emergency Care

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INTRODUCTION

All around the world, acutely ill and injured people of all ages seek care every day. They will call neighbors, the police, or universal emergency numbers for help. They will be assisted by family members, community members with first-aid training, or professional prehospital providers. They may travel to a health care facility by foot, motorcycle, taxi, or ambulance. On arrival, they may or may not find a designated emergency area and providers capable of delivering the care they need.

Emergency care systems (ECSs) address a wide range of acute conditions, including injuries, communicable and noncommunicable diseases, and complications of pregnancy. Especially when there are barriers to health care access, people may seek care *only* when acutely ill or injured. Emergency care is an essential component of universal health coverage—a critical mechanism for ensuring accessible, affordable, high-quality care—and for many people around the world, it is the primary point of access to the health system.

The World Health Organization (WHO) has defined a series of essential functions for an ECS that span from prehospital care and transport through facility-based emergency unit care to early operative and critical care (figure 13.1). Each of these functions can be achieved in many ways, depending on available resources, and each is essential to the delivery of effective emergency care.

Each of the previous eight volumes of this edition of *Disease Control Priorities* (third edition) (*DCP3*) presents a package of essential services and highlights urgent services for conditions likely to result in morbidity or mortality if not addressed rapidly. An ECS is an integrated mechanism to address these time-sensitive conditions, and this chapter integrates the urgent interventions from all the *Disease Control Priorities* packages with the WHO ECS framework to derive a package of essential emergency care services, including key policy strategies for system development. This effort is intended to identify ways in which national health care systems globally can be strengthened to provide emergency care more effectively.

WHAT IS EMERGENCY CARE?

Emergency care has been defined by various attributes, such as time-to-care provision and acuity of the condition addressed. Common definitions include care delivered within minutes or hours (Kobusingye and others 2006) and care for conditions that require rapid intervention to avoid death or disability (Hirshon and others 2013).

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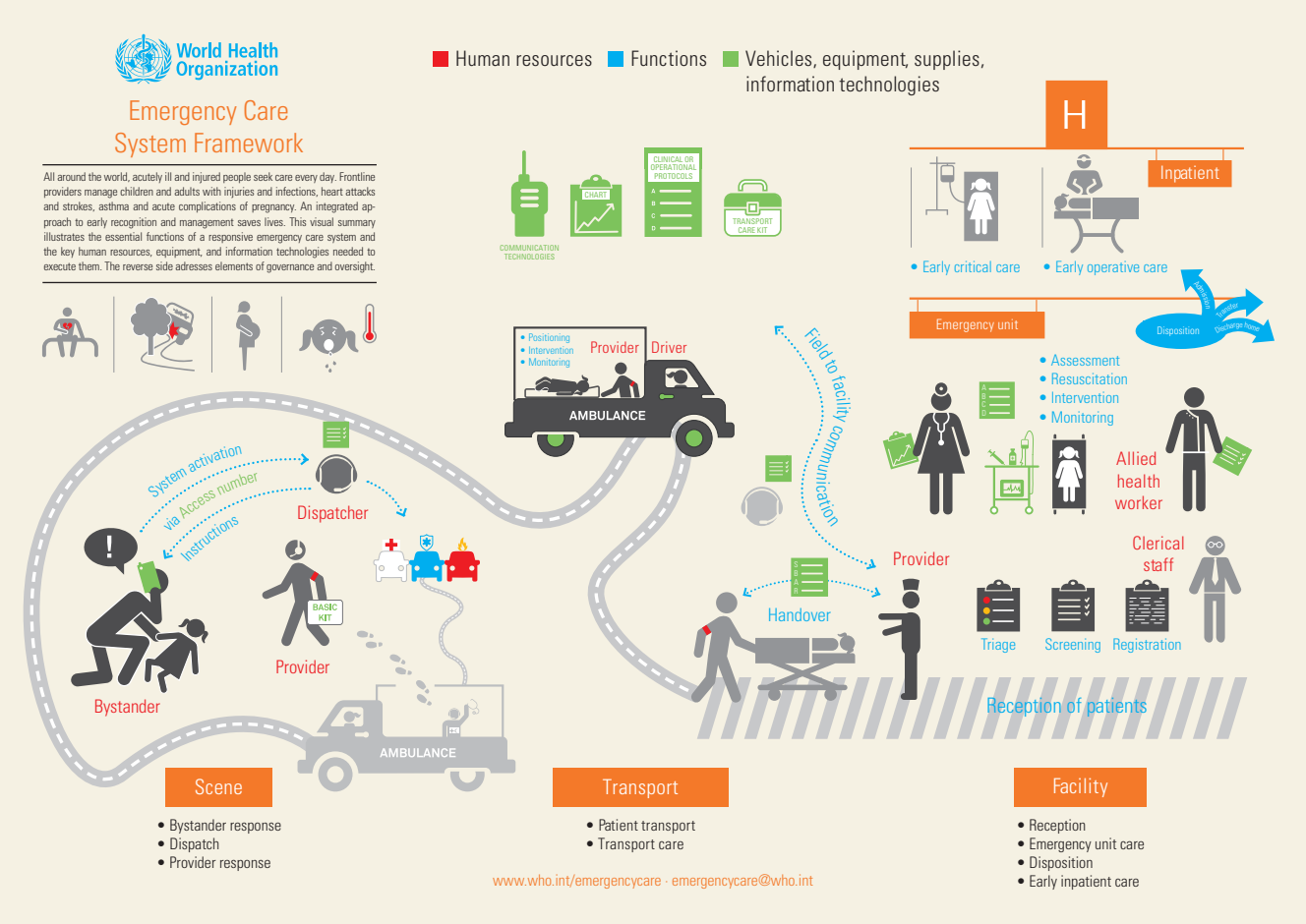
Figure 13.1 WHO Emergency Care System Infographic



