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SHIPBOARD PHARMACEUTICAL INVENTORY MANAGEMENT

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THESIS

SHIPBOARD PHARMACEUTICAL INVENTORY MANAGEMENT

by

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December 2018

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Since its inception in 2013, the Defense Health Agency has implemented several strategic initiatives aimed at controlling military healthcare expenditures, including considerable efforts toward reducing pharmaceutical costs. Despite the success of these initiatives at fixed military medical treatment facilities, where pharmacy officers lead the implementation and management of cost-saving strategies, the military services have not made a concerted effort to expand these initiatives to their operational medicine platforms, where the absence of pharmacy officer involvement has led to a gap in institutional knowledge of pharmaceutical inventory management processes. This case study seeks to mitigate this knowledge deficit by describing these processes for a representative shipboard medical department aboard the USS *Theodore Roosevelt* (CVN 71) to determine the potential for similar cost savings.

Using a qualitative process and critical incident analysis, this report identifies potential drivers of inefficiencies in shipboard pharmaceutical inventory management and procurement. These include process variability based on medication type, lack of relevant performance measures, potential mission-material mismatches on authorized medical allowance lists, and the lack of true subject-matter experts in planning and implementation. This review provides a baseline and enables future targeted research to validate findings and implement systemic changes to reduce inefficiencies and costs.

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SHIPBOARD PHARMACEUTICAL INVENTORY MANAGEMENT

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LIST OF ACRONYMS AND ABBREVIATIONS

AMAL	authorized medical allowance list
ASD (HA)	Assistant Secretary of Defense (Health Affairs)
BPM	business process management
BUMED	Bureau of Medicine and Surgery
C2	command and control
CIT	critical incident technique
CJCS	Chairman of the Joint Chiefs of Staff
CMC	Commandant of the Marine Corps
CMS	Centers for Medicare and Medicaid Services
CNAF	Commander, Naval Air Forces
CNAP	Commander, Naval Air Forces Pacific
CNO	Chief of Naval Operations
COMNAVAIRFOR	Commander Naval Air Forces
CONUS	Continental United States
CRTS	casualty receiving and treatment ship
CSA	Chief of Staff of the Army
CSA	Combat Support Agency
CSAF	Chief of Staff of the Air Force
DA	Defense Agency
DHA	Defense Health Agency
DHP	Defense Health Program
DLA	Defense Logistics Agency
DML	Defense Medical Logistics
DMLPC	Defense Medical Logistics Proponent Committee
DMLSS	Defense Medical Logistics Standard Support
DMMPO	Defense Medical Materiel Program Office
DoD	Department of Defense
DON	Department of the Navy
DSCP	Defense Supply Center Philadelphia
EA	Executive Agent

ECAT	Electronic Catalog
EOQ	economic order quantity
ESA	enterprise support activities
FDA	Food and Drug Administration
FMF	Fleet Marine Force
GAO	Government Accountability Office
GDP	gross domestic product
IT	information technology
MAJCOM	major command
MANMED	Manual for the Medical Department
MEDCOM	Medical Command
MHS	Military Health System
MMM	Maritime Medical Modules
MTF	military treatment facility
NASNI	Naval Air Station North Island
NAVSUP	Naval Supply Systems Command
NBSD	Naval Base San Diego
NCR	national capital region
NDAA	National Defense Authorization Act
NHE	national health expenditures
NMLC	Navy Medicine Logistics Command
NPAB	Navy Pharmacy Advisory Board
NSN	national stock number
OCONUS	Outside the Continental United States
POD	Pharmacy Operations Division
PMART	pre-deployment medication analysis and reporting tool
PPV	pharmaceutical prime vendor
RPPO	repair parts petty officer
SAMS	SNAP Automated Medical System
SECDEF	Secretary of Defense
SECAF	Secretary of the Air Force
SECARM	Secretary of the Army

SECNAV	Secretary of the Navy
SG	Surgeon General
SNAP	Shipboard Non-Tactical Automated Data Processing
SMO	senior medical officer
SOP	standard operating procedure
SWMI	Surface Warfare Medical Institute
TMOP	Tricare Mail Order Pharmacy
TYCOM	type commander
USD (P&R)	Undersecretary of Defense (Personnel & Readiness)
USUHS	Uniformed Services University of the Health Sciences
VHA	Veterans' Health Administration

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For their assistance and support in completing this project, I express my gratitude to the USS *Theodore Roosevelt* medical department. Your enthusiastic and candid cooperation was instrumental to the success of this project, while your sincere interest in the topic and findings encouraged my efforts.

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I. INTRODUCTION

The cost of healthcare has risen significantly over the past six decades, with United States national healthcare expenditures (NHE) increasing from 5% of national gross domestic product (GDP) in 1960 to 17.9% in 2016, as seen in Figure 1 (Cuckler et al., 2018). The Centers for Medicare and Medicaid Services (CMS) project these costs will continue to rise, reaching $6 trillion in the year 2026, almost 20% of GDP (Cuckler et al., 2018). Despite a growth rate that is higher than inflation, prescription drug cost share of NHE has remained relatively constant at approximately 10%, accounting for $328 billion of expenditures in calendar year 2016 (see Figure 2; Centers for Medicare and Medicaid Services [CMS], 2018). In contrast, the Department of Defense (DoD) estimates that pharmaceutical purchases will account for 18.7% of its in-house medical expenditures at DoD-owned and operated military treatment facilities (MTF) both in the continental United States (CONUS) and overseas in fiscal year 2019, with recent pharmaceutical cost history shown in Figure 3 (Department of Defense [DoD], 2018).

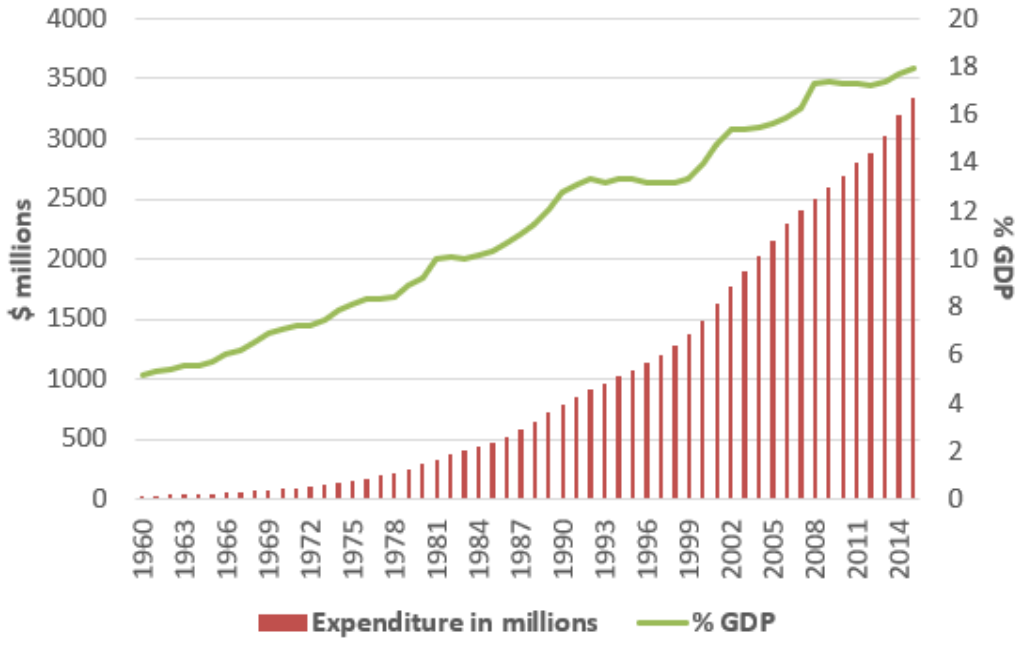

Figure 1. National Healthcare Expenditures and Percent GDP Growth 1960–2017. Adapted from CMS (2017).

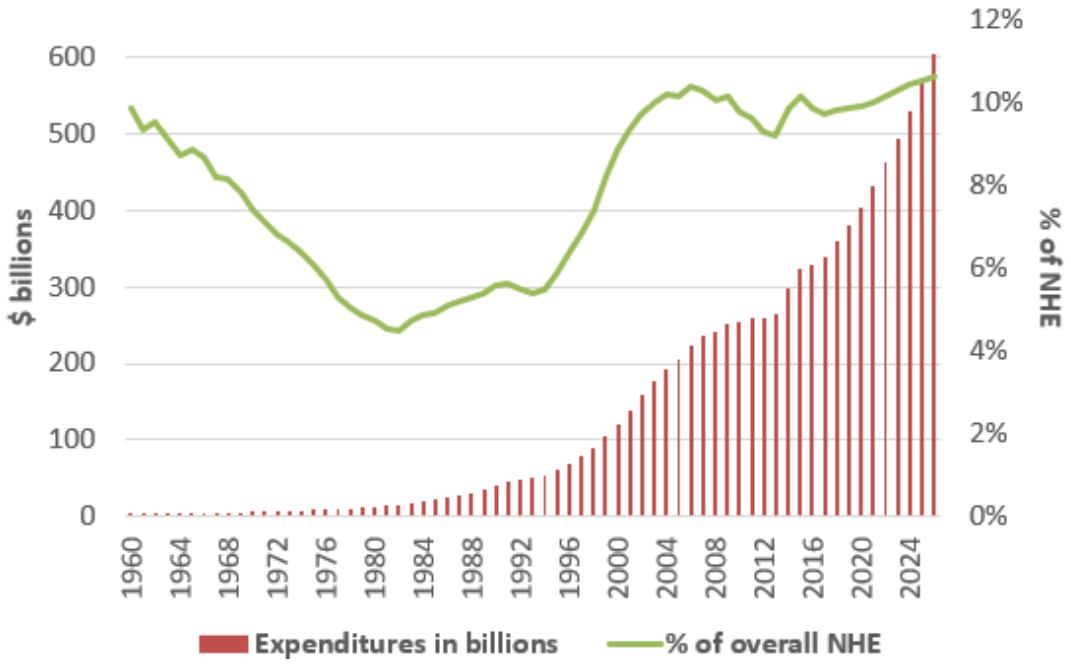

Figure 2. Prescription Drug Expenditures and % of NHE 1960–2026. Adapted from CMS (2018).

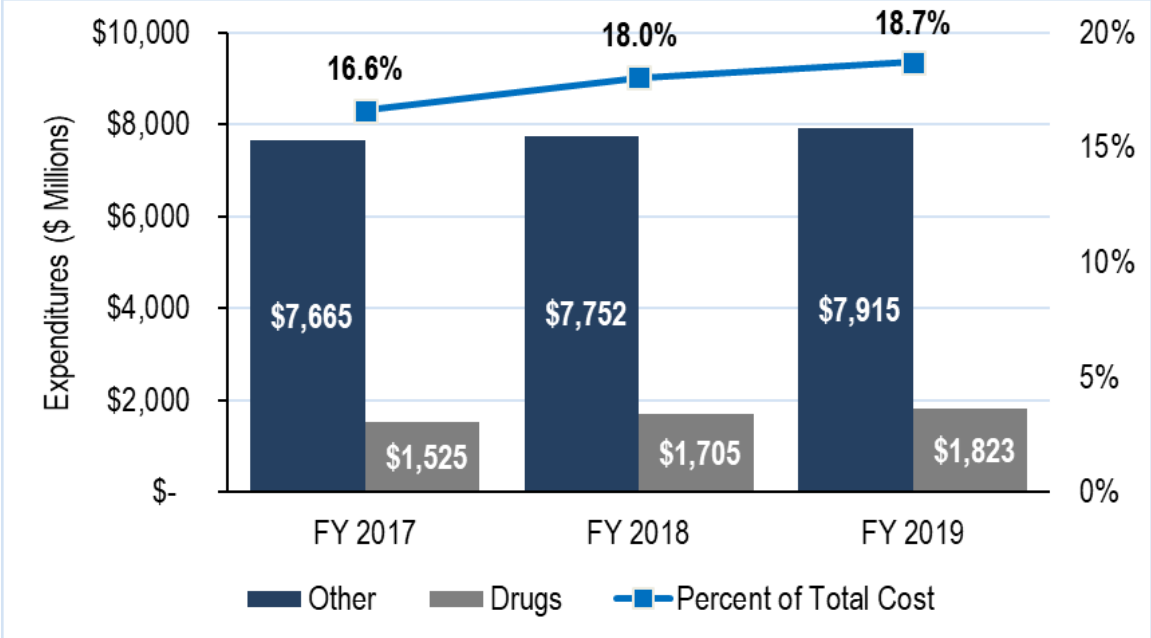

Figure 3. Trends in DoD Medication Expenditures. FY 2017–2019. Adapted from DoD (2018).

