

# Evidence-Based Approach for Disaster Preparedness Authorities to Inform the Contents of Repositories for Prescription Medications for Chronic Disease Management and Control

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*The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the [US] Centers for Disease Control and Prevention.*

**Keywords:** chronic disease; disaster planning; emergencies; medication systems

## Abbreviations:

ICD-9-CM = *International Classification of Diseases, 9th Revision, Clinical Modification*  
NHAMCS = National Hospital Ambulatory Medical Care Survey

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## Abstract

**Introduction:** Chronic diseases are major causes of death and disability and often require multiple prescribed medications for treatment and control. Public health emergencies (e.g., disasters due to natural hazards) that disrupt the availability or supply of these medications may exacerbate chronic disease or even cause death.

**Problem:** A repository of chronic disease pharmaceuticals and medical supplies organized for rapid response in the event of a public health emergency is desirable. However, there is no science base for determining the contents of such a repository. This study provides the first step in an evidence-based approach to inform the planning, periodic review, and revision of repositories of chronic disease medications.

**Methods:** Data from the 2004 National Hospital Ambulatory Medical Care Survey (NHAMCS) were used to examine the prescription medication needs of persons presenting to US hospital emergency departments for chronic disease exacerbations. It was assumed that the typical distribution of cases for an emergency department will reflect the patient population treated in the days after a public health emergency. The estimated numbers of prescribed drugs for chronic conditions that represent the five leading causes of death, the five leading primary diagnoses for physician office visits, and the five leading causes of disease burden assessed by disability-adjusted life years are presented.

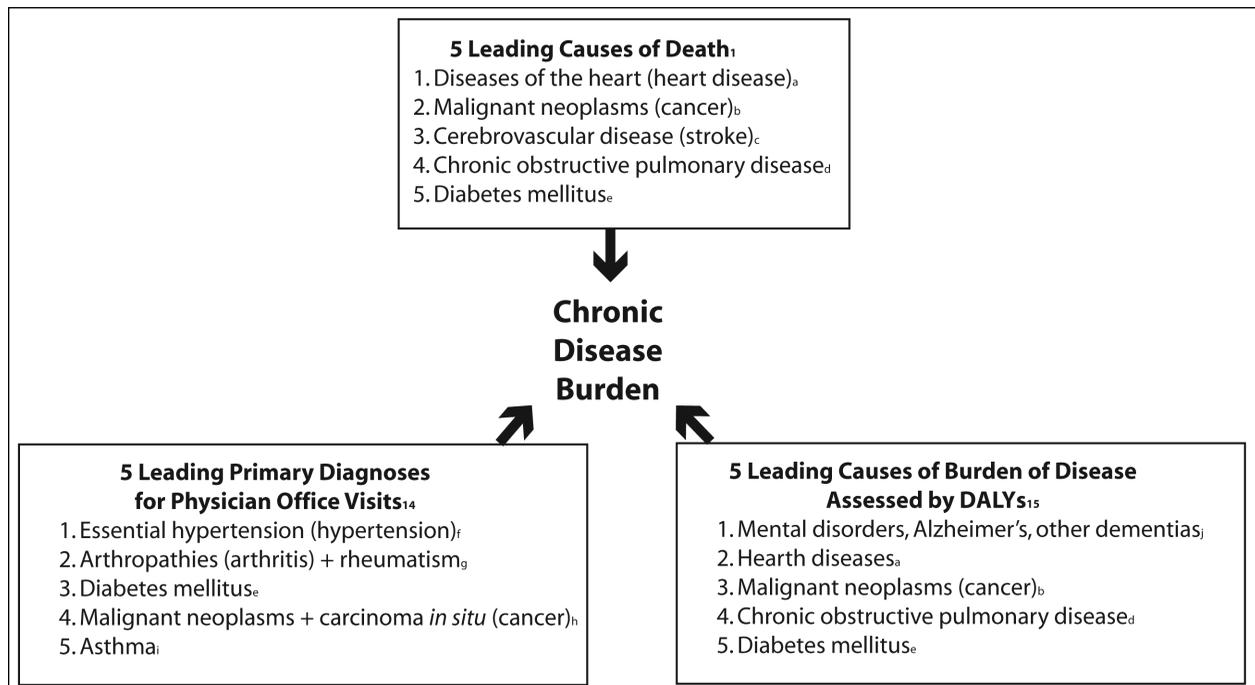
**Results:** The 2004 NHAMCS collected data on 36,589 patient visits that were provided by 376 emergency departments. Overall, the five drug classes mentioned most frequently for emergency department visits during 2004 were narcotic analgesics (30.7 million), non-steroidal anti-inflammatory drugs (25.2 million), non-narcotic analgesics (15.2 million), sedatives and hypnotics (10.4 million), and cephalosporins (8.2 million). The drug classes mentioned most frequently for chronic conditions were: (1) for heart disease, antianginal agents/vasodilators (715,000); (2) for cancer, narcotic analgesics (53,000); (3) for stroke, non-narcotic analgesics (138,000); (4) for chronic obstructive pulmonary disease, anti-asthmatics/bronchodilators (3.2 million); and (5) for diabetes, hypoglycemic agents (261,000). Ten medication categories were common across four or more chronic conditions.