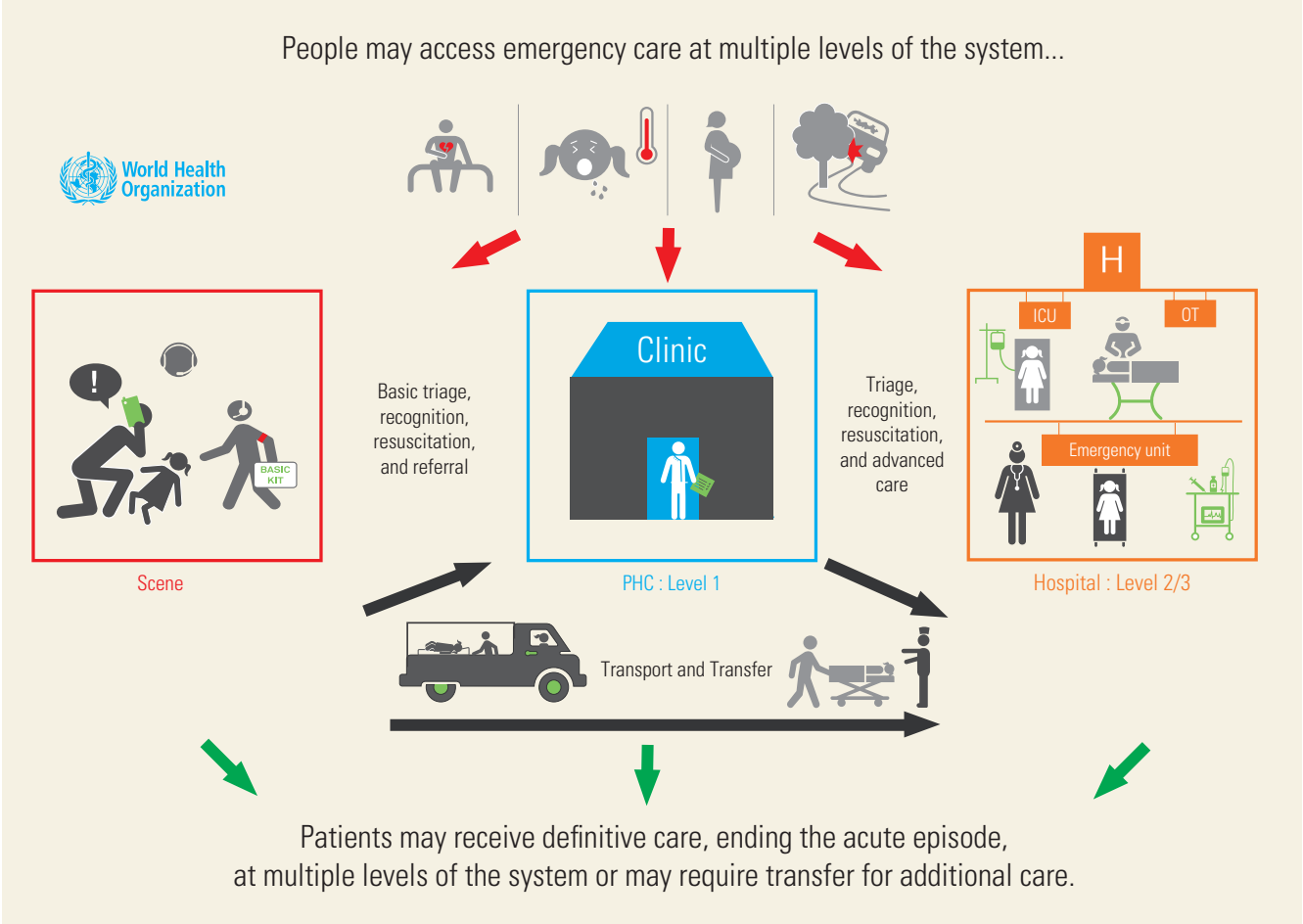
Source: WHO, http://www.who.int/emergencycare/emergencycare_infographic/en/.
Note: H = hospital; WHO = World Health Organization.

Definitions of emergency care that focus on the acuity of the condition itself have the advantage of being independent of the rapidity or level of care that can be achieved by the system and, instead, encompass all rapidly progressive conditions. This approach is preferable to definitions grounded in a specific period for care delivery, since much emergency care would fall outside of a time-bound definition in regions where long transport times are the norm and referrals may take days.

To facilitate consistent understanding across systems at varying levels of development, emergency care is considered here to encompass health services for conditions that require rapid intervention to avert death and disability (such as shock or respiratory failure) or for which delays of hours can worsen prognosis or render care less effective (such as treatment of infections, management of asthma exacerbations, or suturing of wounds). However, users of the health care system may not themselves be able to judge whether a condition is life-threatening; the belief that an emergency condition exists requires at least urgent preliminary assessment by health care professionals.

People in need of care may access the system at many points, including by activating the prehospital system, by visiting a primary health center, or by presenting directly to a hospital-based emergency unit (figure 13.2); providers at every level of the health system deliver emergency care, whether or not they have the dedicated training and resources to do so effectively. Frontline emergency care may involve early recognition and initial resuscitation for dangerous conditions followed by transfer for definitive care (for example, chest drain placement, volume resuscitation, and transfusion performed before transfer for surgery) or may encompass

Figure 13.2 Access to Emergency Care



Source: World Health Organization, http://www.who.int/emergencycare.
Note: H = hospital; ICU = intensive care unit; OT = operating theatre; PHC = primary health clinic.

definitive therapy (such as administration of antibiotics for pneumonia, wound repair, or nonoperative fracture management).

In keeping with the WHO ECS framework, the use of the term *emergency care* in this chapter encompasses care that occurs both before and beyond the emergency unit itself (figure 13.1), including prehospital care and the early operative care and critical care that may occur in an operating room or an inpatient intensive care unit (ICU). Although the focus of this chapter's package is on facility-based emergency care, many of these services can be mapped onto prehospital systems at increasing levels of development. In general, depending on the level of development of a prehospital system, the services may be very basic, similar to those available at a community-based health center, or may include sophisticated critical care approaching that available in an ICU. Further details on emergency care specific to the prehospital setting are covered in chapter 14 of volume 1 of *DCP3* (Thind and others 2015).