To counter these rising pharmaceutical costs, the Military Health System (MHS) implemented various cost-control measures in 2013, including inventory management efforts, brand-to-generic conversion policies, formulary restrictions, and improved contract purchasing compliance. The Defense Health Agency (DHA) centrally manages the implementation of these initiatives but local execution is the responsibility of individual MTF pharmacy departments. In combination with other cost saving initiatives, these measures have resulted in approximately $2.2 billion in cost avoidance over the last 5 years (DHA, 2018a). The DHA, however, does not directly govern shipboard medical departments and their compliance with cost cutting measures is, therefore, not required. Further, no shipboard medical department or force surgeon's staff includes a Navy pharmacist. This lack of central administrative control and involvement of subject matter experts has led to a gap in our knowledge regarding pharmaceutical inventory management processes aboard U.S. Navy ships. Without an understanding of the process and associated purchasing data, potential cost inefficiencies remain unknown. Adherence to similar pharmaceutical cost control measures in shipboard settings should produce further medical cost savings for the DoD.

A. PROBLEM STATEMENT

Recent strategic initiatives intending to reduce pharmaceutical cost outlays within the MHS have primarily focused on MTF and civilian network pharmacy costs, largely overlooking pharmaceutical costs incurred by operational units, including shipboard medical departments in the U.S. Navy. Because the MHS has delegated the implementation of these initiatives to the level of individual MTF pharmacy departments, knowledge of their existence remains within the domain of the Navy Pharmacy community with little corporate knowledge on their positive impact spreading outside of the specialty. This fact, taken in conjunction with the lack of Pharmacy Officer involvement in shipboard medical department operations or planning, results in a knowledge deficit regarding the current pharmaceutical inventory management processes and potential for improved performance and reduced costs in this environment. This study intends to fill that deficit in knowledge

by describing the current process as it exists in a representative unit and suggesting possible improvements.

B. PURPOSE STATEMENT

The purpose of this study is to characterize the process of pharmaceutical procurement, storage, and inventory management in shipboard medical departments using a descriptive case study (Yin, 2003) to identify drivers of inefficiencies as well as to generate higher level awareness for key stakeholders in Navy Medicine, the MHS, and the DoD. Specifically, I describe the current process, identify critical incidents associated with process inefficiencies or inadequacies, and develop recommendations for improvement or further study.

C. RESEARCH QUESTIONS

The primary research questions are: How do shipboard medical departments manage pharmaceutical procurement and inventory? What are the drivers of inefficiencies in these processes?

To answer this, the study incorporates the following secondary questions:

- Does the real-world process match policy?
- How can the process be improved?
- Is pharmaceutical overstock and/or understock a problem?
- Should MTF pharmaceutical cost-saving measures be implemented on ships?
- What is the role of pharmacist subject matter expertise in shipboard management of pharmaceuticals?

D. RESEARCH APPROACH AND METHODOLOGY

Good inventory management processes can significantly reduce costs (Jacobs & Chase, 2013). Pharmacist-led implementation of inventory management policies, in conjunction with additional cost saving measures, have led to significant cost avoidance at MTFs within the MHS. This paper presents a case study to characterize existing inventory management procedures of a representative shipboard medical department. I collected data from semi-structured interviews with personnel involved in the pharmaceutical ordering and inventory management process, documentation review, and observations onboard the Nimitz-class aircraft carrier, USS *Theodore Roosevelt* (CVN 71). The goal of the study is to map the pharmaceutical procurement, storage, and inventory management processes and identify potential sources of inefficiencies. My findings suggest targets for improvement and potential further quantitative study.

I chose to utilize a descriptive case study method to explore the pharmaceutical procurement, storage, and inventory management processes as they currently exist in a representative shipboard medical department. Because the context of these processes is significant, a case study is preferred over other empirical approaches, which decontextualize the phenomenon of interest (Yin, 2003). The processes cannot be considered without the operational context of shipboard medical departments. The case study method allows exploration of complex processes within their practical context through the use of various data sources, considering multiple perspectives to help guide future professional practice (Baxter & Jack, 2008). For this reason, qualitative case study is a useful tool for evaluating processes and developing recommendations. Because the intention of this research is to describe the processes associated with pharmaceutical inventory management in its real-life context, a descriptive case study is most appropriate (Yin, 2003).

The unit of analysis chosen for this study bounds the context to aircraft carriers. This class of ship has significant medical capabilities that ensure routine ordering of pharmaceuticals. Because the different classes of Navy ships have different medical capabilities and resources, the processes within those units could be different. Despite the differences, this analysis will increase awareness of potential sources of friction and

inefficiencies for all operational platforms that do not exist for shore-based MTFs; the similarities between shipboard medical department pharmaceutical management processes are greater than the differences. This study provides a step toward understanding the process in the operational environment. The choice of the USS *Theodore Roosevelt* bounds the case.

E. DATA, OBSERVATIONS, AND ANALYSIS

Because of the nature of this qualitative case study, limited data was available prior to initiating research activities. The primary tool of data collection was in-person interviews with email follow-up. I performed semi-structured interviews with military personnel assigned to the USS *Theodore Roosevelt* chosen based on their subject matter expertise and/or interaction with pharmaceutical inventory management activities onboard. Document review of organizational policies and procedures also informed the study along with a review of archival data, including order tracking data from the ship. Personal interviews, document review, and archival data analysis provided information required to develop this descriptive case study on pharmaceutical procurement and inventory management onboard the USS *Theodore Roosevelt*.

Existing literature on case study research, critical incidents, and process analysis informed the development and analysis of this case study. This research first describes the pharmaceutical inventory management processes as they currently exist for a shipboard medical department and then utilizes critical incident (Flanagan, 1954; Gremler, 2004) and qualitative process analysis (Dumas, La Rosa, Mendling & Reijers, 2013) to identify potential areas of inefficiencies and cost savings.

F. BENEFIT TO THE NAVY

The 2017 National Defense Authorization Act (NDAA) included requirements for significant reforms to the MHS. Specifically, Section 702 divests the military services of MTF administration responsibility, instead realigning these facilities under the DHA. With this change, the military service medical commands, headed by their respective Surgeons General, will refocus their efforts to operational medical support and readiness. In line with this initiative to increase active duty medical personnel focus on support of service

component medical needs, this study focuses on pharmaceutical logistics afloat, an area for which the MHS has directed relatively little organized effort and attention. By characterizing the current process, identifying areas for improvement, and making recommendations, this study will raise general awareness of an operational problem.

G. ORGANIZATION OF STUDY

Chapter II explains the organization of the MHS and the roles of Navy Medicine and Navy Pharmacy in the delivery of the military's healthcare benefit as well as key differences between shore-based medical facilities and shipboard medical departments. It also examines literature relevant to this study, including case study strategy, inventory management, critical incidents, and qualitative process analytics. Chapter III contains the case study which describes the pharmaceutical inventory management process of USS *Theodore Roosevelt*, a Coronado, California-based aircraft carrier, identifies some critical incidents described by various members of the ship's medical department relevant to this process, and a qualitative analyzes the process. The purpose is to map the process to identify potential sources of inefficiencies. Lastly, Chapter IV presents observations and recommendations for cost and time savings based on the analysis.

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II. BACKGROUND

This chapter describes the current organization of military medicine. Military medicine is unique in its dual mission of maintaining readiness and the provision of a comprehensive health benefit around the world. The readiness mission includes both the readiness of medical personnel to support operational requirements with respect to clinical and professional competency as well as the medical readiness of all forces in support of their world-wide deployability. The execution of these missions is the responsibility of the Military Health System (MHS).

After an overview of the structure of the MHS, I provide a description of the role of the Navy medical department, Bureau of Medicine and Surgery (BUMED), and the Navy Pharmacy community in the provision of pharmaceutical care. This is followed by an overview of shipboard medical departments, with a focus on their differences from fixed shore-based medical facilities.

A. MILITARY HEALTH SYSTEM

The MHS is the DoD's comprehensive, global healthcare system, serving 9.4 million beneficiaries around the world, including active duty servicemembers of the seven uniformed services, reserve component members, military retirees, and their dependents. The MHS provides direct patient care at nearly 700 MTFs administered by the individual military services, the Army, Navy, and Air Force, as well as purchased civilian health care administered by the Tricare health benefit plan (Defense Health Agency [DHA], 2018a). The MHS provides health services in a diverse array of settings including operational environments, shipboard medical departments, and remote overseas locations as well as the more traditional CONUS-based ambulatory care clinic, community hospital, and medical center as illustrated in Figure 4. It integrates combat medicine, peacetime healthcare, public health initiatives, education and training, and research and development activities (DHA, 2018a).

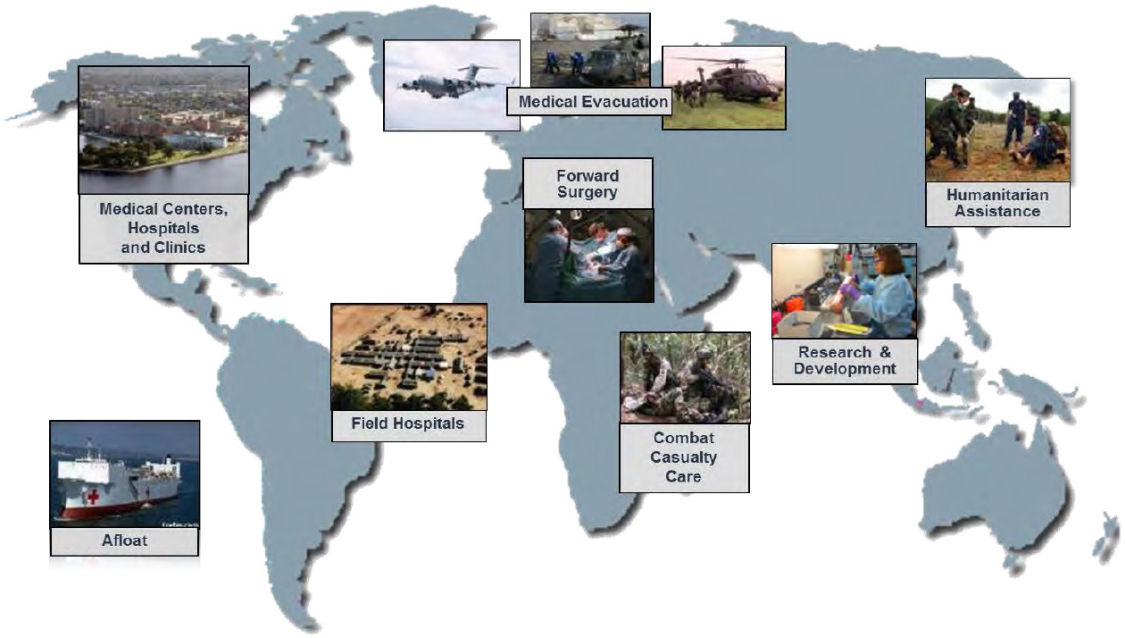

Figure 4. MHS Global Distribution of MHS Direct Care Platform. Source: DHA (2014).

The MHS employs more than 140,000 personnel in their direct care system, including active duty officers and enlisted medical personnel as well as DoD civilians and contractors. These personnel staff the 51 hospitals, 381 ambulatory care clinics, 247 dental clinics, and 251 veterinary facilities of the MHS. In fiscal year 2018, the Tricare health benefit plan contracted with over 600,000 individual civilian network healthcare providers, 3,664 hospitals, and 58,427 pharmacies to form the MHS's purchased care system (DHA, 2018a). This purchased care system functions similarly to a typical private health insurance system, with eligible beneficiaries receiving health services from contracted private sector facilities and Tricare issuing payment for pre-negotiated rates. Table 1 provides additional descriptive data for the MHS (DHA, 2018a).

Table 1. Military Health System by the Numbers—2017. Source: DHA (2018a).