**Conclusions:** Persons with chronic diseases have an urgent need for ongoing care and medical support after public health emergencies. These findings provide one evidence-based approach for informing public health preparedness in terms of planning for and review of the prescription medication needs of clinically vulnerable populations with prevalent chronic disease.

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## Introduction

Chronic diseases are a major cause of death and disability worldwide. In 2005, the World Health Organization estimated that 58 million persons died of chronic diseases worldwide, representing about 61% of global mortality.<sup>1,2</sup> In



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**Figure 1**—Defining the chronic disease burden in the United States (DALYs = disability-adjusted life years; ICD-9 = *International Classification of Diseases*, 9th edition)

<sup>a</sup>ICD-9 codes 390-398, 402, 404-429; <sup>b</sup>ICD-9 codes 140-208; <sup>c</sup>ICD-9 codes 430-438; <sup>d</sup>ICD-9 codes 490-496; <sup>e</sup>ICD-9 code 250; <sup>f</sup>ICD-9 code 401; <sup>g</sup>ICD-9 codes 710-719, 725-729; <sup>h</sup>ICD-9 codes 140-208, 230-234; <sup>i</sup>ICD-9 code 493; <sup>j</sup>ICD-9 codes 290-319, 331.0; <sup>k</sup>

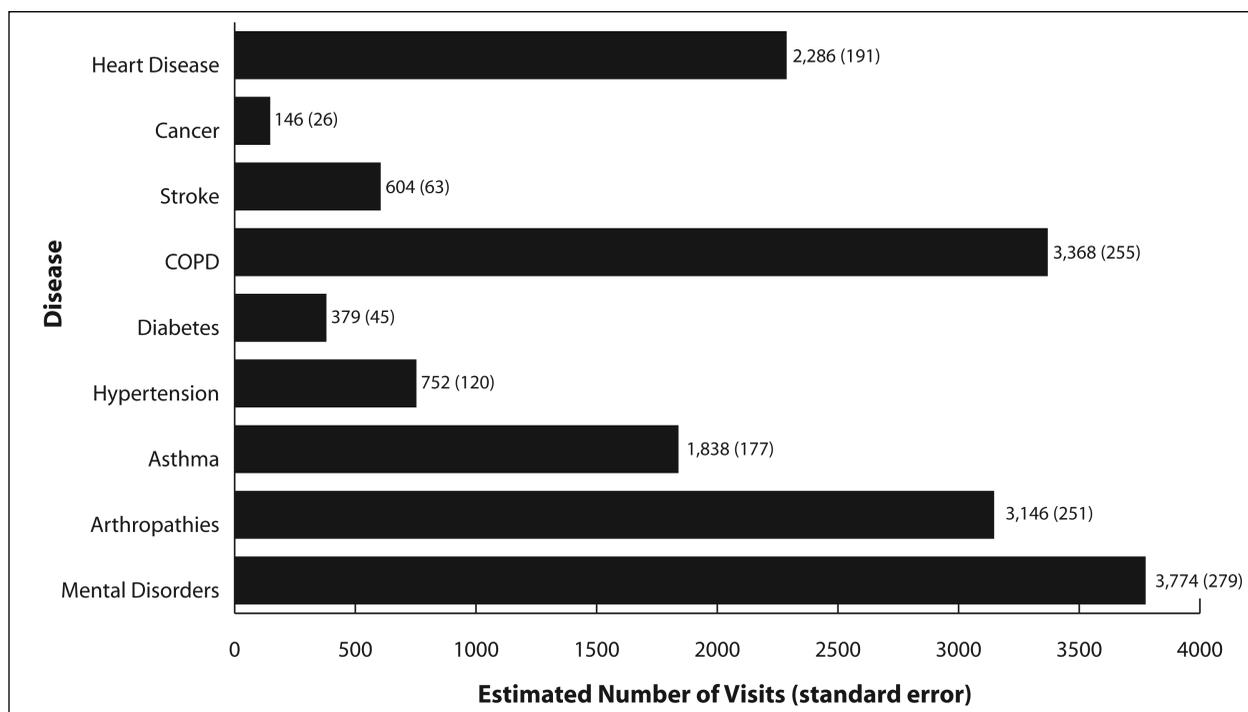
the United States, chronic diseases account for about 70% of all deaths, and an estimated 133 million Americans live with one or more forms of chronic disease.<sup>3</sup> Additionally, more than 80% of Medicare beneficiaries aged  $\geq 65$  years have at least one chronic condition, 65% have two or more chronic conditions, 43% have three or more chronic conditions, and 24% have four or more chronic conditions.<sup>4</sup>