WHY FOCUS ON EMERGENCY CARE?

Expanding the availability of disease-specific treatments and procedures is essential. The effectiveness of these interventions is compromised, however, without the initial emergency care interface that links undifferentiated patient presentations to appropriate definitive care. For the most part, people seeking care for acute illness or injury do not know if they have a condition requiring oxygen, antibiotics, pericardiocentesis, or surgery. They generally present complaining of fever, pain, or difficulty breathing rather than pneumonia, appendicitis, or tamponade. They do not necessarily know when they are

critically ill and cannot go directly to ICUs or operating rooms. In most parts of the world, initial emergency care is delivered by frontline providers (often cadres other than doctors) acting with limited diagnostic resources. Emergency care includes both the early assessment that helps narrow a chief complaint toward a diagnosis, as well as the initial management that allows survival until a diagnosis-oriented therapy can be identified and accessed. The failure (a) to designate and staff emergency care areas, (b) to train frontline providers in recognition of and resuscitation for dangerous conditions, and (c) to create organized ECSs to match people rapidly with the care they need, will cost lives, even where life-saving resources are already available somewhere in the system (Dare and others, 2015; Grimes and others 2011; Hsiao and others 2013; Irfan, Irfan, and Spiegel 2012).

A systematic approach to emergency care—centered on acuity-based triage, early recognition and resuscitation, and simple initial management and referral—has been shown to decrease the mortality associated with a range of medical and surgical conditions. Implementation of a systematic emergency unit approach to early recognition and treatment has been shown to reduce significantly mortality from both pneumonia and sepsis (Gaieski and others 2010; Hortmann and others 2014; Rivers 2001). Better-organized trauma systems have been shown to decrease preventable deaths among the severely injured by 50 percent and to improve functional outcomes among survivors (Siman-Tov, Radomislensky, and Peleg 2013; Tallon and others 2012). Recognition and emergency treatment for myocardial infarction delivered within 60 minutes rather than hours has been shown to reduce mortality twofold (Terkelsen and others 2010); early noninvasive positive pressure ventilation reduces in-hospital mortality (RR [95% CI]: 0.66 [0.48, 0.89]) in patients with heart failure (Vital, Ladeira, and Atallah 2013). Early treatment with aspirin (within 48 hours) for ischemic stroke has been shown to reduce both morbidity and mortality (Sandercock and others 2014), and early intensive blood-pressure lowering (within six hours) has been shown to improve functional outcomes in hemorrhagic stroke (Anderson and others 2013). Three obstetric emergencies—hemorrhage, hypertensive disorders, and sepsis—are responsible for more than half of the maternal deaths worldwide (Say and others 2014) and are highly treatable with simple emergency care interventions (Holmer and others 2015).

Despite the substantial positive impact emergency care can have, however, many low- and middle-income countries (LMICs) lack the fundamentals of organized emergency care: basic prehospital care and transport, a dedicated area and standards for hospital-based emergency care, and a core of nonrotating providers trained in the care of emergencies and assigned to the emergency unit. These gaps are reflected in wide global discrepancies in outcomes across the range of emergency conditions:

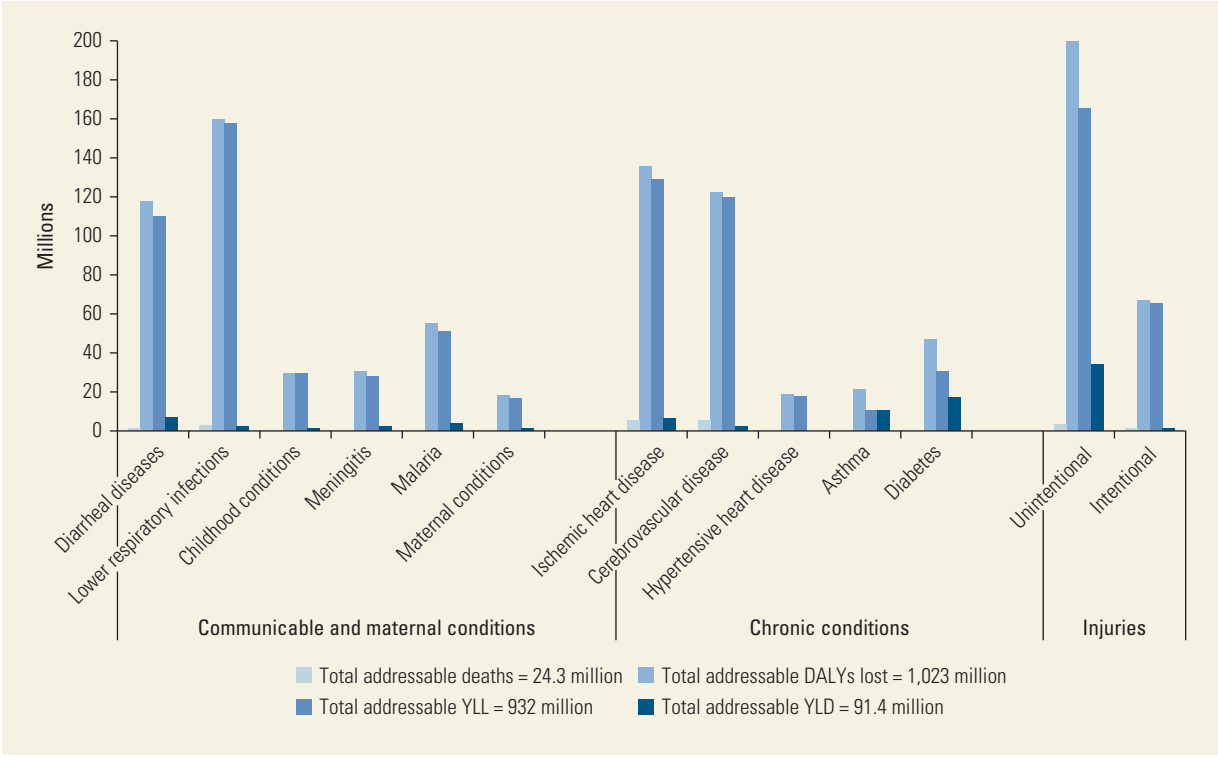
- Overall mortality rates from diabetic ketoacidosis are less than 1 percent in high-income countries (HICs) (Nyenwe and Kitabchi 2011) but are as high as 30 percent in LMICs (Mbugua and others 2005).
- The estimated lifetime risk of maternal mortality in HICs is 1 in 3,300, compared to 1 in 41 in LMICs (Alkema and others 2016).
- Although available data are limited and range widely, mortality from sepsis in LMICs is likely to be more than twice that in HICs (Silva and others 2004; Stevenson and others 2014; Tanriover and others 2006).
- Even within a single country, the discrepancy in outcomes associated with limited access to emergency care can be dramatic: in one Indian study, being poor was associated with reduced access to timely emergency treatments for acute myocardial infarction and with a 50 percent relative increase in mortality (Xavier and others 2008).
- Finally, modeling studies estimate that between 20 and 38 percent of the global injury burden (between 1 million and 2 million fatalities each year and around 52 million disability-adjusted life years, or DALYs) could be averted if severe injury outcomes in LMICs were similar to those in HICs (Higashi and others 2015; Mock and others 2012).