TYPE OF CARE	AVERAGE NUMBER PER WEEK
Inpatient Admissions	**Total: 19,274** Military Facilities: 4,337 Network Facilities: 7,133 TRICARE For Life: 7,804
Outpatient Visits	**Total: 2,033,402** Military Facilities: 793,429 Network Facilities: 657,358 TRICARE For Life: 582,615
Births	**Total: 2,116** Military Facilities: 789 Network Facilities: 1,327
Prescription Workload	**Total: 2,288,296** Military Pharmacies: 860,507 Network Pharmacies: 442,710 Home Delivery: 155,236 TRICARE For Life: 829,843

The fiscal year 2017 budget for the MHS was $52 billion dollars, accounting for close to 10% of the overall DoD budget (DoD, 2016). In fiscal year 2017, purchased care delivered by civilian providers under Tricare contracts accounted for roughly half of MHS total costs, a trend down from previous years (DHA, 2018b). When considered separately, purchased care pharmaceutical cost as a percent of total MHS pharmaceutical costs is close to 60%. Figure 5 shows that recent initiatives have reduced purchased care pharmaceutical costs approximately 15% from almost 75% in fiscal year 2015 (DHA, 2018b). Despite this downward trend, the percent of total pharmaceutical costs represented by purchased care pharmaceutical costs remains high when compared with the percent of all health care costs represented by purchased care.

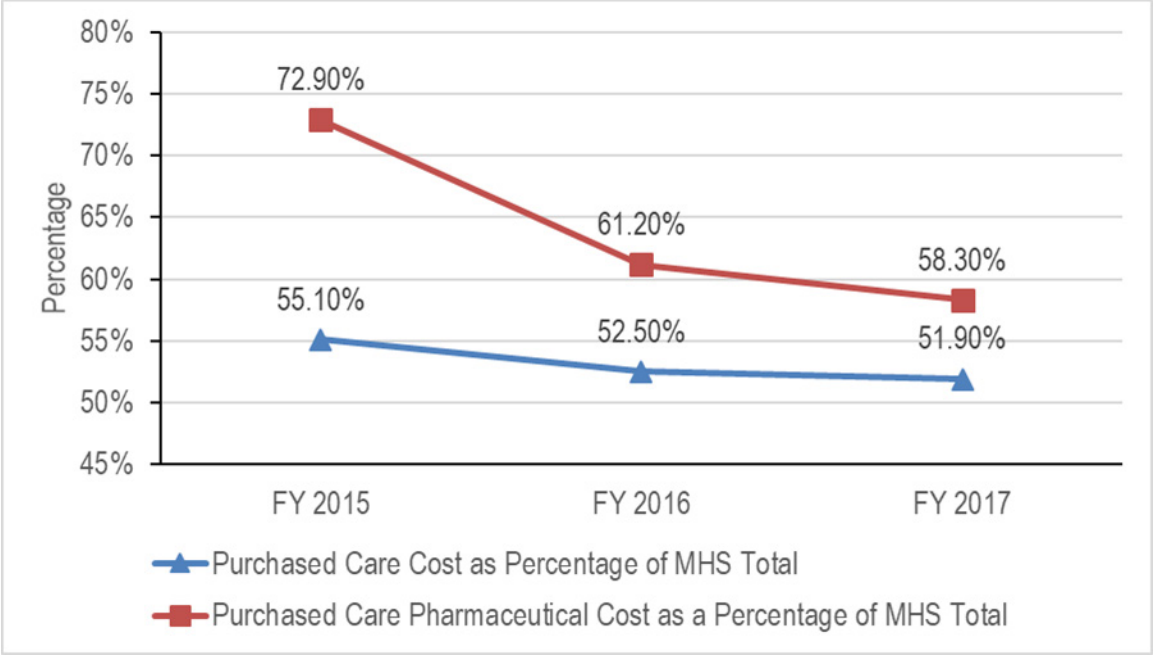

Figure 5. Trends in Purchased Care Costs as a Percentage of MHS Total, FY 2015–2017. Adapted from DHA (2018b).

1. Mission and Vision

The DoD tasks the MHS with providing a "ready medical and medically ready force" (DHA, 2018b, p. 2). Because of its unique operational support mission, the MHS has expanded upon the traditional healthcare mission of care, health, and cost with the addition of readiness to form the Quadruple Aim strategic framework (see Figure 6; DHA, 2018b):

- Increased Readiness
- Better Care
- Better Health
- Lower Cost

To achieve this mission, the MHS focuses its strategic goals on its workforce, the military services, patients, and Combatant Commands.

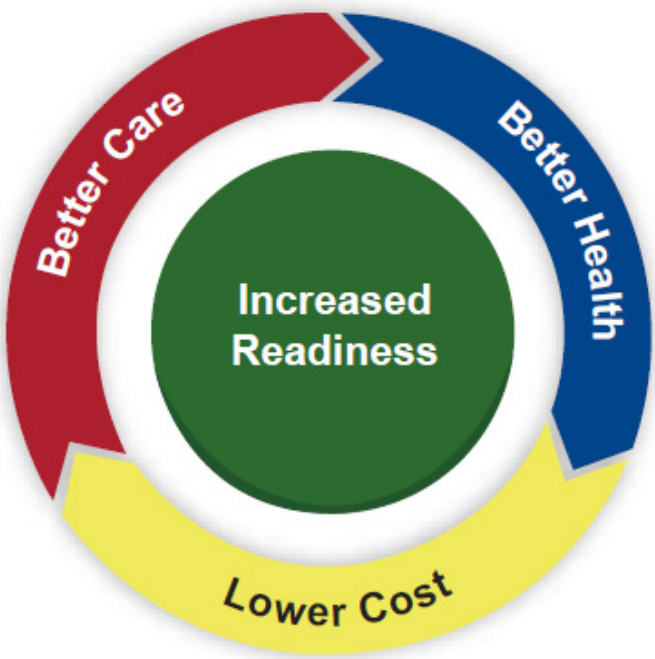

Figure 6. MHS Quadruple Aim—Strategic Direction and Priorities. Source: DHA (2018b).

2. Organizational Structure

The Assistant Secretary of Defense for Health Affairs (ASD(HA)) heads the MHS under the Undersecretary of Defense for Personnel & Readiness (USD(P&R)), however, the military department medical commands report to their respective Service Secretaries via Service Chiefs. This results in a complex organizational structure in which the ASD(HA) is responsible for integrated policy development and the military services are responsible for policy implementation, as illustrated in Figure 7 (DHA, 2014). In 2011, then Deputy Secretary of Defense established a task force to review MHS governance and make recommendations for future changes. This task force reviewed potential organizational models and recommended the formation of the Defense Health Agency (DHA) as a Combat Support Agency under the ASD(HA), responsible for management of the Tricare health benefit plan, administration of joint MTFs in the national capital region (NCR), and execution of shared service activities, termed enterprise support activities (ESAs), including (DoD, 2011a):

- Acquisition and Procurement
- Budget and Resource Management
- Education and Training
- Facilities
- Health Information Technology
- Medical Logistics
- Pharmacy Programs
- Public Health
- Research and Development
- Tricare Health Plan

Since its creation in 2011 and initial operations in 2013, the responsibilities of the DHA have continued to expand. NDAA 2017 mandated significant changes to the organization of the MHS with the intention of eliminating redundancies, improving consistency, and reducing costs. Most significantly, the act required the realignment of all MTFs under DHA administrative control. A four-phase implementation of this mandated realignment began in October 2018 with 5 MTFs in the southeast United States and will be completed in 2021 when MTFs outside the continental U.S. (OCONUS) come under the control of DHA (DHA, 2018a).

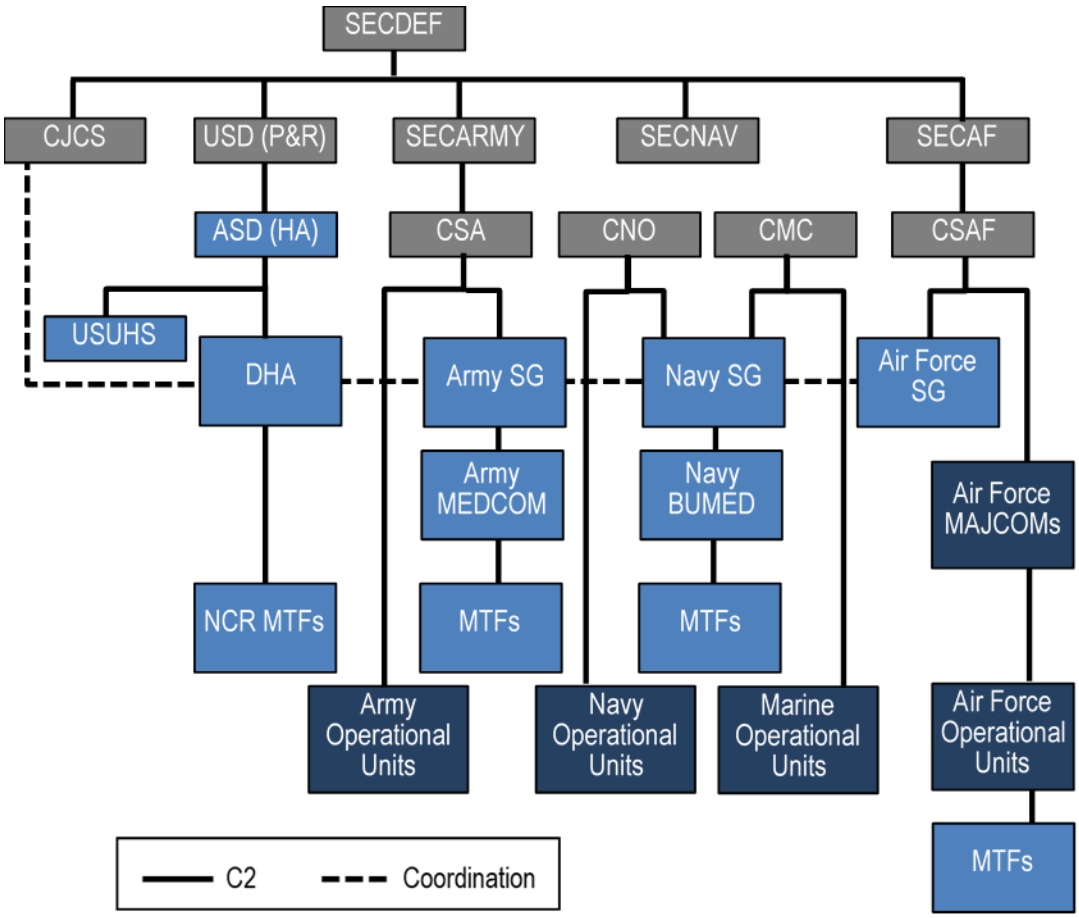

Figure 7. Military Health System Organizational Chart. Adapted from DHA (2014).

3. Defense Health Agency

DoD Directive 5136.13 established the DHA in September 2013 in response to the Deputy Secretary of Defense directed Task Force on Military Health System Governance report issued in 2011 (DoD, 2011a). The agency reached full operating capability in October 2015. Its charter defines the DHA as a Defense Agency (DA), performing medical activities common to all military services, and a Combat Support Agency (CSA), providing operational support to the Combatant Commands (DoD, 2011b). DHA is responsible for management of the Tricare health benefit plan, Defense Health Program (DHP) funds, shared medical services, and NCR MTFs (DoD, 2011b). By October 2021, DHA will manage all MTFs in compliance with NDAA 2017.

A three-star general officer heads the DHA as Director. Under the Director, nine divisions oversee the DHA's key responsibilities as shown in Figure 8 (DHA, n.d.-a).

Figure 8. DHA Organizational Structure. Source: DHA (n.d.-a).

a. Pharmacy Operations Division

DHA provides pharmacy shared service support to the medical departments of the Army, Navy, and Air Force through its Pharmacy Operations Division (POD), which was established in 2013 with the creation of the DHA. The POD is aligned under the Healthcare Operations (J3) division of DHA. The POD manages the DoD's pharmacy benefit with input from the Pharmacy Working Group, manned by the Service Pharmacy Consultants to the Surgeons General. The goal of this collaborative effort between the DHA and

military services is to integrate the direct and purchased care pharmacy benefit to ensure consistency of pharmaceutical care across the MHS's 708 worldwide military pharmacies and over 58,000 network retail pharmacies while also reducing costs. In support of this initiative, all MHS pharmacy departments integrated under the administrative control of the DHA in October 2018, regardless of the status of the parent MTF, rather than following the four-phase plan developed for each facility. The POD sets MHS pharmacy policy, monitors MHS drug usage and cost trends, manages the DoD medication formulary (list of medications available to MHS beneficiaries), supports pharmacy information technology initiatives, and works in conjunction with the Defense Logistics Agency (DLA) for pharmaceutical contracting (DHA, 2018c).