Most of these chronic diseases require one or more prescribed medications. This high prevalence and the associated use of multiple medications that control chronic diseases have increased concerns about the potential health consequences of public health emergencies, particularly disasters due to natural hazards, that may disrupt the availability or supply of essential medications and medical supplies for chronic disease prevention and control.<sup>5,6</sup> For instance, during or following an event, pharmacies in or around an affected area may close or quickly deplete their inventories, making it difficult for patients who remain in the area to obtain critical medications (new prescriptions or refills) and medical supplies.<sup>7</sup> Displaced persons who evacuate without essential medications and medical supplies, or those who deplete their prescriptions before being able to return home, also are vulnerable to acute exacerbations of their condition(s).<sup>8</sup> Acute exacerbation of chronic diseases can lead to severe complications or death, and was a leading concern among medical personnel treating displaced persons after Hurricane Katrina in 2005.<sup>6</sup>

A repository of pharmaceuticals (e.g., vasodilators, diuretics, thrombolytics, analgesics, antibiotics, life-support

medications) and medical supplies (e.g., oxygen, intravenous infusion supplies, airway maintenance supplies) organized for rapid response in the event of a public health emergency may be beneficial in order to provide services to displaced populations and restore affected healthcare systems after the event.<sup>9</sup> While assets from the federally managed [US] Strategic National Stockpile may be sent to the site of a national crisis, the initial response will be managed locally. Planning at each level involves complex decision-making concerning the formulation of a repository of pharmaceuticals and medical supplies. Insufficient medication supplies may lead to inadequate treatment, whereas excessive supplies represent wasted resources.<sup>10</sup> In addition, it may be beneficial for such a repository to be subject to a periodic science- or evidence-based review, as opposed to one based largely on the consensus of an expert committee.

To address this need and inform the consideration of medications and supplies for chronic conditions, the prescription medication needs of persons admitted to emergency departments for chronic disease exacerbations were examined. The underlying assumption is that the typical distribution of cases for an emergency department will reflect the patient population treated in the days ( $>24$  hours) after the onset of a public health emergency (i.e., disaster due to natural hazard), plus a potential increase in the number of patients who have sustained minor traumatic injuries (e.g., injuries and wounds) related to recovery efforts and an increase in medication refills.<sup>11</sup> Data from the National Hospital Ambulatory Medical Care Survey



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**Figure 2**—Estimated numbers of emergency department visits for leading causes of chronic disease morbidity and mortality in the United States: National Hospital Ambulatory Medical Care Survey, 2004 (see Figure 1 for ICD-9 codes used to define chronic disease categories; COPD = chronic obstructive pulmonary disease)

Drug class	Estimated no. of drug mentions (in thousands)	Drug class	Estimated no. of drug mentions (in thousands)
1. Analgesics, narcotic	30,748	11. Erythromycin/lincosamide/macrolide	4,677
2. Non-steroidal anti-inflammatory	25,251	12. Anti-anxiety agents	4,395
3. Analgesics, non-narcotic	15,215	13. Quinolones and derivatives	4,333
4. Sedatives and hypnotics	10,409	14. Antihistamines	4,197
5. Cephalosporins	8,167	15. Skeletal muscle hyperactivity	3,487
6. Antiasthmatics/bronchodilators	8,081	16. Vaccines/antisera	3,332
7. Penicillins	7,013	17. Diuretics	3,157
8. Disorders, acid or peptic	6,818	18. Anti-anginal agents/vasodilators	3,053
9. Adrenal corticosteroids	5,806	19. Hypoglycemic agents	2,871
10. Regulation of electrolytes/water balance	5,219	20. Anesthetics, local (injectable)	2,821

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**Table 1**—Twenty most frequent drug class mentions during emergency department visits

Source: National Hospital Ambulatory Medical Care Survey, 2004

See the Appendix for detail of the most frequent generic medications within each drug class.

(NHAMCS) were used to examine the types of medications prescribed to patients who were treated in emergency departments. Given the prevalence of chronic disease in the United States and previous problems with medication availability during and after disasters,<sup>12–14</sup> the approach of this study focused on medications used by persons with chronic conditions identified as among the five leading causes of death, five leading causes of disability, and five leading indications for outpatient physician office visits.

This approach adequately captures the underlying clinical vulnerability of the population with prevalent chronic disease.