Overall, the global burden of disease that potentially can be addressed by prehospital and facility-based emergency care is estimated at a staggering 54 percent of the annual deaths in LMICs (Thind and others 2015) (figure 13.3).

Although severe global discrepancies exist in outcomes from emergency conditions, both these modeling estimates and direct evidence suggest that emergency care has the potential to narrow this gap dramatically. Powerful examples of feasible life-saving emergency care interventions in LMICs include the following:

- Organizing low-cost prehospital systems was associated with a dramatic decrease in all-condition mortality in Cambodia and Iraq (Husum and others 2003), in road-traffic mortality in Iraq (Murad and others 2012), and in snakebite mortality in Nepal (Sharma and others 2013). A recent review and meta-analysis estimated that simple prehospital systems can reduce injured patients' risk of death by 25 percent (Henry and Reingold 2012).

Figure 13.3 Burden of Disease That Can Potentially Be Addressed by Prehospital and Emergency Care in Low- and Middle-Income Countries



Source: Thind and others 2015 (data from WHO 2013).
Note: DALYs = disability-adjusted life years; LMICs = low- and middle-income countries; YLD = years lived with disability; YLL = years of life lost.

- Designating an area for emergency care of all critical patients at a third-level hospital in Romania transformed care and halved mortality.[1]
- In Malawi, restructuring a hospital intake area to create a dedicated emergency care area and initiating formal triage were associated with halved inpatient mortality and a reduction in the proportion of deaths occurring within 24 hours from 36 to 12.6 percent (Molyneux, Ahmad, and Robertson 2006).
- Timely simple interventions (fluids, antibiotics, and clinical monitoring) within the first six hours of hospitalization in Ugandan adults with serious infection reduced mortality from 46 to 33 percent (Jacob and others 2012).
- In rural Mali, improved access to emergency obstetric care halved the risk of maternal mortality and reduced the risk nearly threefold among women with hemorrhage (Fournier and others 2009). Growing evidence indicates that a range of simple nonsurgical interventions for complications of childbirth can dramatically improve maternal mortality in LMICs (Kausar and others 2012; Miller, Lester, and Hensleigh 2004; Paxton and others 2005).
- The introduction of standardized resuscitation protocols in Colombia reduced hospital length of stay and all-cause mortality among injured patients by a quarter (Kesinger, Puyana, and Rubiano 2014).
- Short course trainings in trauma management were associated with reduced mortality in injured patients from 19.9 to 15.1 percent in China (Wang and others 2010) and from 8.8 to 6.3 percent in Rwanda with no significant increase in resource usage (Petroze and others 2015).
- Finally, one modeling study, although dependent on the assumption of available oxygen, predicted that the use of pulse oximetry, combined with current WHO guidelines for recognition of severe illness, has the potential to avert up to 148,000 deaths per year in the 15 countries across Africa and Asia with the highest global burden of childhood pneumonia (Floyd and others 2015).

Evidence from around the world shows that emergency care is an effective means of saving lives, and evidence from LMICs suggests that feasible and simple steps to improve emergency care could rapidly improve

outcomes and reduce global disparities in outcomes. More broadly, the recently adopted United Nations Sustainable Development Goals (SDGs)[2] and their associated targets provide guidance for coordinated action to end poverty, protect the planet, and promote health on a global level. ECSs directly address nearly all the health-related SDG targets, as well as those on disasters and violence (table 13.1), and the SDG targets are unlikely to be met without strengthening ECSs globally.

THE WHO EMERGENCY CARE SYSTEM FRAMEWORK

To facilitate systematic assessment and targeted development of integrated ECSs, the WHO ECS framework (annex 13A) was designed with input from more than 30 LMICs. This consensus-based document defines essential emergency care functions at the scene of injury or illness, during transport, and through emergency unit