Since the establishment of the DHA in 2013, the POD has been responsible for the management and tracking of pharmacy specific cost containment measures including:

- Re-capture of prescription workload from purchased care to direct care initiatives (retail to MTF shift)
- Formulary maintenance
- Brand to generic conversion during procurement of pharmaceuticals
- Contract purchasing compliance
- MTF inventory management policies

In the first year of DHA operation, fiscal year 2014, these initiatives accounted for $215 million in cost savings, 34% above the $160 million goal (see Figure 9) (Jones, 2014). In the first full operational capacity year for the DHA, fiscal year 2015, pharmaceutical cost saving initiatives saved an additional $354.6 million, 70% more than the $208 million goal (Jones, 2014; Jones, 2016). In fiscal year 2016, the last year for which data is publicly available, these initiatives resulted in $417.9 million cost savings, 82% above the $230 million goal (McManis, 2017). The actual cumulative cost savings in fiscal years 2014 through 2016 are shown in Figure 10, with the cumulative savings goal as a comparator (Jones, 2014; Jones, 2016; McManis, 2017).

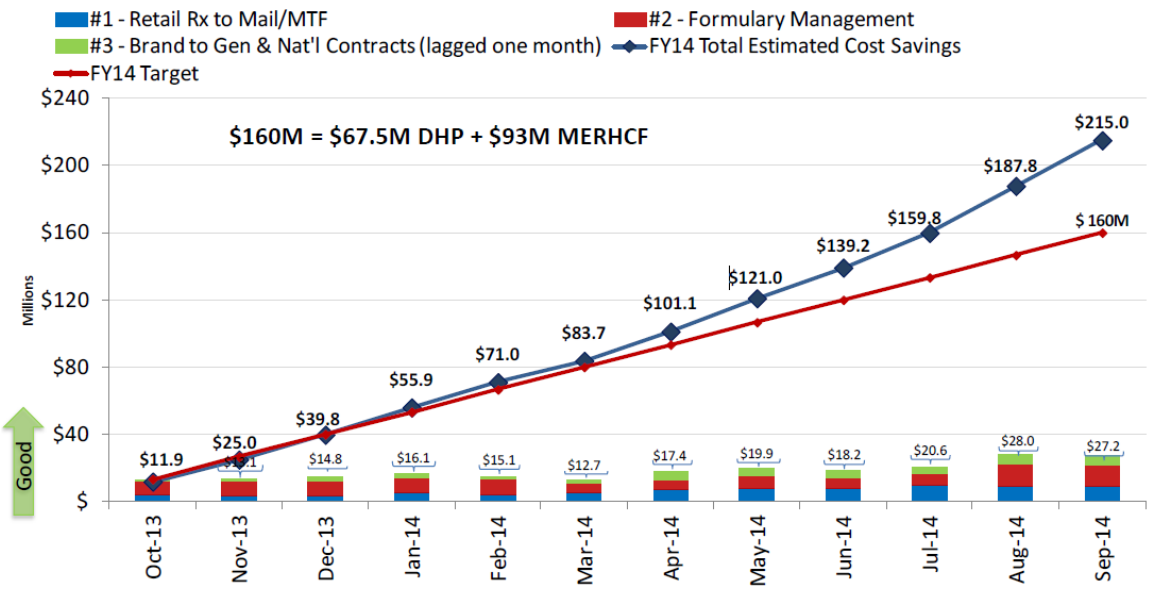

Figure 9. FY 2014 Pharmacy Savings Index. Source: Jones (2014).

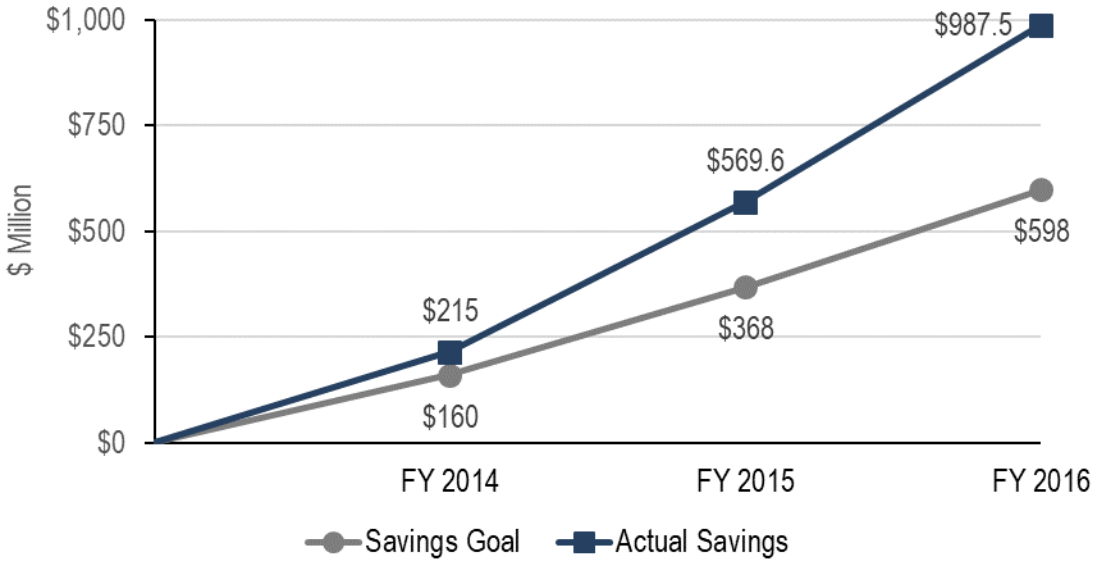

Figure 10. Cumulative Pharmacy Cost Savings FY 2014–16. Adapted from Jones (2014); Jones (2016); McManis (2017).

(1) Retail to Mail Order/MTF

There are three points of service for the MHS pharmacy benefit: network retail pharmacies, Tricare Mail Order Pharmacy (TMOP), and MTF pharmacies. The retail point of service is the most expensive of these options, with brand name drugs costing the government close to four and a half times as much at retail pharmacies when compared to MTFs and more than twice as much as mail order (DHA, 2018b). The POD has spearheaded several initiatives to shift retail prescription workload to a less expensive point of service including requirements to fill maintenance prescriptions (medications used continuously for chronic health conditions such as hypertension or diabetes) via mail order or MTF as well as increasing co-payment cost share at the retail point of service. As a result of these initiatives, the share of retail pharmacy-filled purchased care prescriptions decreased by 5%, from 24% to 19%, since fiscal year 2015 while mail order share has increased (DHA, 2018b).

(2) Formulary Management

Federal regulation implemented the DoD Uniform Formulary in 2005, which is currently administered by the DoD Pharmacy and Therapeutics Committee (Tricare Pharmacy Benefits Program, 2005). The establishment of the DHA tightened formulary management guidelines and committee schedules. The POD also made changes to the status of new Food and Drug Administration (FDA) approved medications, commonly the most expensive medications on the market, on the DoD Uniform Formulary. Historically, new drugs were automatically included and available for Tricare coverage upon approval until and unless the Pharmacy and Therapeutics Committee reviewed them for non-formulary status. Rule 2015 changed the process to put new drugs into pending status, available under non-formulary terms only, and giving the Committee 120 days to review them for inclusion (Civilian Health and Medical Program of the Uniformed Services: TRICARE Pharmacy Benefits Program, 2015).

(3) Brand to Generic Conversion

Brand name medications are significantly more expensive than their generic counterparts due to patenting and monopolistic pricing, with the average cost to the DoD

for a 30-day supply of brand at MTFs in fiscal year 2017 being $67 versus $15 for generic (DHA, 2018b). To track MTF purchasing of generic medications, the POD initiated a monthly report, which includes a small number of recently generic medications to guide pharmacy purchasing. Since the implementation of this initiative, generic drug dispensing in the direct care sector has increased from 62.6% to 74.9% of prescriptions filled at MTFs (DHA, 2018b).

(4) Contract Compliance

The DoD has entered into national drug contracts in coordination with the Veterans Health Administration (VHA) for close to 200 pharmaceutical products (DHA, 2018b). These contracted items are significantly less expensive than non-contracted substitutes. Like generic medication purchasing, the DHA began tracking and reporting each MTF's compliance with these national contracts and resulting in a slight increase in national contract utilization over last fiscal year (DHA, 2018b).

b. Medical Logistics (MEDLOG)

DLA is the DoD Medical Materiel Executive Agent (EA), managing Class VIIIA medical materiel, which includes pharmaceuticals, across the DoD (DHA, 2018d). They partner with the DHA's Medical Logistics Division (DHA MEDLOG), formerly known as the Defense Medical Materiel Program Office (DMMPO), in this role. DHA MEDLOG's stated mission is to promote standardization, interoperability, and efficiency of medical equipment and supplies across all services, which they achieve through actions of the Defense Medical Logistics Proponent Committee (DMLPC) (DHA, n.d.-b). The DHA has implemented a variety of performance metrics to improve and standardize medical logistics and monitors MTF compliance. The DHA MEDLOG Enterprise Activity coordinates with the DHA POD in pharmaceutical procurement and management for operational forces (DHA, 2018d). Additionally, DHA MEDLOG manages all medical materiel National Stock Numbers (NSN), which DLA assigns to standardize supply items routinely used in the DoD supply system (DLA, 2010).

4. Navy Bureau of Medicine and Surgery

The Bureau of Medicine and Surgery (BUMED) is an echelon 2 command headed by the Navy Surgeon General, a 3-star flag officer in the medical department and the principal advisor for Navy medical matters to the Secretary of the Navy via the CNO. With the implementation of NDAA 2017, BUMED will refocus away from the administration of the healthcare benefit at Navy installation MTFs and instead onto operational medical requirements, recruitment and training of active duty medical personnel, provision of ready medical forces, maintenance of a medical ready force, and installation support activities such as occupational and environmental health programs (DoD, 2017a).

BUMED administers the Navy Medicine program through the Manual for the Medical Department (MANMED). Officers of the Medical Department are commissioned into the Medical Corps, Dental Corps, Medical Service Corps, or Nurse Corps while enlisted members form the Hospital Corps.

The Navy Pharmacy community is one of 31 specialty communities in the Medical Service Corps, which is organized into three major categories: Healthcare Administrators, Clinical Care Specialists, and Healthcare Scientists (Department of the Navy [DON], 2018). The community consists of 128 active duty pharmacist officers, 625 active duty enlisted pharmacy technicians, along with DON civilians and contractors. These personnel staff 105 Navy MTF pharmacies in 10 different countries (T. Ha, email to author, June 14, 2018). The Pharmacy Consultant to the Surgeon General, a pharmacist in the rank of O-6, also holds the role of Navy Pharmacy Specialty Leader.

The Navy Pharmacy Advisory Board (NPAB) first implemented the Navy Pharmacy Standard Operating Procedures (SOP) Manual to standardize pharmacy processes and procedures in 2014. That Navy Pharmacy SOP outlines standard procedures for inpatient and outpatient pharmacy activities as well as pharmaceutical supply policies and procedures for fixed medical treatment facilities under the command and control of BUMED. The Navy Pharmacy SOP does not apply to non-fixed medical facilities, including shipboard medical departments pharmacies.

5. Operational Medicine

The DoD directs the military departments to provide medical support to military members through the full range of military operations (DoD, 2004). Operational medicine includes essential medical capabilities, both clinical and logistic, necessary to meet operational requirements (Whitley et al., 2016). These include combat casualty care, response to injuries from chemical, biological, radiological, nuclear, or explosive incidents (CBRNE), and other special programs such as aerospace and undersea medicine (Whitley et al., 2016). According to Dr. James Zimble, a former President of the Uniformed Services University of Health Sciences (USUHS) (Zimble, 1996, p. 187):

> The main purpose of medical support is to conserve combat power… Military medicine involves prevention, diagnosis, and treatment by medical personnel who are integrated into the operations they support.