### Methods

The NHAMCS is a national, probability sample survey conducted by the National Center for Health Statistics of the [US] Centers for Disease Control and Prevention, in conjunction with the US Census Bureau. The survey captures ambulatory care visits to emergency departments that operate 24 hours-per-day in non-federal short-stay or general hospitals in the US. For each patient visit, trained hospital

Disease category	Drug class	Estimated no. of drug mentions (in thousands)	Ten most frequently mentioned generics within drug class	Estimated no. of drug mentions (in thousands)
Heart disease	Anti-anginal agents/vasodilators	715	Nitroglycerin	640
	Diuretics	707	Furosemide	632
	Analgesics, non-narcotic	587	Heparin	205
	Anticoagulants/thrombolytics	573	Aspirin	527
	Beta-blockers	501	Metoprolol	349
	Analgesics, narcotic	336	Morphine	202
	Calcium channel blockers	329	Diltiazem	254
	Regulation of electrolytes/water balance	300	Sodium chloride	140
	Hypoglycemic	214	Sodium chloride	108
	Adjunct to anesthesia/analeptics	211	Oxygen	123
Cancer	Analgesics, narcotic	53	Morphine	19
	Disorders, acid or peptic	25	Pantoprazole sodium	9
	Sedatives and hypnotics	23	Promethazine	21
	Regulation of electrolytes/water balance	23	Sodium chloride	16
	Calcium channel blockers	22	Diltiazem	18
	Analgesics, non-narcotic	20	Acetaminophen	14
	Hypoglycemic	20	Insulin	7
	Diuretics	19	Furosemide	12
	Cephalosporins	17	Ceftriaxone	9
	Antiasthmatics/bronchodilators	16	Ipratropium bromide	11
Stroke	Analgesics, non-narcotic	138	Aspirin	121
	Anticoagulants/thrombolytics	132	Glopigrel	51
	Analgesics, narcotic	86	Morphine	41
	Beta-blockers	83	Metoprolol	44
	Regulation of electrolytes/water balance	82	Sodium chloride	38
	Anticonvulsants	49	Phenytoin	22
	Anti-anxiety agents	48	Lorazepam	35
	Diuretics	48	Hydrochlorothiazide	30
	Hyperlipidemia	46	Atorvastatin calcium	20
	ACE inhibitors	46	Lisinopril	19
Chronic obstructive pulmonary disease	Antiasthmatics/bronchodilators	3,245	Albuterol sulfate	1,650
	Adrenal corticosteroids	1,808	Prednisone	881
	Erythromycin/lincomamide/macrolide	589	Azithromycin	515
	Analgesics, non-narcotic	339	Acetaminophen	265
	Non-steroidal anti-inflammatory	296	Ibuprofen	240
	Anti-tussive/expectorant/mucolytic	293	Combination (e.g., pseudoephedrine, dextromethorphan, + guaifenesin)	143
	Analgesics, narcotic	266	Combination (e.g., hydrocodone + acetaminophen)	181
	Cephalosporins	201	Ceftriaxone	140
	Quinolones and derivatives	199	Levofloxacin	152
	Penicillins	176	Amoxicillin	122
Diabetes	Hypoglycemic	261	Insulin	193
	Regulation of electrolytes/water balance	60	Sodium chloride	35
	Analgesics, narcotic	52	Combination (e.g., hydrocodone + acetaminophen)	20
	Sedatives and hypnotics	40	Promethazine	31
	Disorders, acid or peptic	40	Metoclopramide	22
	Analgesics, non-narcotic	38	Acetaminophen	20
	Vertigo/motion sickness/nausea	33	Ondansetron hydrochloride	25
	Non-steroidal anti-inflammatory	31	Ibuprofen	14
	ACE inhibitors	20	Lisinopril	8
	Anti-anxiety agents	18	Lorazepam	10

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Table 2—Ten most frequent drug mentions during emergency department visits for leading causes of chronic disease burden  
 Source: National Hospital Ambulatory Medical Care Survey, 2004