Table 13.1 Sustainable Development Goals Directly Addressed by Emergency Care

Sustainable Development Goal targets	Emergency care interventions
3.1: By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births	Interventions include treatment for obstetric emergencies such as hemorrhage, hypertensive disorders, and sepsis.
3.2: By 2030, end preventable deaths of newborns and children under age five years, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-five mortality to at least as low as 25 per 1,000 live births	Interventions include treatment of acute pediatric diarrhea, pneumonia, and sepsis.
3.3: By 2030, end the epidemics of HIV/AIDS, tuberculosis, malaria, and neglected tropical diseases, and combat hepatitis, water-borne diseases, and other communicable diseases	Interventions include recognition and treatment of acute infections.
3.4: By 2030, reduce by one-third premature mortality from noncommunicable diseases through prevention and treatment and promote mental health and well-being	Interventions include treatment of acute exacerbations of noncommunicable diseases such as heart attack, stroke, and asthma.
3.5: Strengthen the prevention and treatment of substance abuse	Interventions include treatment of overdose and emergency-unit harm-reduction interventions.
3.6: By 2020, halve the number of global deaths and injuries from road-traffic accidents	Interventions include postcrash emergency care for injury.
3.7: By 2030, ensure universal access to sexual and reproductive health care services, including family planning, information, and education; and the integration of reproductive health into national strategies and programs	Interventions include time-sensitive postexposure treatments.
3.8: Achieve universal health coverage, including financial risk protection; access to quality essential health care services; and access to safe, effective, quality, and affordable essential medicines and vaccines	Interventions include continuous access to timely essential services for acute illness and injury. Emergency care is the primary point of access to the health system for many, especially among vulnerable populations.
3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination	Interventions include management of acute exposures.
3d: Strengthen the capacity of all countries, particularly LMICs, for early warning, risk reduction, and risk management of national and global health risks	The ECS is a critical site for syndromic surveillance and for preparedness to mitigate the risk of health system collapse in the face of mass events.
11.5: By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations	The ECS is an essential substrate for emergency response and health system resilience.
16.1 Significantly reduce all forms of violence and related death rates everywhere	Interventions include treatment for victims of violence and early recognition of vulnerable individuals.

Source: Sustainable Development Goal targets, http://www.un.org/sustainabledevelopment/sustainable-development-goals/.
Note: ECS = emergency care system; HIV/AIDS = human immunodeficiency virus/acquired immune deficiency syndrome.

and early inpatient care. The functions are mapped across the WHO Health System Building Blocks (WHO 2010), and each function is associated with general categories of human and material resources as well as information and governance elements. The framework—intended to facilitate system planning and development activities—identifies the components of each essential function to allow policy makers and planners to coordinate system development activities and identify and use existing processes and resources more effectively.

Different systems may achieve each function in different ways, based on available resources. For example, system activation may occur in a high-resource setting with a universal access number linked to a central, computerized dispatch and global positioning system. In other settings, system activation may involve the use of simple mobile phone–based protocols that guide dispatchers to provide advice on first aid and use landmark maps to identify patient location.

At the same time, the framework is designed to account for all the basic functions of emergency care. Each function corresponds to specific human, material, and governance requirements. In the case of patient transfer, for example, it is impossible for one person to drive and care for a patient simultaneously, so essential human resources include both the driver and provider. The authority responsible for medical equipment is not likely to be the same as that responsible for vehicle maintenance, and distinct governance components are required. The framework identifies minimum resource categories and ensures that all essential functions are addressed.

Since few countries will have the available resources to implement all components of a fully developed ECS at once, the WHO ECS framework is designed to allow policy makers to identify gaps in care delivery and to create context-relevant priority action plans for system development.The framework is linked with the WHO Emergency Care System Assessment (ECSA) tool, a survey-based tool designed to help policy makers and planners assess a national or regional ECS and set priorities for system development (WHO, n.d.). The ECSA allows users to rate the level of development of components of an ECS on a progressive scale. By providing specific descriptions of each progressive stage, the tool provides a road map, allowing users to generate action priorities rapidly from identified gaps (figure 13.4). For example, for a given component rated at the lowest level (level one), the next most appropriate and feasible targets would likely be the elements described in levels two and three.

WHO ECSAs and associated priority development meetings have been conducted in more than 25 countries across multiple regions. Although each country's assessment differs, shared challenges have been identified across many low- and low-middle-income countries, including the following:

- The need for better coordination of prehospital and facility-based care
- Limited or no coverage of prehospital systems, especially in rural areas
- Critical emergency care service gaps at first-level hospitals (some countries report gaps in both equipment and skills, whereas several middle-income countries report limited emergency care due to first-level hospital provider knowledge gaps, even when equipment is available)
- Lack of nonrotating staff assigned to the emergency unit, which limits coordinated action to improve care and processes
- Limited data on emergency care delivery and poor links for existing data to system planning and quality-improvement efforts
- Lack of standard clinical management and documentation in prehospital and facility settings
- Gaps in dedicated emergency care training across the system, especially regarding integration into formal curricula and ongoing certification requirements
- Insufficient funding and lack of dedicated funding streams
- Lack of security for prehospital and facility-based emergency care staff.

Areas targeted for priority action by multiple countries include the following:

- Designating or strengthening the authority of a government agency to ensure better coordination
- Creating policies to improve access to emergency care, including legislation mandating access without requirement for prior payment and explicit integration of emergency care services into national insurance plans
- Coordinating development of dedicated emergency units with fixed staff at first-level hospitals
- Establishing dedicated emergency care training programs for diverse cadres, including (depending on the system) lay people; undergraduate health professions students; and a range of providers, such as clinical officers, nurses, and generalist and specialist doctors
- Implementing standardized clinical charts based on WHO data sets to facilitate systematic clinical approaches, as well as standardized data collection to inform quality improvement and system planning
- Developing and disseminating formal triage and condition-specific management protocols.

Figure 13.4 Example of Progressive Ratings in the WHO Emergency Care System Assessment Tool

* 8.3 Emergency unit staffing in facilities:

An **emergency unit** is any dedicated intake area for acutely ill and injured patients. This may be referred to as the emergency department/room/ward, accident and emergency, casualty, etc.

First-level hospitals are the lowest level of hospital that receives referrals. In many countries these are district hospitals.

Third-level hospitals are the highest level of facility.

Note that in some countries there may be other facility levels in between first-level and third-level that are not addressed here.

	First-level hospitals	Third-level hospitals
[1] There are no dedicated emergency units or no providers with specific responsibility for emergency unit patients until they are admitted.	○	○
[2] There are staff that register and direct patients in the emergency unit to inpatient areas (the unit has a sorting function, but minimal care is provided).	○	○
[3] Providers from inpatient services have on-call responsibility to cover emergency unit patients, but are not assigned to be in the emergency unit.	○	○
[4] Providers from inpatient services are assigned to be in the emergency unit, rotating through for limited intervals (for example, one-month blocks).	○	○
[5] There are a core of nonrotating providers that permanently staff the emergency unit.	○	○
I don't know.	○	○
Cannot answer for another reason (explain):	○	○

Source: WHO, http://who.int/emergencycare/activities/en.