For the Navy, the Fleet Health Services directorate for each type command (TYCOM) provides these capabilities to operational units, including shipboard and Fleet Marine Forces (FMF). A force surgeon and staff, which consists of Medical, Dental, Medical Service, and Nurse Corps officers and Hospital Corpsmen of various specialties, lead the Fleet Health Services directorate. The force surgeons also act as staff advisors to the Line and ensure operational medical departments are fully equipped and staffed with well trained and credentialed clinicians (Commander Naval Air Forces [COMNAVAIRFOR], 2012).

a. Shipboard Medical Procedures

While BUMED's Manual for the Medical Department places garrison care for operational forces under the responsibility of the Navy Surgeon General, shipboard medical care is instead the responsibility of the unit commander via their medical departments (BUMED, 2018). Shipboard medical departments are under the administrative command of their force surgeon and under the operational command of the Line via the ship's Commanding Officer (COMNAVAIRFOR, 2012). A series of instructions governs shipboard medical department policies and procedures by force type: surface, submarine, and air. These instructions standardize and guide medical operations afloat throughout the deployment cycle (COMNAVAIRFOR, 2012).

Medical capability varies significantly with ship class. Excluding hospital ships, amphibious assault ships (LHD) have the largest medical capability of all surface ships and serve as casualty receiving and treatment ships (CRTS) in amphibious operations (Surface Warfare Medical Institute [SWMI], 2016). Surface combatant ships, including guided missile cruisers and destroyers, have limited medical capability and rely on medical evacuation to a higher echelon for casualty care (SWMI, 2016).

The Commander, Naval Air Forces (CNAF) is the TYCOM for all aircraft carriers, including Nimitz-class carriers (CVN) like the USS *Theodore Roosevelt*. In this role, CNAF is responsible for the promulgation of shipboard medical department policies to guide medical care for operational forces afloat. The CNAF force surgeon accomplishes this with the Shipboard Medical Procedures Manual (COMNAVAIRFORINST 6000.1A).

CVN medical departments are responsible for the prevention and treatment of disease and injury for their crewmembers. A Senior Medical Officer (SMO) heads each medical department and advises the CVN Commanding Officer on all health-related matters. The SMO is also responsible for the administrative and material readiness of the medical department. The focus of the ship's medical department is routine, primary care and emergency response. The medical department also provides shipboard preventative, environmental, and occupational health and safety services (COMNAVAIRFOR, 2012).

b. Authorized Medical Allowance Lists

Navy operational forces must maintain a minimum quantity of medical materiel, guided by authorized medical allowance lists (AMAL), which set unit allowance standards (BUMED, 1999). The quantities of medical materiel mandated by AMALs provides enough supply for 60 days of operations (BUMED, 1999). The Naval Medical Logistics Command (NMLC) is responsible for reviewing and updating AMAL inventories (BUMED, 2012). Operational unit class, associated medical capabilities, and anticipated operations AMAL contents and quantities. AMALs facilitate standardization of inventory and interoperability within the Defense Medical Logistics (DML) system (DoD, 2017b). The ship's SMO is responsible for maintaining all medical equipment and supplies onboard (COMNAVAIRFOR, 2012).

B. LITERATURE REVIEW

The purpose of this section is to familiarize readers with methodologies and disciplines used in this report to map and analyze the pharmaceutical inventory management processes onboard the USS *Theodore Roosevelt*. This review will focus on the case study method, critical incidents, process analysis, and inventory management processes.

1. Case Study Research Strategy

Researchers can use three basic approaches to study a topic: quantitative, qualitative, or mixed-methods. The choice between strategies depends on the research question, data collection strategy, and methodology. Unlike quantitative research methods, qualitative research does not rely on the use of statistical or other mathematical analysis of numerical empirical data (Creswell, 2009). Instead it tends to focus on complex phenomenon and utilizes flexible methods to collect and analyze data in the form of words or other non-numerical types of representation (Creswell, 2009). Qualitative methods are especially useful in primarily exploratory research where the topic of study is not well understood (Creswell, 2009).

Case study is a type of qualitative research in which the context of the research topic is significant. It allows for an in-depth study of a particular situation that leads to holistic understanding of complex, real-life events using a variety of data sources. The use of case study is appropriate when the researcher has no control of the behavior of study participants or events and the context of the phenomenon of study is relevant (Yin, 2003).

Despite the advantages discussed above, case study as a research strategy also faces some criticism. In addition to concerns about the value of practical knowledge generated from case study, generalizability of single case outcomes, and ability to test hypotheses in case study, critics focus on potential preconceptions and biases of case study researchers and their potential to influence analysis. Researchers can counter this claim by using methodical, systematic procedures when conducting case study research (Yin, 2003). There are six steps in performing systematic case study research, shown in Figure 11.

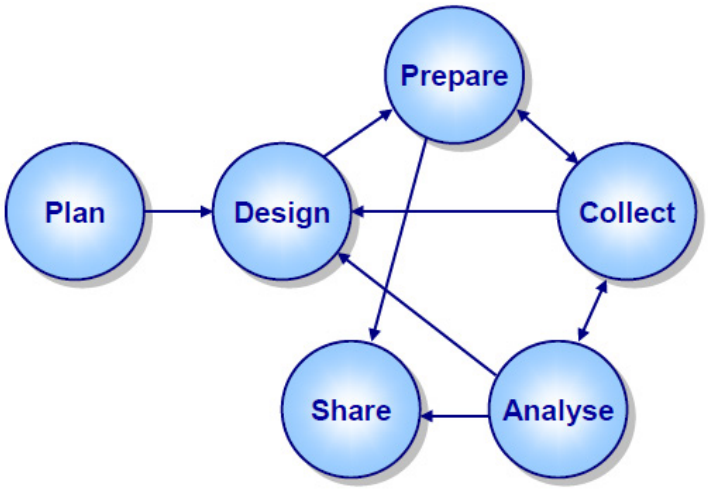

Figure 11. Steps in Case Study Research. Source: Baškarada (2013).

a. Plan/Define

In the planning stage of a case study, like other research strategies, the researcher must first define the research problem and identify the research question (Yin, 2003). The research question and study objectives must support case study as an appropriate research methodology, which the U.S. General Accounting Office (GAO) describes as "a method for learning about a complex instance…in its context" (GAO, 1990, p. 15). There are three main types of case studies researchers can consider. Exploratory case studies are preliminary studies used to help define research questions and hypotheses (Yin, 2003). Descriptive case studies focus on a sample in depth to reveal patterns (Mills, Durepos, & Wiebe, 2010). Lastly, explanatory case studies test theories by investigating causal relationships (Baškarada, 2013). The research question defined in this phase will help determine which type of case study is appropriate.

b. Design

Research design links the research questions with the data to be collected. The design of a case study includes the research question(s), propositions, unit of analysis, data collection, and data analysis methods. These components must provide a logical sequence for meeting the study objectives (Yin, 2003).

c. Prepare

Because of the absence of a routine formula for carrying out a case study, it is one of the most difficult research methodologies and researchers must be adequately prepared (Yin, 2003). In the preparation phase, the researcher develops the case study protocol, gains relevant approvals, and identifies and mitigates potential issues in the study design (Baškarada, 2013). Additionally, the researcher must become familiar with the study domain to facilitate real-time adjustments to data collection if they become necessary (Yin, 2003).

Good case study research requires the researcher to possess certain critical skills including the ability to ask questions, be a good listener, be flexible and adaptable, have a sufficient grasp of the research topic, and be unbiased (Yin, 2003). Researchers should utilize the preparation phase to assess their ability in these areas and remediate gaps.

d. Collect

In this phase, researchers carry out the approved study protocol collecting data from documents, archival records, interviews, direct or participant observation, and physical artifacts (Yin, 2003). In general, the use of multiple sources of data with convergence of evidence will increase the validity of the case study outcomes (Yin, 2003).

e. Analyze

The analyze phase of a case study requires the researcher to focus on relevant collected data to address the study's initial propositions (Yin, 2003). The GAO describes the observe, think, test, revise (OTTR) concept for data analysis, an iterative process that occurs during data collection and continues until the researcher has a plausible explanation, there is no unexplained data, or new data will not lead to new insights (GAO, 1990).

f. Share

The final phase of a case study presents the researcher's findings to the intended audience (Baškarada, 2013). The goal of the case study report is to provide the audience with the information necessary to make their own conclusions (Yin, 2003).

2. Critical Incident Technique

The critical incident technique (CIT) is a qualitative method for gathering important information on the topic of study through direct observation, survey, or interview (Flanagan, 1954). Flanagan first defined incidents as being critical when they are observable and have definite consequences (Flanagan, 1954). Since its inception, however, researchers in a variety of disciplines have utilized CIT in diverse ways, highlighting the technique's flexibility. Most commonly, researchers collect information on critical incidents through interviews, which helps remove researcher bias and preconception as interviewees provide information on what they perceive to be the most significant incidents. CIT is beneficial for investigating processes because it helps identify inefficient or ineffective tasks at the user level and is particularly suited to solving practical problems.

In his original work, Flanagan defines and describes the five steps of CIT as establishing a general aim, creating plans and specifications, collecting data, analysis, and reporting (Flanagan, 1954). These steps mirror those described for case study research above, but the techniques used in collecting and interpreting data differ. Unlike the case study, where the objective is to understand a phenomenon holistically, in a CIT study the researcher focuses on incidents that contribute significantly to the phenomenon of study. Researchers primarily collect data through interviews, which ensures that the incidents discussed are the most relevant to the topic of investigation from a user perspective (Gremler, 2004).

3. Qualitative Process Analysis

Processes include the events, tasks, activities, and decisions that transform inputs into outputs. Process design affects both quality and efficiency of process outputs. Business process management (BPM) seeks to improve outcomes through the BPM life cycle of process identification, discovery, analysis, redesign, implementation, and monitoring. Process analysis can be quantitative, using specific performance measures, or qualitative. Qualitative analysis aims to reduce waste and identify weaknesses in business processes. This type of analysis helps to identify and prioritize areas of interest for process redesign (Dumas, La Rosa, Mendling, & Reijers, 2013).

a. Value-Added Analysis

Value-added analysis requires classifying process steps, identifying unnecessary tasks, and eliminating waste. This requires also understanding the intended process outcome. Steps are value-added if they directly contribute to the intended outcome for either the customer or the organization (Dumas et al., 2013).

b. Root Cause Analysis

Root cause analysis identifies the cause of an undesired outcome in a process. Typically, root cause analysis requires interviewing stakeholders to gather multiple perspectives on the cause of the outcome to develop cause-effect (or fishbone) diagrams and why-why (or tree) diagrams (Dumas et al, 2013). Figures 12 and 13 present diagram templates.

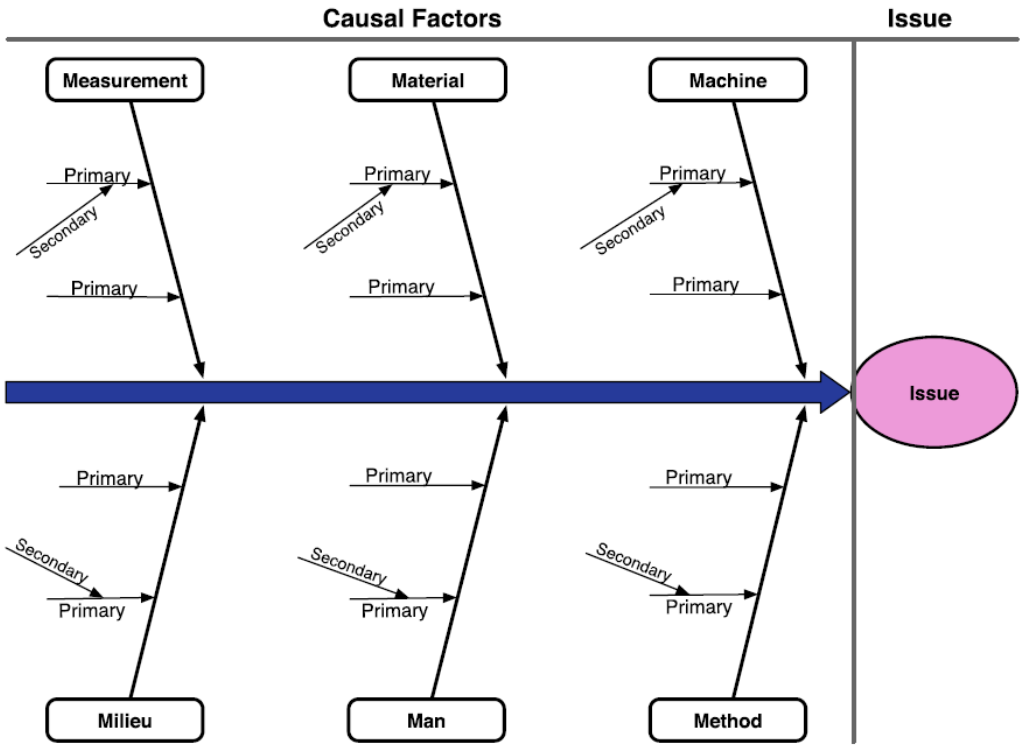

Figure 12. Cause-Effect Diagram Template. Source: Dumas et al (2013).