*continued on page 451*

Disease category	Drug class	Estimated no. of drug mentions (in thousands)	Ten most frequently mentioned generics within drug class	Estimated no. of drug mentions (in thousands)
Hypertension	Alpha agonist/alpha-blockers	227	Clonidine	227
	Beta-blockers	220	Metoprolol	109
	ACE inhibitors	187	Enalapril	70
	Analgesics, non-narcotic	180	Aspirin	124
	Diuretics	134	Hydrochlorothiazide	69
	Calcium channel blockers	119	Amlodipine	71
	Analgesics, narcotic	112	Combination (e.g., hydrocodone + acetaminophen)	50
	Antitrigonal agents/vasodilators	106	Nitroglycerin	76
	Non-steroidal anti-inflammatory	92	Ibuprofen	33
	Regulation of electrolytes/water balance	83	Sodium chloride	47
	Nonsteroidal anti-inflammatory	1,685	Ibuprofen	823
	Analgesics, narcotic	1,480	Combination (e.g., hydrocodone + acetaminophen)	1,032
	Analgesics, non-narcotic	424	Acetaminophen	290
	Sedatives and hypnotics	219	Promethazine	173
Arthropathies (arthritis) and rheumatism	Skeletal muscle hyperactivity	203	Cyclobenzaprine	120
	Cephalosporins	177	Cephalexin	119
	Adrenal corticosteroids	131	Methylprednisone	70
	Anti-asthmatics/bronchodilators	110	Albuterol sulfate	49
	Diuretics	105	Furosemide	45
	Anti-anxiety agents	104	Diazepam	66
	Anti-asthmatics/bronchodilators	2,260	Albuterol sulfate	1,226
	Adrenal corticosteroids	1,247	Prednisone	702
	Erythromycin/lincosamide/macrolide	214	Azithromycin	191
	Non-steroidal anti-inflammatory	171	Ibuprofen	141
	Analgesics, non-narcotic	150	Acetaminophen	95
	Antitussive/expectorant/mucolytic	99	Combination (e.g., pseudoephedrine, dextromethorphan, + guaifenesin)	49
	Antihistamines	93	Cetirizine	30
	Analgesics, narcotic	90	Combination (e.g., hydrocodone + acetaminophen)	64
Asthma	Inhaled corticosteroids	77	Fluticasone propionate	73
	Topical steroids	71	Dexamethasone	70
	Anti-anxiety agents	988	Lorazepam	634
	Anti-psychotic/antimanic agents	592	Haloperidol/risperidone	148
	Antidepressants	467	Paroxetine HCl	77
	Sedatives and hypnotics	256	Promethazine	106
	Anticonvulsants	251	Divalproex sodium	87
	Analgesics, non-narcotic	230	Acetaminophen	168
	Vitamins/minerals	201	Thiamine	118
	Non-steroidal anti-inflammatory	194	Ibuprofen	81
	Analgesics, narcotic	193	Combination (e.g., hydrocodone + acetaminophen)	107
	Regulation of electrolytes/water balance	164	Sodium chloride	84

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Table 2 (continued)—Ten most frequent drug mentions during emergency department visits for leading causes of chronic disease burden Source: National Hospital Ambulatory Medical Care Survey, 2004

personnel or Census Bureau field representatives complete a brief one-page patient record form, which represents the sampling unit for the NHAMCS. Detailed methods of the survey have been described previously.<sup>15</sup>

This analysis focuses on ambulatory care visits to hospital emergency departments during 2004. The 2004 NHAMCS was conducted between 29 December 2003 and 26 December 2004. The survey collected data on 36,589 patient visits provided by 376 emergency departments (hospital sampling response rate, 91%). To obtain national estimates of emergency department visits, each record is assigned an inflation factor or patient visit weight. The estimated number of visits to emergency departments made by all patients in the US then can be obtained by aggregating patient visit weights.

Data collected from each sample visit included information on the medications provided during the visit. Generic names and standard therapeutic drug classification codes used in the National Drug Code Directory were available for up to eight medications in 2004. Records with drug mentions were isolated in order to process the drug data. Estimates of drug mentions were obtained by multiplying the patient visit weight by the number of medications recorded at the sample visit.

The estimated number of drug mentions by several conditions that define the chronic disease burden in the US are listed in the Appendix.<sup>1,16,17</sup> Visit records were categorized according to the physician's primary (first listed) discharge diagnosis for the visit, coded according to the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM). All analyses were completed using SAS v9 (Cary, NC) and SUDAAN v9 (Research Triangle Park, NC).

## Results

In 2004, an estimated 110.2 million visits were made to hospital emergency departments in the US, or about 38.2 visits per 100 persons. The estimated numbers of emergency department visits made for conditions that define the chronic disease burden (Figure 1) in the US are in Figure 2. An estimated 2.3 million visits were for heart disease, the leading cause of death in the US. Nearly 3.4 million visits were made to an emergency department by patients with chronic lung disease, and of these, 55% were asthma related. Mental disorders (3.8 million) and arthropathies (3.1 million) also accounted for a large number of emergency department visits during 2004.

The 20 most frequent drug mentions by drug class for all emergency department visits during 2004 are in Table 1. Overall, the five drug classes mentioned most frequently were narcotic analgesics (30.7 million), non-steroidal anti-inflammatory drugs (25.2 million), non-narcotic analgesics (15.2 million), sedatives and hypnotics (10.4 million), and cephalosporins (8.2 million).