In addition to guiding in-country system development efforts, these shared priorities and country-identified needs also serve to guide WHO technical resource development and program agendas.

ESSENTIAL PACKAGE OF EMERGENCY CARE

Each volume of this edition of *Disease Control Priorities* highlights a set of urgent time-dependent elements from among its essential package. Although these elements do not in themselves form a comprehensive package of basic emergency care services, they identify a range of services that an effective ECS must be able to provide. As such, they serve as a foundation for the package described here.

Each essential package defines a set of services, including the capacity to recognize or manage specific conditions and to perform specific procedures or other interventions. Although many of the urgent elements specify a diagnosis (pneumonia or meningitis) or diagnosis-specific intervention (appendectomy), most emergency care is by its nature syndrome-based

(addressing shortness of breath, shock, or altered mental status). Even in a fully resourced system, the entire arc of emergency unit assessment and management may occur before establishing a diagnosis. This scenario is especially true where diagnostic resources are limited. In this chapter, the essential urgent services identified in other packages from *DCP3* are integrated with the components necessary to the practice of frontline care for the undifferentiated acutely ill patient, creating a comprehensive package of basic emergency care services (table 13.2).

The emergency care package includes nearly all the urgent elements identified in other packages from this edition, except where these do not fall in the scope of emergency care (for example, electroconvulsive therapy for depression or hepatitis B vaccination). In addition, the critical presenting *syndromes* in emergency care—difficulty breathing, shock, altered mental status—and their commonly associated diagnoses are used to identify additional elements (table 13.3). As with the other packages in this edition, the essential

Table 13.2 Essential Package of Emergency Care

Protocols with Training and Capacity to Perform			
Primary health center	**First-level hospital**	**Referral and specialized hospitals**	**Crosscutting policy interventions**
Recognition of danger signs in children and adults	Acuity-based triage of children and adults		• Ensure that the National Ministry of Health has a directorate dedicated to emergency care (not limited to disaster response).
Vital signs measurement			• Conduct a standardized national assessment of the emergency care system (using the WHO ECSA or a similar tool) to identify gaps and inform system development.
BLS	ALS		• Ensure that emergency care is explicitly incorporated into the National Health Plan.
Neonatal resuscitation (including kangaroo care and thermal care for preterm newborns)	Full supportive care for preterm newborns		• Establish national legislation ensuring access to emergency care without regard to ability to pay.
Basic approach to difficulty in breathing, shock, altered mental status, trauma	Advanced approach to difficulty in breathing, shock, altered mental status, trauma	Advanced condition-specific algorithms for life-threatening conditions	• Ensure that hospitals at all levels include dedicated emergency units—areas dedicated to the provision of emergency care and staffed with at least a core of nonrotating personnel who are specifically trained in the care of emergency conditions. • Disseminate dedicated training for emergency care across cadres, including training in basic emergency care for all prehospital providers, basic emergency care training for all cadres of facility-based providers who treat patients with emergency conditions, dedicated emergency care training integrated into undergraduate medical and nursing curricula, and residency or specialist training programs in emergency medicine.
Detection of sepsis	Emergency management of sepsis		• Establish acuity-based triage systems at all facilities that regularly receive acutely ill and injured patients. • Establish prehospital care systems based on WHO or other international standards, including a dedicated certification pathway for prehospital care providers and a toll-free, universal access number for emergency care.

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Table 13.2 Essential Package of Emergency Care (continued)

Protocols with Training and Capacity to Perform			
Primary health center	**First-level hospital**	**Referral and specialized hospitals**	**Crosscutting policy interventions**
			• Develop critical process and clinical protocols as identified in the WHO ECS framework (including transport and referral protocols, prehospital and facility-based clinical treatment protocols, disaster and mass casualty).
Detect and initiate treatment of severe malnutrition	Advanced treatment of severe malnutrition		• Implement standardized clinical charts and registries incorporating essential data points, such as those based on WHO standards, to facilitate quality improvement efforts.
Post exposure prevention of STI/ HIV, emergency contraception, counseling			
	Basic case-based syndromic surveillance and reporting		
	Basic communicable disease isolation	Advanced communicable disease isolation	
	Disaster and mass casualty protocols	Advanced regional response protocols for disaster and mass casualty	

Emergency Unit Procedures			
Primary health center	**First-level hospital**	**Referral and specialized hospitals**	
Cervical spine immobilization	Endotracheal intubation		
Oral and nasal airway placement	Surgical airway		
Bedside swallow evaluation			
	BVM ventillation	Mechanical Ventilation	
		Noninvasive positive pressure ventilation	
	Oxygen administration		
	Needle decompression for tension pneumothorax		
	Placement of chest drain		
	IV fluid infusion (peripheral) for neonates, children, adults	IV infusion (central)	
		Pericardiocentesis	
	Defibrillation	Pacing	
		Cardioversion (including synchronized)	
Safe physical restraint			
	NGT placement		

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Table 13.2 Essential Package of Emergency Care (continued)

Emergency Unit Procedures		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
	Lumbar puncture	
	Passive rewarming techniques	Active invasive rewarming techniques
Drainage of superficial abscess		
Basic wound care	Suturing laceration	
	Escharotomy/fasciotomy	
Splinting for extremity injury	Nonoperative fracture management (closed reduction and casting)	
	Reduction of simple dislocated joint	
	Placement of external fixator; use of traction	
	Relief of urinary obstruction: catheterization or suprapubic cystostomy	
Management of labor and delivery in low risk women (BEMNOC)	(See operative services below)	
	Procedural sedation	
	Regional block	

Operating Theatre Services		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
	Spinal anesthesia	
	General anesthesia	
	Repair of perforations: for example, perforated peptic ulcer, typhoid ileal perforation	Surgical intervention for gastrointestinal bleeding
	Appendectomy	
	Colostomy	
	Gallbladder removal	
	Hernia, including incarceration	
	Trauma laparotomy	
	Open reduction and internal fixation for fractures	
	Irrigation and debridement of open fractures	
	Emergency surgery for obstruction	
	Trauma-related amputations	