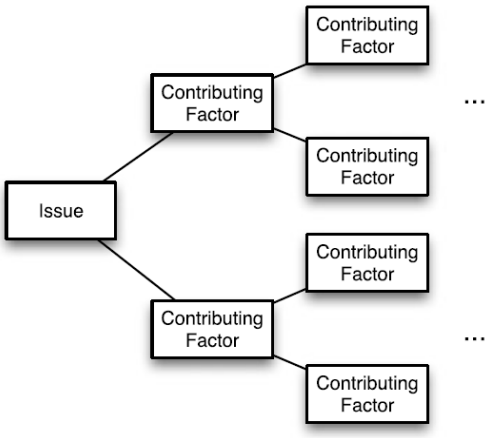

Figure 13. Why-Why Diagram Template. Source: Dumas et al (2013).

4. Inventory Management

Inventory management processes reduce costs and increase customer satisfaction by balancing the costs of overstock with the costs of shortages (Jacobs & Chase, 2013). These processes specify both when and how much inventory to order. Methods for managing inventory typically fall into one of two categories on the basis of their time periodicity. Periodic inventory management processes rely on physical tracking of inventory on a specified schedule while continuous processes require real-time tracking of inventory. In general, periodic inventory methods are fixed-time and continuous inventory methods are fixed-quantity (Jacobs & Chase, 2013).

a. Inventory Management Definitions

1. Re-order point. Inventory level at which a new order should be placed.
2. Lot Size. Quantity of inventory received at replenishment.
3. Safety Stock. An amount of inventory carried in excess of expected demand to buffer against variability.
4. Lead Time. Time elapsed between order placement and order receipt.
5. Cycle Count. Physical count of on-hand inventory on a more frequent basis than once a year (Jacobs & Chase, 2013).

b. Periodic Inventory Management

Periodic inventory management systems require inventory cycle counts at specified time periods. In these models, the order quantity varies while the time between orders stays the same (Jacobs & Chase, 2013). An example periodic inventory management policy is the *s, S* policy. The *s, S* policy is a minimum/maximum inventory policy in which *s* is the reorder point (minimum) and *S* is the order up to level (maximum). In this system, the inventory position is reviewed after a set time period and an order is placed if the level is at or below *s*. The order quantity brings the inventory back up to *S* and varies based on how far the inventory level falls below the reorder point at the time of replenishment.

c. Continuous Inventory Management

Continuous inventory management systems require tracking of inventory levels on a perpetual basis. These systems have constant order quantities and varying order times (Jacobs & Chase, 2013). An example continuous inventory management policy is the economic order quantity (EOQ), or (Q, R) model. The EOQ model is a fixed replenishment point and quantity policy. In the model, an optimal order quantity (Q*) that minimizes total inventory costs is ordered whenever the on-hand inventory level falls below a certain point (R).

d. Pharmacy Inventory Management

The literature supports the use of three basic approaches for management of pharmaceutical inventory: visual review, periodic, or continuous (Ali, 2011). The below section describes these approaches, including advantages and disadvantages (Galka, 2016).

(1) Visual Review

Visual review of pharmaceutical inventory is a low cost, convenient, and informal method of inventory management. Pharmacies utilizing this method keep a list of medications as they fall below a set minimum level throughout the day. Staff typically compile this list by adding items as they use them then generate an order based on the list at the end of the day. Despite its advantages, this system has significant risk of stock outs due to lack of systematic rigor. The visual review method is typically used by small

pharmacies with low workload volume and inventory levels (Bouldin, Holmes, & Garner, 2011).

(2) Periodic Review

The periodic review method is similar to visual review, with the exception of incorporating a planned periodicity for counting inventory instead of only when used during normal pharmacy operations. For more commonly used items the review period can be shorter than slower moving items. The periodic review method is also inexpensive to implement but requires larger safety stock to cover review periods (Bouldin et al., 2011).

(3) Continuous Review

The continuous review method for pharmacy inventory management is also known as perpetual inventory. This method requires tracking inventory losses as staff fill and dispense prescriptions and updating on-hand counts in real time via electronic interface. In this process, the system automatically places an order once the on-hand inventory reaches the re-order point. This method is advantageous because it reduces risk of stock out and allows for robust analysis of inventory data, however, cost for implantation can be prohibitive (Bouldin et al., 2011).

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III. USS *THEODORE ROOSEVELT* (CVN 71)

This chapter describes my visit to the USS *Theodore Roosevelt* (CVN 71), a Nimitz-class aircraft carrier, at its homeport in Coronado, California, and characterizes its pharmaceutical inventory management processes. It is based on data collected through 8 interviews with both medical and supply department crewmembers, archival documents and data, and observations. Archival documents included order and request forms, while archival data included pre-collected information on order tracking history. While onboard, I discovered the general sentiment of the medical department staff was that the processes as they currently exist are cumbersome, not comprehensive, and complex, which can negatively affect patient care. This section first gives an overview of the ship's medical capabilities and pharmacy services, then describes the pharmaceutical management processes as explained in the seven interviews that took place during my visit, identifies the critical incidents that interview respondents reported, and provides qualitative analysis of the process.

A. MEDICAL DEPARTMENT

The medical department of the USS *Theodore Roosevelt* includes surgical, intensive care, and general inpatient medical capabilities. Limited laboratory, pharmacy, and radiology ancillary services are also available to support these capabilities (SWMI, 2016). The focus of the medical department is on prevention, crew medical readiness, primary care, and first response. Additionally, the medical department provides forward resuscitation and in theater hospitalization when underway (COMNAVAIRFOR, 2012). Tables 2 and 3 expand on the ship class's staffing and medical capabilities while Figure 14 shows a generic representation of a CVN medical department's organizational chart. These represent the operational status of a CVN medical department with embarked air wing and temporary duty anesthesia provider during underway periods.

Table 2. Nimitz-Class Medical Department Complement, Including Embarked Air Wing. Adapted from SWMI (2016).

Corps	Staffing
Medical Officer	5
Dental Officer	5
Nurse Officer	2 (including CRNA)
Medical Service Officer	5
Hospital Corpsmen	47

Table 3. Medical Capabilities of Nimitz-Class Aircraft Carriers. Adapted from SWMI (2016).

Capability	Staffing
Operating Room	1
Intensive Care Unit Beds	2
Ward Beds	52
Ancillary	Laboratory, Radiology, Pharmacy
Additional Services	Preventative Medicine, Biomedical Repair, Radiation Health, Psychology, Optometry fabrication

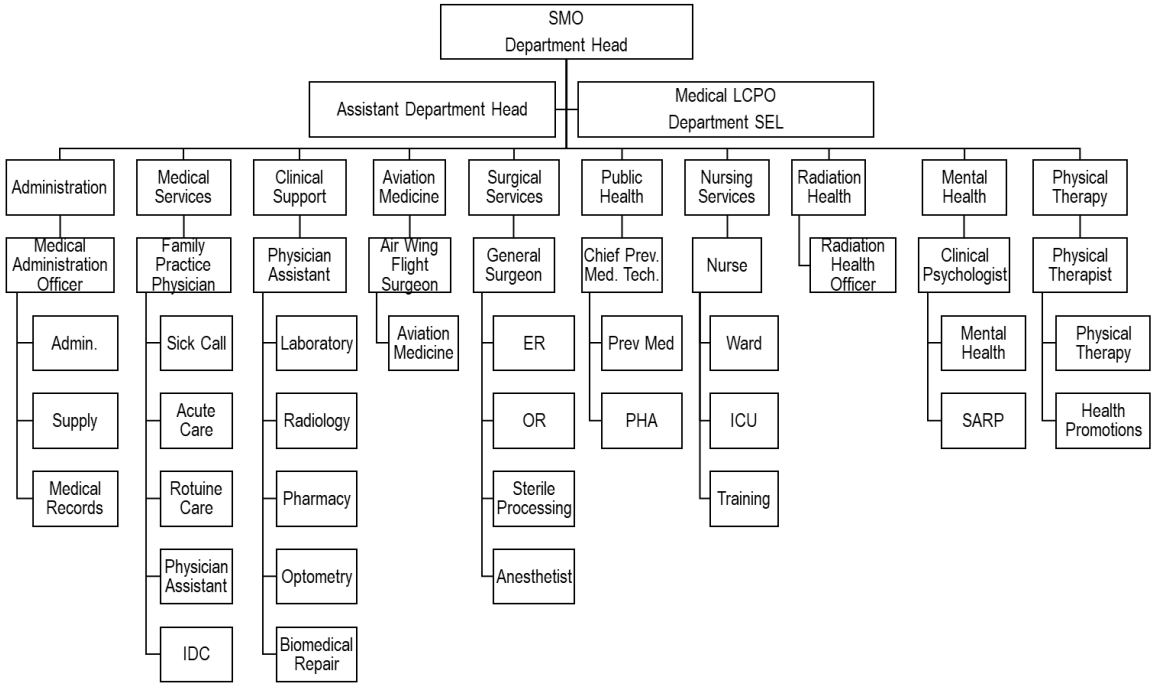

Figure 14. Medical Department Organizational Chart. Source: COMNAVAIRFOR (2012).

The USS *Theodore Roosevelt*, like all Nimitz-class aircraft carriers, has a single billeted pharmacy technician (NEC 8482). There are no licensed Pharmacy Officers assigned to either the ship's medical department or the TYCOM force surgeon's staff. Provision of pharmacy services depends on coverage from general duty corpsmen with pharmacy technician provided pharmacy training (USS *Theodore Roosevelt*, 2018). The ship's physician assistant heads the pharmacy as pharmacy officer in charge. Pharmacy policies and procedures are guided by a locally developed medical department standard operating procedures manual, which references the Navy Pharmacy SOP for a variety of best pharmacy practices (USS *Theodore Roosevelt*, 2018).

The stated mission of the pharmacy is "to provide for the pharmaceutical needs of embarked personnel with acute illnesses or injury while in port or underway" (USS *Theodore Roosevelt*, 2018, p. 10). The pharmacy provides routine services during normal working hours while in port. When underway, the pharmacy also provides 24-hour emergency and inpatient services. The pharmaceutical inventory maintained onboard is intended to fulfill acute medical needs, emergency response, and new initiation of maintenance medications (USS *Theodore Roosevelt*, 2018).

B. PHARMACEUTICAL ORDERING PROCESS

This section describes the fundamental process for managing pharmaceutical inventory, ordering, and receiving pharmaceuticals. It starts with a basic overview of the various information technology systems used in these processes, followed by a step-by-step guide for non-controlled pharmaceuticals, and, finally, a discussion of non-routine processes.

1. Information Technology Systems

The USS *Theodore Roosevelt* uses a variety of systems to help manage its pharmaceutical supply. Electronic Catalog (ECAT) is the primary system used for the procurement of non-controlled pharmaceuticals, while R-Supply is primarily used for controlled pharmaceuticals and vaccines. Defense Medical Logistics Standard Support (DMLSS) Maritime supports inventory tracking.

a. ECAT (Electronic Catalog)

ECAT is an online ordering system developed and supported by the Defense Logistics Agency's Medical Supply Chain Division. It facilitates ordering and payment of medical supplies from various manufacturers and distributers through a single portal. DLA negotiates volume discount prices for items included in ECAT and prices presented to each ECAT customer are "Total Delivered Prices," which include all delivery and administrative costs (DLA, n.d.). As of October 2017, ECAT is the primary tool for fleet procurement of pharmaceuticals purchased under the prime vendor contract (DLA, 2017).

b. R-Supply (Relational Supply)

R-Supply is an internet-based logistics application used by operational Navy and Marine Corps platforms. It has inventory, logistics, and financial management capabilities including ordering and receiving, maintaining financial records, and issuing materials (Naval Supply Systems Command [NAVSUP], 2005).

c. DMLSS (Defense Medical Logistics Standard Supply) Maritime

DMLSS Maritime is a component of the Maritime Medical Modules (MMM) information technology package, formerly known as SAMS, that tracks pharmaceutical inventory and expirations dates by AMAL. DMLSS Maritime users must update on-hand inventories manually in the system. The DMLSS inventory is used to track the medical department's readiness.

d. Cardinal Health

Cardinal Health is the U.S. Navy's Fleet Pharmaceutical Prime Vendor (PPV). The Cardinal Health web portal is no longer utilized for order placement to their regional distribution centers in favor of ECAT as of October 2017, however, it remains available to fleet medical departments for use of online tools and reports, including the ability to check for inventory availability at the local distribution center (DLA, 2017).