The 10 most frequent drug mentions for selected chronic conditions are summarized in Table 2. The estimated number of drug mentions is listed by drug class and the most frequently mentioned generic drug within each class. For example, an estimated 707,000 mentions of diuretics occurred during 2004 for emergency visits of patients with

a principal diagnosis of heart disease. The diuretic identified most frequently was furosemide (632,000 drug mentions). Similarly, there were 3.2 million mentions of anti-asthmatics/bronchodilators during emergency department visits for chronic obstructive pulmonary disease, and the agent mentioned most frequently was albuterol sulfate (1.65 million drug mentions).

Table 3 is a summary of drug categories mentioned during emergency department visits for leading causes of chronic disease burden in the US in 2004. Analgesics and controlled substances, metabolic and nutrient agents, and psychotropic agents were among the leading drugs mentioned for each of the leading causes of the chronic disease burden defined in Figure 1. Gastrointestinal agents or anti-emetics, antibacterial/antifungal/antiviral agents, diuretics, beta-blockers, and anti-asthmatics/bronchodilators/inhaled corticosteroids also were common across the leading chronic conditions.

## Discussion

Disasters due to natural hazards and other public health emergencies are capable of overwhelming the resources of an affected community, and in particular, the capacity of the healthcare system. The immediate health burden on a community, often measured in terms of morbidity and mortality, losses or disruptions in infrastructure and supplies, and damage to the health infrastructure, varies with the nature of the event.<sup>18</sup> In areas in which community resources are drained by emergency responses or are insufficient to meet the health needs of the population, the provision of additional resources often are necessary to provide services for displaced populations and restore the affected healthcare systems.

The underlying medical vulnerability of a population should be an important factor in determining the composition of a pharmaceutical and medical supply repository. Authorities may closely approximate this medical vulnerability by considering the leading causes of death, leading causes of disability, and most frequent indications for physician visits. Knowledge of the underlying medical vulnerability of a population also will be useful for authorities, since the nature of the event (e.g., earthquake, volcanic eruption, heat wave, hurricane) likely will influence which patients may be more impacted (e.g., patients with respiratory, cardiovascular, gastrointestinal, or dermatological conditions).

The 25 most frequently mentioned drug categories prescribed for the prevention and control of chronic diseases during ambulatory care visits to emergency departments in non-federal, short-stay, or general hospitals in the US in 2004 were identified. Within these categories, the drugs most frequently prescribed for more than one major leading cause of death or disability included medications for mental health, analgesics, metabolic and nutrient-related agents, gastrointestinal agents, diuretics, beta-blockers, bronchodilators and other anti-asthmatic medications, angiotensin-converting enzyme inhibitors, neurologic agents, calcium channel blockers, hormonal agents, antihistamines, hypoglycemic agents, antianginal agents, and anticoagulants. Thus, this analysis suggests which drug categories might be considered, as well as the relative quantities of each, depending on the number of diseases for which they frequently are prescribed.

Medication category*	Heart disease	Cancer	Stroke	COPD	Diabetes	Hypertension	ARTH	Asthma	Mental
Analgesics and controlled substances	x	x	x	x	x	x	x	x	x
Coronary vasodilators/antianginal agents	x					x			
Diuretics	x	x	x			x	x		x
Anticoagulants/thrombolytics	x		x						
Beta-blockers	x		x		x	x	x		
Calcium channel blockers	x	x				x			
ACE inhibitors			x		x	x			x
Angiotensin II receptor antagonists					x				
Alpha-blockers						x			
Other cardiovascular-renal/antihypertensive agents	x								
Hyperlipidemia			x						
Hypoglycemics		x			x				
Metabolic and nutrient agents	x	x	x	x	x	x	x	x	x
Psychotropics (sedative/hypnotic; antianxiety; antipsychotic; antimanic; antidepressant; other)	x	x	x	x	x	x	x	x	x
Anesthetics	x								
Antibacterial/antifungal/antiviral agents		x		x	x		x	x	x
Gastrointestinal agents/antiemetics		x	x	x	x	x	x		x
Antiasthmatics/bronchodilators/inhaled corticosteroids		x		x			x	x	x
Antitussives/expectorants/mucolytics/cold remedies				x				x	
Oncolytics/antineoplastics		x							
Hormones/steroids				x			x	x	
Neurologic/skeletal muscle/anticonvulsants			x				x	x	x
Otologics					x				
Antihistamines and other respiratory tract drugs				x				x	x
Dermatologics/mucous membrane				x				x	

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**Table 3**—Summary of drug categories mentioned during emergency department visits for leading causes of chronic disease burden

Source: National Hospital Ambulatory Medical Care Survey, 2004

(\*Medication categories without drug mentions for the selected disease groups were as follows: antidotes/antitoxins/antivenins, immunologic agents/vaccines/antisera, hematologic agents, ophthalmics, pharmaceutical/surgical aids/dental products, homeopathic products, and radiopharmaceutical/contrast media; COPD = chronic obstructive pulmonary disease; ARTH = arthropathies (arthritis) and rheumatism; mental = mental disorders, Alzheimer's, and other dementias; ACE = angiotensin-converting enzyme)