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Table 13.2 Essential Package of Emergency Care (continued)

Operating Theatre Services		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
	Burr hole	
	Drainage of septic arthritis	
	Surgery for ectopic pregnancy	
	Cesarean section	
	Hysterectomy for uterine rupture or intractable postpartum hemorrhage	
	Dilation and curretage	
Radiology Services		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
	Comprehensive X-ray services	CT services
	Radiology performed ultrasound	
	Point of care ultrasound	
Laboratory Services		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
Point of care testing: glucose, malaria, urinalysis and urine pregnancy test, hemoglobin.	Point of care HIV testing. Laboratory complete blood counts, simple coagulation studies, urea, and electrolytes. Slide microscopy for cell counts, malaria, and wet preparation. STI testing. Capcity to collect blood culture in emergency unit prior to antibiotic administration.	Comprehensive laboratory services for emergency diagnoses, including troponin and cardiac markers, blood gas, thyroid studies, therapeutic drug levels
Medications		
ABCDEs		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
	IV paralytic (depolarizing and nondepolarizing agent)	
Oral steroids	IV steroids (for airway, CNS, and antenatal)	
Inhaled bronchodilator	Nebulized bronchodilator	
IM adrenaline	IV adrenaline	
Oral rehydration solution	IV fluids for rehydration	
	Transfusion (whole blood, FFP, packed red blood cells)	
Oral aspirin		Systemic anticoagulation

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Table 13.2 Essential Package of Emergency Care (continued)

Medications		
ABCDEs		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
		Thrombolytic (streptokinase for STEMI)
	Insulin	
Oral (buccal) glucose	IV glucose	
Antidotes		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
Activated charcoal		
	Naloxone	Antithyroid agents
	Bicarbonate infusion	
	Atropine	
	Antivenin[a]	
	Pyridoxine	
Oral Vitamin K	IV Vitamin K	
Cardiac		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
Oral diuretics	IV diuretics	
		Adenosine
		Advanced vasopressor support
		Amiodarone
	Nitroglycerin SL	IV Nitroglycerin
	IV antihypertensive agent	IV Betablockers or CCB
		IV Calcium
	Oral potassium	IV Potassium
CNS		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
Oral antipsychotic	IM & IV antipsychotic	
Oral and rectal benzodiazepine	IM & IV benzodiazepine	
Oral and IM analgesia	IV analgesia	
	Local anesthesia for injection	

table continues next page

Table 13.2 Essential Package of Emergency Care (continued)

Obstetrics and Gynecology		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
Initiate antenatal steroids		
IM magnesium sulphate (loading dose)	Magnesium sulphate infusion[a]	
	Oxytocin for IV infusion	
	Second-line agent for PPH	
	Anti-D immunoglobulin	
	Oral agents for management of ectopic pregnancy, emergency contraception	

Vaccines		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
Tetanus vaccine		
Rabies vaccine	Antirabies immunoglobulin[a]	

Antimicrobials		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
Oral antibiotics for lung, skin, GI, or GU source (including syndromic STI treatment); PPROM)	IV antibiotics (for lung, skin, GI, GU, or CNS source; PPROM)	
Topical antifungals		
Oral antifungal		IV antifungal
Oral antimalarials	IV antimalarials	
Oral antihelminthics		
	Oral antiviral (acyclovir or equivalent)	IV antiviral (acyclovir or equivalent)
Opthalmic topical antibacterial		
Topical antidermatoparasitic agent		

Other		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
Oral paracetamol		
Oral antiemetic	IV antiemetic	
Oral zinc		
Topical agents for burn dressing		

table continues next page

Table 13.2 Essential Package of Emergency Care (continued)

Other		
Primary health center	**First-level hospital**	**Referral and specialized hospitals**
Topical steroid	Mannitol	
		Agents for acute glaucoma (IV acetazolamide, opthalmic topical steroid, opthalmic topical beta-blocker)
Surface and skin disinfectants		

Note: All resources mapped to lower levels are expected to be available at higher levels. ABCDEs = airway, breathing, circulation, disability, exposure; ALS = advanced life support; BEMNOC = basic emergency newborn and obstetric care; BLS = basic life support; BVM = bag valve mask; CCB = calcium channel blocker; CNS = central nervous system; CT = computed tomography scan; ECS = emergency care system; ECSA = emergency care system assessment; FFP = fresh frozen plasma; GI = gastrointestinal; GU = genitourinary infection; HIV = human immunodeficiency virus; IM = intramuscular; IV = intravenous; NGT = nasogastric tube; PPH = postpartum hemorrhage; PPROM = preterm premature rupture of the membranes; SL = sublingual; STEMI = ST-elevated myocardial infarction; STI = sexually transmitted infections; WHO = World Health Organization.
a. In many regions, antivenin will be kept centrally by public health authorities. Ensure timely availability to first-level hospitals.

Table 13.3 Key Diagnoses Associated with Critical Syndromes

Difficulty breathing	Shock	Altered mental status
Airway injury and inflammation	Sepsis	Coma
Foreign body	Gastroenteritis and diarrhea	Delirium
Pneumohemothorax	Bradycardia	Hypo- and hyperglycemia
Pneumonia	Hemorrhage	Hypoxia
Pleural effusion	Cardiac valvular disease	Hypo- and hyperthermia
Asthma	Abnormal cardiac rhythm or cardiac failure	Electrolyte or thyroid abnormality
Chronic obstructive pulmonary disease	Gastrointestinal bleeding	Liver disease
Anemia	Tension pneumothorax	Kidney disease
Myocardial ischemia	Anaphylaxis	Poisoning and envenomation
Cardiac failure	Spinal cord injury	Psychosis
Pericardial effusion		Seizure
Pulmonary embolism		Stroke
Drug overdose		Tumor
Chest wall injury		Traumatic brain injury
Paralysis		Central nervous system infections, including HIV-related

Note: HIV = human immunodeficiency virus.

package for emergency care highlights interventions that should be considered part of universal health coverage (Jamison and others 2013).