2. Inventory Management: Non-controlled Pharmaceuticals

The AMAL system results in a modified *s, S* inventory management policy that sets the AMAL level as the minimum inventory level (*s*) that triggers reorder (or reorder point). Document review did not uncover any fleet-wide standard maximum inventory level (*S*) for operational units using the AMAL system. In the case of the USS *Theodore Roosevelt*, local policy sets the pharmaceutical inventory *S* level at 110% of AMAL level (USS *Theodore Roosevelt*, 2018). Practically, this results in AMAL levels functioning as safety stock.

Non-controlled pharmaceuticals are the most commonly ordered product type. The following process, therefore, represents the most common actions of the pharmacy technician for pharmaceutical procurement.

a. Inventory Process

The pharmacy technician is responsible for maintaining required pharmaceutical inventory, as defined by the AMALs assigned to all Nimitz-class aircraft carriers. On the USS *Theodore Roosevelt*, the technician maintains three AMALs: Pharmacy (3034), Crash Cart (3054), and Force Health Protection (3005). The appendix displays the contents of the 3034 Pharmacy AMALs as it existed in August 2018. Regardless of a pharmaceutical's status on a required AMAL, the technician maintains updated inventory records of all on-hand pharmaceuticals in DMLSS-Maritime. Inventories of non-AMAL medications are tracked within DMLSS as "9999" inventory.

There is no fleet-wide procedure for pharmacy inventory processes, in contrast to the Navy Pharmacy, which provides policies and procedures for all fixed MTF pharmacies. COMNAVAIRFORINST 6000.1A (July 2012) describes minimum cycle count policies for AMAL items as required at SMO turnover, six months prior to deployment, and annually (COMNAVAIRFOR, 2010). Because this periodicity is insufficient for consumable medical supplies, including pharmaceuticals, local policy requires the pharmacy technician to perform monthly inventory reviews and build orders for needed items at that time as defined by AMAL requirements. Additionally, because the technician is aware of daily usage and operations, they are able to place intermittent orders for

replacement items immediately after use. This blends the visual and periodic review methods for pharmacy inventory management. DMLSS-Maritime, however, is intended to maintain a perpetual, or continuous, inventory, leading to mismatch between the process and the evaluation of the process. The technician begins the ordering process after identifying needed items.

b. Ordering Process

First, the pharmacy technician accesses ECAT via web browser. The technician searches for pharmaceuticals in need of replenishment via National Stock Number (NSN) and adds the quantity needed to achieve 110% AMAL quantity to an electronic cart. Once a full order is built in ECAT, the pharmacy technician must "park" the order cart and notate the cart number provided by the system. The current pharmacy technician restricts each ECAT order cart to approximately 10 line items.

Next, the technician fills out a supply microrequest form via Microsoft Excel, including the ECAT cart number. Figure 15 shows the pharmacy technician's view of the electronic microrequest form. After completion, the technician prints a hardcopy form and routes it for signature and approval. A medical department Repair Parts Petty Officer (RPPO), a hospital corpsman in the rank of E-5 or above who is responsible for managing AMAL inventories per instruction (COMNAVAIRFOR, 2012), and the Pharmacy Division Officer or Department Head must sign the microrequest form before the Supply Department (S-1 Division) will accept it. The pharmacy technician must physically walk all microrequest forms for signature and eventual submission to the S-1 division.

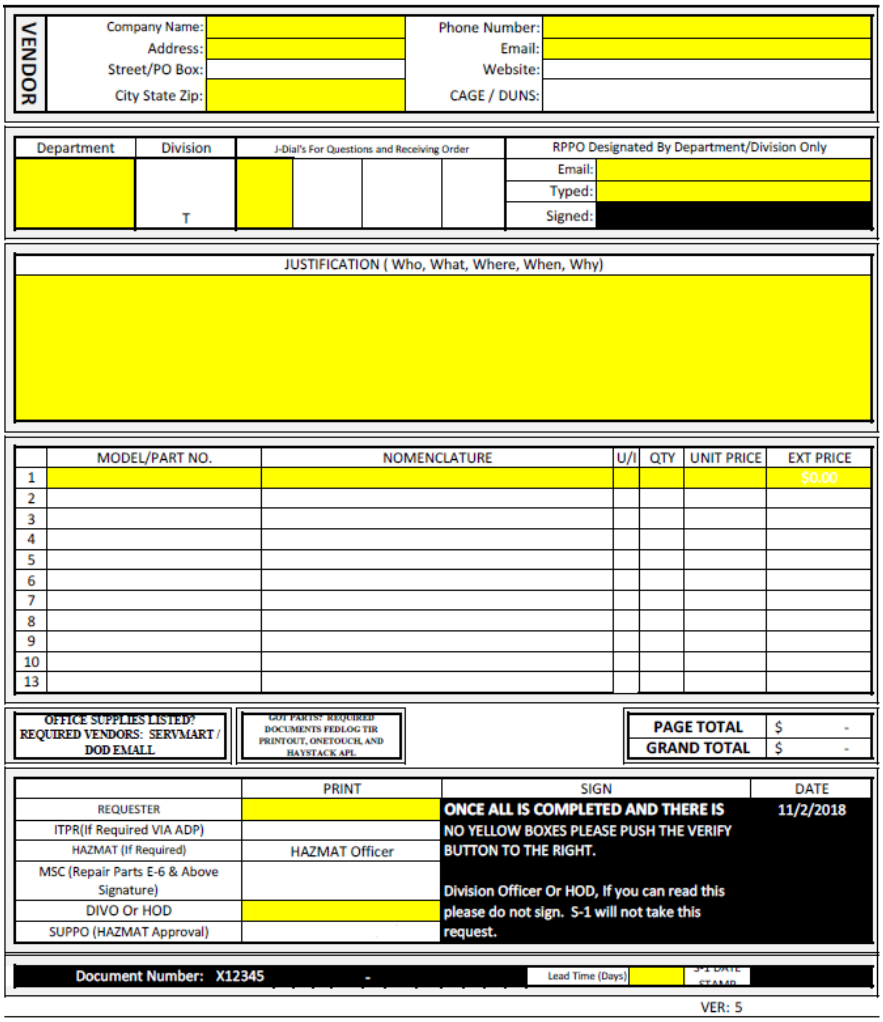

Figure 15. Micro Request Form

Once a complete microrequest form is presented to supply, S-1 provides a document number (or requisition number) for the ECAT order. A document number is a unique reference number to identify a transaction throughout the supply chain (DLA, 2012). When a document number is issued, funds also become obligated for the order. After receiving a document number, the pharmacy technician enters the number into ECAT for the parked cart and then submits the order electronically.

c. Order Feedback

After order placement, the pharmacy technician receives order information feedback from DLA's Defense Supply Center in Philadelphia (DSCP) via email from the

ECAT helpdesk. This follow-up includes information on the ability of the PPV to fulfill the order request. The PPV automatically cancels orders for items that cannot be filled at the time of request due to non-availability at the distribution center assigned to the ordering location under a "fill-or-kill" policy (DLA, 2017). This policy allows for partial fulfillment if a quantity less than the order quantity is available, providing that the vendor cancels remaining unfilled quantities (DLA, 2017). The DSCP order information email includes information on items the vendor "killed" in full or in part. The pharmacy technician must re-order those items the vendor cancelled, starting the process over from the beginning. Funds obligated for the cancelled items are not de-obligated at this point due to lack of interface between ordering and funding technologies.

d. Order Tracking

The pharmacy technician onboard the USS *Theodore Roosevelt* has developed and implemented a local policy for tracking pharmaceutical orders. After completing the steps in the ordering process described above, the technician records order information in a Microsoft Excel Workbook. Figure 16 provides a sample view of this workbook. Information recorded in this document includes item, quantity ordered, cost, cart number, document number, and date ordered. The technician also records the date of order receipt when available. The workbook also includes notes regarding partial or non-fulfillment of order and whether the order was placed via credit.

ITEM DESCRIPTION	REQUISTION #	QTY ORDERED	QTY FILLED	CART #	ORDER PLACED	ORDER RECEIVED	DOCUMENT #	NOTES
ALEVE 220MG CAPLET 100S	R212478156A005	5	5	06052018-xxxxxx	6/5/2018	6/14/2018	xxxx-xxxx	
LOW-OGESTREL-28 TABLET 28S	R212478156A006	8	8	06052018-xxxxxx	6/5/2018	6/14/2018	xxxx-xxxx	
CYCLAFEM 1-35-28 TABLET 28S	R212478156A007	10	10	06052018-xxxxxx	6/5/2018	6/14/2018	xxxx-xxxx	
TRIAMCINOLONE 0.1% OINT 15G	R212478156A008	48	24	06052018-xxxxxx	6/5/2018	6/14/2018	xxxx-xxxx	
CIPRODEX OTIC SUSP 7.5ML	R212478156A009	36	36	06052018-xxxxxx	6/5/2018	6/14/2018	xxxx-xxxx	
ATROPINE 0.1MG/ML ABBOTJECT 10ML	R212478156A010	5	5	06052018-xxxxxx	6/5/2018	6/14/2018	xxxx-xxxx	
EPINEPHRINE 0.1MG/ML SYRINGE 10ML	R212478156A011	10	2	06052018-xxxxxx	6/5/2018	6/14/2018	xxxx-xxxx	*PARTIAL
LIDOCAINE 1%-EPI 1:100,000 20ML	R212478156A012	3	0	06052018-xxxxxx	6/5/2018	6/14/2018	xxxx-xxxx	*REJECTED *re-ordered 12 Jun 18
MAGNESIUM SULFATE 50% VIAL 2ML	R212478156A013	2	0	06052018-xxxxxx	6/5/2018	6/14/2018	xxxx-xxxx	*REJECTED *re-ordered 12 Jun 18
CALCIUM CHLORIDE 10% SYRNG 10ML	R212478156A014	3	0	06052018-xxxxxx	6/5/2018	6/14/2018	xxxx-xxxx	*REJECTED *re-ordered 12 Jun 18

Figure 16. Partial View of USS *Theodore Roosevelt* Pharmaceutical Order Tracker

e. Receiving Process

Local policy informs the pharmacy technician that pharmaceutical orders should be received within 5 business days; however, the Fleet PPV contract mandates that the vendor will deliver the order to the contracted receiving location on the next business day between 0700 and 1000 (DLA, 2017). The contracted delivery location for the USS *Theodore Roosevelt* is the DLA Distribution Center in San Diego, California, which is located on Naval Base San Diego (NBSD) approximately 9 miles from the ship's pierside location. Along with all other supplies destined for the ship, the distribution center processes these pharmaceutical orders and directs them to a warehouse on Naval Air Station North Island (NASNI). Supply personnel assigned to the Beach Deck are responsible for retrieving these supplies from the NASNI warehouse, located across the street from the ship, and delivering them to the S-8 division, Shipping and Receiving.

Once the pharmacy technician receives notification that a pharmaceutical order has arrived on the ship, they retrieve them from the hangar bay. The technician reviews the receipted items by verifying quantity received and expiration date of the items, adds the received inventory information to DMLSS, and posts the receipt to ECAT. They must also report any discrepancies in items or quantities received in ECAT at the time of receipt posting. Finally, the technician records the delivery date in the order tracker.