The results should be interpreted with consideration of the following limitations. The findings reflect the prescription medication needs of persons admitted to emergency departments for chronic disease exacerbations, as well as medications, such as thrombolytics and heparin, administered for acute conditions. As such, they may underestimate

the number of medications needed if large numbers of individuals are separated from their core medications, such as during a flood. Certain populations, such as the elderly, are more likely to have multiple co-morbid chronic conditions. This analysis utilized the primary discharge diagnosis; therefore, the number of medications for chronic condi-

tions may be underestimated. Also, it is important to reinforce that these estimates are most helpful for addressing the short-term needs of displaced populations and do not address issues of continuity of care that are so important for the long-term management of many chronic diseases. Future research may consider incorporating information from community pharmacies to better reflect long-term medication needs in a given community. In addition, it is important that the evidence-based approach for periodic review presented here is updated regularly with the most recent data to reflect changes in pharmaceutical management of disease and in the burden of chronic diseases in the geographic area of interest.

Traditionally, disaster planning efforts regarding pharmaceutical and medical supply repositories have reflected an emphasis on emergency relief for injuries and chemical, biological, radiological, nuclear and explosive events.<sup>5</sup> Although medications to address these types of events are critically important, they may not be sufficient in the setting of a large-scale disaster that leads to large numbers of displaced persons and interruptions in the supplies of routine medications. Persons with chronic diseases such as heart disease, cancer, stroke, chronic respiratory diseases, and diabetes, and those with chronic disability, also will have urgent needs for ongoing care and medical support.<sup>5</sup> Chronic conditions and medications for the treatment and management of chronic diseases were common reasons for visits to emergency-treatment facilities (e.g., hospitals, disaster medical assistance teams, military-aid stations) during the period immediately following Hurricane Katrina in

2005.<sup>19</sup> Among a sample of adults aged  $\geq 18$  years evacuated to shelters in Houston following Hurricane Katrina, approximately 40% reported a prevalent chronic disease and that they needed medication.<sup>20</sup> In a study of medication needs of displaced Hurricane Katrina survivors residing at a San Antonio evacuee center over a 20-day period, nearly three-quarters of defined daily doses of medication dispensed by local retail pharmacies to these survivors were for chronic care medicines including medications for the management of respiratory conditions (e.g., inhaled steroids, inhaled anti-cholinergics), cardiovascular agents (e.g., anti-hypertensives, anti-arrhythmics, anti-hyperlipidemics), neuropsychotropic agents (e.g., anti-depressants, anti-psychotics), and medications for management of endocrine disorders (e.g., insulin, oral hypoglycemics, thyroid replacements).<sup>21</sup> The findings in this analysis provide one evidence-based approach for informing public health preparedness in terms of planning for and review of the prescription medication needs of clinically vulnerable populations with prevalent chronic disease.

### Conclusions

Chronic diseases are a major cause of morbidity and mortality, and most chronic diseases require multiple prescribed medications for treatment and control. The underlying clinical vulnerability for chronic disease is adequately captured by the five leading causes of death, five leading causes of disability, and five leading indications for outpatient physician office visits. This analysis provides a first step in an evidence-based approach for planning for the prevention and control of chronic diseases during public health emergencies.

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**Appendix—Most frequent drug mentions during emergency department visits**  
 Source: National Hospital Ambulatory Medical Care Survey, 2004