The following general assumptions were used as a guide in assigning components to levels of the system. It is not assumed that primary health centers have the capacity to deliver intravenous infusions or that emergency units in first-level hospitals have electrocardiogram and cardiac monitoring available. Hence, intravenous therapies are only included at the first-level hospital and above, and therapies dependent on a diagnosis of cardiac rhythm are included only at the second- or third-level hospitals. Practice conditions will vary among countries and regions, and so this constitutes a minimum package. Countries and regions with greater capacity at lower levels of the health system may want to map package components from higher levels to lower-level facilities.

COST-EFFECTIVENESS OF EMERGENCY CARE SERVICES IN LMICS

Many examples of individual emergency care services are highly cost-effective in LMICs, including the following:[3]

- *Dedicated emergency unit with formal triage*. The creation of the dedicated emergency unit in Malawi described earlier (associated with halved inpatient mortality and a reduction in the proportion of early deaths from 36 to 12.6 percent) had a cost of US$1.95 per patient (Molyneux, Ahmad, and Robertson 2006).
- *Oxygen for pneumonia*. In Papua New Guinea, introduction of an improved oxygen system (oxygen concentrators and pulse oximeters) decreased mortality risk for children with pneumonia by 35 percent. The estimated cost of this system was US$118 per patient treated, US$3,868 per life saved, and US$116 per DALY averted (Duke and others 2008).
- *Pulse oximetry for childhood pneumonia*. The modeling study that described the impact of implementing pulse oximetry combined with WHO guidelines showed that the intervention was extremely cost-effective, with estimates ranging from US$3.26 to US$72.01 per DALY averted, in the 15 countries across Africa and Asia with the highest global burden of childhood pneumonia (Floyd and others 2015).
- *Treatment of acute myocardial infarction*. In India, the incremental cost of treating, with either aspirin to a 95 percent coverage level or aspirin plus streptokinase to an 80 percent coverage level, treatment-eligible patients with acute myocardial infarction who were not yet being treated was US$0.56 and US$701 per DALY averted, respectively (Megiddo and others 2014). Early electrocardiogram diagnosis to facilitate triage and referral was shown to be cost-effective in India at US$17 per quality-adjusted life year (QALY) (Gaziano and others 2017).
- *Emergency obstetric care*. In rural India, an emergency obstetric hospital provided services at an estimated cost of US$0.43 per capita per year for the community (or US$1.50 per woman of childbearing age) (McCord and others 2001).
- *Trauma surgery*. In a Cambodian hospital dealing almost exclusively with injury (about 90 percent of cases), surgical interventions (though not all were emergency surgeries) cost approximately US$133 per DALY averted (Gosselin and Heitto 2008).
- *Emergency obstetric services*. A small hospital in rural Bangladesh demonstrated substantial DALYs averted primarily through the institution of emergency obstetric services (McCord and Chowdhury 2003).

PRIORITIES FOR ACTION

The following key priorities for policy makers and planners were derived from the WHO ECS framework (annex 13A) and represent key policy components to support delivery of the essential package of care:

- Ensure that the national ministry of health has a directorate dedicated to emergency care (not limited to disaster response).
- Conduct a standardized national assessment of the ECS (using the WHO ECSA or a similar tool) to identify gaps and inform system development.
- Ensure that emergency care is explicitly incorporated into the national health plan.
- Establish national legislation ensuring access to emergency care without regard to ability to pay.
- Ensure that hospitals at all levels include dedicated emergency units—areas dedicated to the provision of emergency care and staffed with at least a core of nonrotating personnel who are specifically trained in the care of emergency conditions.
- Disseminate dedicated training for emergency care across cadres, including training in basic emergency care for all prehospital providers, basic emergency care training for all cadres of facility-based providers who treat patients with emergency conditions, dedicated emergency care training integrated into undergraduate medical and nursing curricula, and residency or specialist training programs in emergency medicine.
- Establish acuity-based triage systems at all facilities that regularly receive acutely ill and injured patients.
- Establish prehospital care systems based on WHO or other international standards, including a dedicated certification pathway for prehospital care providers and a toll-free, universal access number for emergency care.
- Develop critical process and clinical protocols as identified in the WHO ECS framework (including transport and referral protocols, prehospital and facility-based clinical treatment protocols, and disaster and mass casualty protocols.
- Implement standardized clinical charts and registries incorporating essential data points, such as those based on WHO standards, to facilitate quality improvement efforts.

CONCLUSIONS

Conditions that can be addressed by emergency care (such as injuries, infections, obstetrical complications, stroke, myocardial infarction, and respiratory failure) account for a substantial health burden. The interventions needed to address these conditions are very cost-effective, even in limited-resource settings, but critical gaps remain in emergency care governance and delivery in LMICs. Improving the organization of and planning for emergency care services substantially improves the outcomes of patients with emergency conditions. Most of the evidence for such improvements comes from HICs, but there is growing evidence that such improvements can also be made—affordably, sustainably, and with dramatic impact—in LMICs. The WHO ECS framework and the complementary essential package of emergency care services represent a mechanism by which emergency care can be scaled up globally, accelerating progress toward universal health coverage and a range of other SDG targets.

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ANNEX

The annex to this chapter is as follows. It is available at http://www.dcp-3.org/DCP.

- Annex 13A: WHO Emergency Care Systems Framework.

NOTES

World Bank Income Classifications as of July 2014 are as follows, based on estimates of gross national income (GNI) per capita for 2013:

- Low-income countries (LICs) = US$1,045 or less
- Middle-income countries (MICs) are subdivided:
  (a) lower-middle-income = US$1,046 to US$4,125
  (b) upper-middle-income (UMICs) = US$4,126 to US$12,745
- High-income countries (HICs) = US$12,746 or more.

1. R. Arafat, Ministry of the Interior, Department for Emergency Situations, Government of Romania, personal communication with the author based on internal facility data, March 2016.
2. For more information on the SDGs, see http://www.un.org/sustainabledevelopment/sustainable-development-goals/.
3. All costs are adjusted to 2012 US$.

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