*continued on page 456*

Drug class	Estimated no. of drug mentions (in thousands)	Five most frequently mentioned generics within drug class	Estimated no. of drug mentions (in thousands)
Analgesics, narcotic	30,748	Combination (e.g., hydrocodone + acetaminophen)	18,729
		Morphine	4,435
		Meperidine	3,077
		Hydromorphone	2,304
		Hydrocodone	525
Non-steroidal anti-inflammatory	24,251	Ibuprofen	14,887
		Ketorolac tromethamine	6,359
		Naproxen	2,504
		Celecoxib	453
		Rofecoxib	231
Analgesics, non-narcotic	15,215	Acetaminophen	10,976
		Aspirin	3,394
		Tramadol	693
		Combination(e.g., butalbital + aspirin )	147
		Sodium thiosalicylate	6
Sedatives and hypnotics	10,409	Promethazine	8,350
		Hydroxyzine	1,106
		Midazolam HCl	306
		Zolpidem tartrate	241
		Phenobarbital	127
Cephalosporins	8,167	Cephalexin	3,190
		Ceftriaxone	3,074
		Cefazolin	906
		Cefdinir	176
		Cefotaxime sodium	158
Anti-asthmatics/bronchodilators	8,081	Albuterol sulfate	4,167
		Ipratropium bromide	1,096
		Combination (e.g., fluticasone + salmeterol)	1,057
		Albuterol	494
		Levalbuterol HCl	380
Penicillins	7,013	Amoxicillin	3,374
		Combination(e.g., amoxicillin + clavulanic acid)	2,181
		Penicillin V potassium	578
		Penicillin	540
		Ampicillin	129
Disorders, acid or peptic	6,818	Metoclopramide	1,824
		Famotidine	1,516
		Pantoprazole sodium	983
		Ranitidine	740
		Lansoprazole	601
Adrenal corticosteroids	5,806	Prednisone	2,679
		Methylprednisolone	1,846
		Prednisolone	494
		Prednisolone sodium phosphate	290
		Budesonide	132
Regulation of electrolytes/water balance	5,219	Sodium chloride	2,987
		Potassium replacement solutions	1,208
		Combination(e.g., carbohydrates + electrolytes)	414
		Calcium replacement agents	222
		Potassium chloride	125

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**Appendix (continued)**—Most frequent drug mentions during emergency department visits  
 Source: National Hospital Ambulatory Medical Care Survey, 2004

*continued on page 457*

Drug class	Estimated no. of drug mentions (in thousands)	Five most frequently mentioned generics within drug class	Estimated no. of drug mentions (in thousands)
Erythromycin/lincosamide/macrolide	4,677	Azithromycin	3,268
		Clindamycin	563
		Erythromycin	421
		Clarithromycin	388
		Combination(e.g., erythromycin + sulfisoxazole)	31
Anti-anxiety agents	4,395	Lorazepam	2,393
		Diazepam	1,062
		Alprazolam	676
		Chlordiazepoxide	70
		Hydroxyzine	65
Quinolones and derivatives	4,333	Levofloxacin	2,268
		Ciprofloxacin HCl	1,371
		Gatifloxacin	342
		Moxifloxacin HCl	174
		Ofloxacin	131
Antihistamines	4,197	Diphenhydramine	2,774
		Cetirizine	460
		Loratadine	270
		Fexofenadine	263
		Combination(e.g., fexofenadine + pseudoephedrine)	203
Skeletal muscle hyperactivity	3,487	Cyclobenzaprine	1,922
		Orphenadrine	413
		Metaxalone	402
		Methocarbamol	383
		Carisoprodol	229
Vaccines/antisera	3,332	Combination(e.g., tetanus + diphtheria toxoid)	1,427
		Tetanus	1,677
		Rabies	119
		Diphtheria toxoid	69
		Influenza virus vaccine	19
Diuretics	3,157	Furosemide	2,045
		Hydrochlorothiazide	608
		Spironolactone	155
		Combination (e.g., triamterene + hydrochlorothiazide)	142
		Bumetanide	72
Anti-anginal agents/vasodilators	3,053	Nitroglycerin	2,670
		Isosorbide	217
		Hydralazine	55
		Nesiritide	18
		Combination (e.g., hydralazine + thiazide)	14
Hypoglycemic agents	2,871	Insulin	1,237
		Metformin	531
		Glipizide	221
		Glyburide	169
		Rosiglitazone maleate	139

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**Appendix (continued from page 456)**—Most frequent drug mentions during emergency department visits  
Source: National Hospital Ambulatory Medical Care Survey, 2004

Drug class	Estimated no. of drug mentions (in thousands)	Five most frequently mentioned generics within drug class	Estimated no. of drug mentions (in thousands)
Anesthetics, local (injectable)	2,821	Lidocaine	1,717
		Phenazopyridine	528
		Tetracaine	189
		Bupivacaine	182
		Combination (e.g., lidocaine HCl + epinephrine)	115
Vertigo/motion sickness/nausea	2,776	Ondansetron hydrochloride	1,637
		Meclizine	689
		Trimethobenzamide	295
		Granisetron	50
		Prochlorperazine	43
Beta-blockers	2,741	Metoprolol	1,432
		Atenolol	722
		Labetalol HCl	148
		Carvedilol	143
		Propranolol	107
Antidepressants	2,683	Sertraline	447
		Paroxetine HCl	397
		Escitalopram oxalate	299
		Fluoxetine hydrochloride	291
		Trazodone	273
Anticoagulants/thrombolytics	2,486	Heparin	702
		Enoxaparin sodium	618
		Warfarin sodium	537
		Clopidogrel	518
		Combination (e.g., dipyridamole + aspirin)	30
Anticonvulsants	2,117	Phenytoin	589
		Gabapentin	361
		Divalproex sodium	344
		Clonazepam	319
		Carbamazepine	115

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