3. Non-routine Ordering Processes

Although the above process represents the majority of pharmaceutical procurement activities, there are a variety of non-routine processes as well. Those processes are discussed here.

a. Non-AMAL Medications

The process for ordering non-AMAL non-scheduled medications differs from AMAL processes in one important way. Before ordering a medication that is not on one of the ship's AMALs, the medical department must first get approval from TYCOM, Naval Air Forces Pacific Fleet. An officer of the ship's medical department must submit

justification for ordering the requested medication, routed through the SMO. Approvals are valid for 2 years.

b. Controlled Substances

Controlled substances cannot be ordered through the ECAT system. The pharmacy technician must instead use R-Supply. Currently, the ship's pharmacy technician does not have access to this system.

c. Immunizations

Similar to controlled substances, immunizations must be ordered through R-Supply. The current order delivery process for items procured through ECAT does not support the maintenance of cold chain receipt, storage, and management requirements for immunizations, increasing the risk of product loss.

d. Pre-deployment Prescription Process

The intent of pharmacy AMALs is to provide pharmaceutical coverage for acute illness, first response, casualty care, and the initiation of new medications (USS *Theodore Roosevelt*, 2018). Crewmembers must obtain long-term medications through a shore-based pharmacy, either at an MTF or via mail order. To facilitate this process prior to deployment and reduce the risk that personnel will run out of needed medications while underway, the DoD Pharmacoeconomic Center provides shipboard medical departments with a unit-specific Pre-Deployment Medication Analysis and Reporting Tool (PMART) report of current medications for all crewmembers. The medical department uses this report to place new 180-day supply prescriptions for fill prior to deployment. Crewmembers can fill these prescriptions at an MTF or via mail-order (COMNAVAIRFOR, 2012).

C. CRITICAL INCIDENTS

Descriptions of critical incidents arose, frequently unprompted, throughout the interview process. Interview subjects tended to describe the processes in terms of situations where it has failed in the past. Of note, healthcare providers not involved in the actual ordering of medications but nonetheless impacted by their availability, described a number of critical incidents not directly related to inventory management or procurement processes but instead impacted by their failures. I describe these incidents below, both those directly related to process failures and those that the process impacted.

1. AMAL Item Availability

Because AMALs define inventory requirements by NSN, the product required to fulfill AMAL requirements can be fairly restrictive. NSNs identify commercial pharmaceuticals by their National Drug Code (NDC), which is unique to a manufacturer specific item. For example, NSN 6505-016-18-9132, which is an item required for the 3034 Pharmacy AMAL, is associated with the branded formulation of the general anesthetic propofol in a concentration of 10 mg/mL and 20mL volume. If this item becomes unavailable for purchase, the ability of the pharmacy technician to substitute a generic formulation of the same medication or a different volume container to meet the clinical need depends on the central management of that item number at the DHA MEDLOG level and whether it has been linked with all pharmaceutically equivalent products. If not, the DMLSS inventory of the 3034 Pharmacy AMAL will reflect a deficiency of their AMAL quantities, despite having an appropriate substitution in stock.

A direct observation of this type of event occurred during my visit. An intravenous antihistamine medication required for use in allergic reaction, diphenhydramine 50mg/mL, was unavailable in the prefilled syringe formulation required by the 3034 Pharmacy AMAL due to national backorder. The ship acquired a clinically appropriate substitute, vials of the same medication, concentration, and volume. Despite this, DMLSS would not accept the medication as equivalent, leading to inaccurate reporting of the ship's readiness and additional administrative burden for the pharmacy technician to track true AMAL deficiencies outside of DMLSS-Maritime.

2. Non-AMAL Medication Ordering

The current pharmaceutical ordering process allows for individual ships to request permission for off-AMAL purchasing from their TYCOM. Local policy allows TYCOM approval for non-AMAL medications to remain valid for 2 years. However, the short tours and condensed turnover for the single pharmacy technician billeted has resulted difficulty maintaining the appropriate documentation and timelines for these medication approvals. Additionally, approval of non-AMAL medication requests at the TYCOM level does not ensure Pharmacy Officer consultation, who, as subject matter expert, could ensure that the exact item approved is preferred based on pricing or storage requirements.

One interviewee described a situation where a non-AMAL medication carried in the pharmacy, while clinically appropriate, was not cost-efficient and the documentation associated with its approval was not available to justify the added cost. In this case, the non-AMAL item was a 1-gram package of the antibiotic azithromycin. This package size corresponds with a commonly prescribed course of therapy for this medication, as opposed to the 30-count bottles already on the 3034 Pharmacy AMAL. Using this pre-packaged formulation is more convenient for the dispensing staff, but also safer, as medication dispensing in shipboard medical departments is often performed by non-pharmacy technician corpsmen. However, the cost of procuring the approved item was significantly more than that of the AMAL medication. Despite the still relatively low cost, this incident provides an example of a situation in which a Pharmacy Officer subject matter expert could have offered a more optimal choice to ensure convenience, safety, and cost efficiency for this clinical need.

3. Controlled Substance Delivery

Because controlled substance ordering follows a different process than non-controlled substances, there are differences in order receipt as well. Orders for controlled substances must be placed via R-Supply and are not delivered in recognizable pharmaceutical packaging, resulting in misdirection of orders to non-pharmacy spaces. In one described instance, this difference in pharmaceutical delivery led to an order for

controlled substances being distributed to non-medical, administrative spaces. Pharmacy received the items when administrative staff recognized the mistake.

4. Obligated Funds for Cancelled Orders

Orders placed via ECAT obligate funds when assigned a document number, which occurs prior to order placement. Because of the PPV contracted "fill or kill" policy, orders for items not available at the time of submission from the local distribution center retain obligated funds despite their cancellation. There is no communication between the ECAT ordering system and R-Supply, where the Supply department obligates funds. Upon receipt of the order, the pharmacy technician enters information in ECAT regarding non-filled items, but this does not remove funding.

5. Pre-deployment Medication Process

Prior to deployment, the medical department requested a PMART report for their crew and placed new 180-day prescription orders for all long-term medications via Tricare Mail Order Pharmacy in accordance with COMNAVAIRFOR 6000.1a. Despite following the procedures, the ship did not receive all the requested medications in time for deployment, which resulted in duplicating the effort at Naval Medical Center San Diego pharmacy. Additionally, the PMART report did not include medication profiles for embarked air wing personnel, which resulted in medication shortages for this population while underway.

6. AMAL Deficiencies

After a recent underway period, cruise reports described the AMAL as "not anesthesia friendly." Per reports, items included on AMALs are outdated or incompatible and ignore the need for specific anesthesia care to the point of omitting current standard of care medications. The process for acquiring non-AMAL medications required to meet standard of care was lengthy and required constant input from the anesthesia provider. Because this provider is not permanently attached to the ship, the risk associated with having a process dependent on their actions to meet medical needs during operations is

significant. The additional process required to obtain medications to meet anesthesia standard of care is also not in accordance with the intent of the AMAL system.

D. QUALITATIVE PROCESS ANALYSIS

This section presents the results of pharmaceutical ordering process identification and discovery onboard the USS *Theodore Roosevelt*, value analysis classification of the process steps, and root cause analysis for poor process outcomes in the form of cause-effect diagram.

1. Process Flow Diagram

Discovery of the as-is pharmaceutical ordering process relied heavily on interviews. Figure 17 illustrates the described ordering process for non-controlled pharmaceuticals in a process flow diagram. This diagram represents only the pharmacy functional area, with steps required by other areas, such as supply or DSCP, not included. Examples of these activities include obligating of funding, tracking document numbers, and retrieval from the on base warehouse. The steps taken by other functional areas can increase process cycle time, which ultimately impacts the medical department. However, they are also not within the department's direct control for process improvement. Focusing the process diagram on medical department functions also focuses the analysis on their personnel, resources, and time management to determine options for improved efficiencies within medical administrative control.

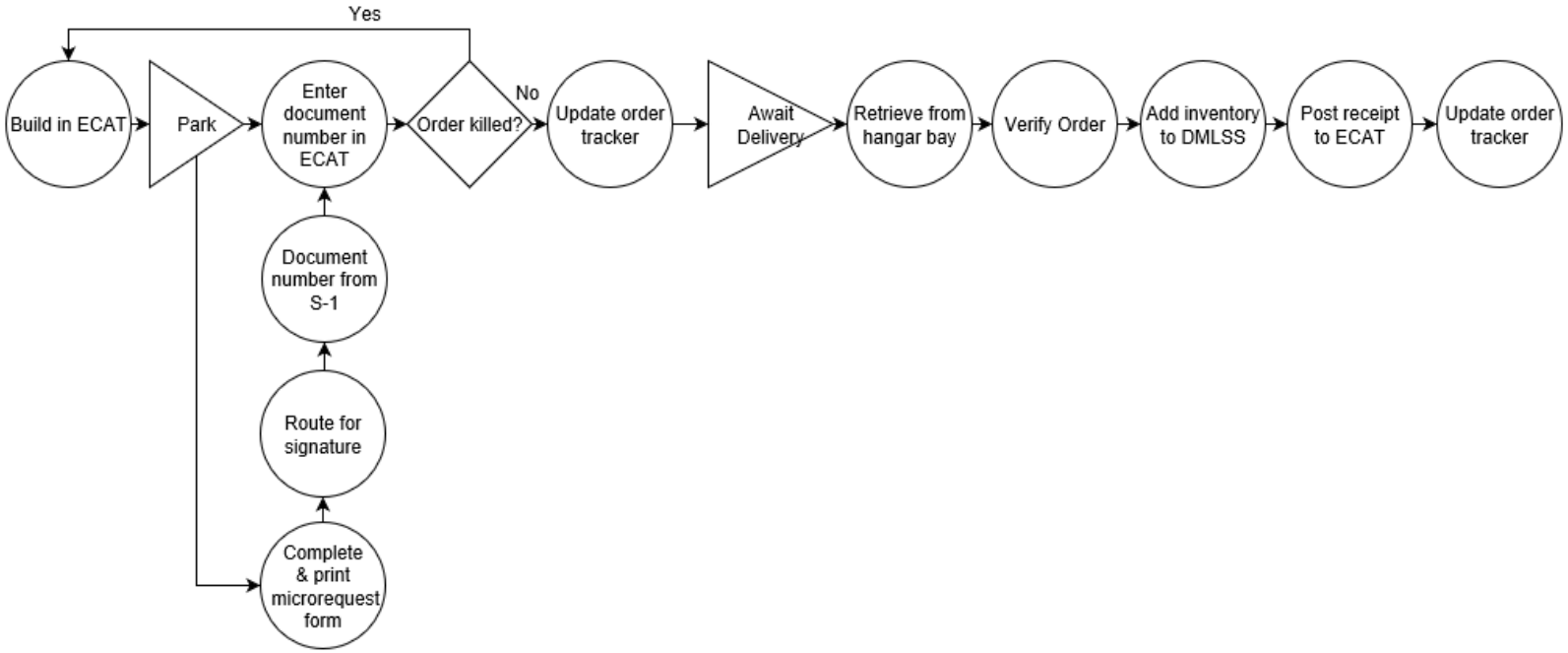

Figure 17. Process Flow Diagram for Ordering Non-controlled Pharmaceuticals

2. Value-Added Analysis

After mapping the current ordering process, qualitative analysis allowed the classification of each step by their value added. Steps that contribute to maintaining necessary on-hand pharmaceutical inventory or steps that contribute to process performance management are value added, while those that duplicate efforts or result in unnecessary wait times are non-value added (Dumas et al., 2013). Dumas et al makes further distinction in value added steps, classifying those that contribute to outcomes as "value added" and those that aid in performance management as "business value added," but for the purpose of the analysis below I combine both into a single "value added" classification. Table 4 presents the results of this classification, with some critical non-pharmacy steps included in italics. This classification facilitates future attempts at waste management. Organizations should eliminate non-value added steps whenever possible to improve process efficiency. They should also critically evaluate value added steps necessary for process management to determine their continued value to organizational goals (Dumas et al., 2013). I present recommendations for eliminated non-value added steps and evaluating process management value added steps in the next chapter.

Table 4. Classification of Pharmaceutical Ordering Process Steps

Step	Classification
Build in ECAT	Value added
Park	Non-value added
Complete microrequest form	Non-value added
Print microrequest form	Non-value added
Route microrequest form for signature	Non-value added
Submit microrequest for to S-1 *Assigned document number*	Non-value added *Value added*
Enter document number in ECAT	Value added
Update order tracker	Value added
Await delivery *Receive at NBSD warehouse* *Transfer to NASNI warehouse* *Retrieve from warehouse*	Non-value added *Non-value added* *Non-value added* *Non-value added*
Retrieve from hangar bay	Value added
Verify order	Value added
Add inventory to DMLSS	Value added
Post receipt to ECAT	Value added
Update order tracker	Value added

3. Cause-Effect Diagram

While interviewing personnel involved in or impacted by the pharmaceutical ordering process a repeated concern for process failure focused on medication shortages while underway, either actual or potential. Figure 18 organizes potential causes for medication shortages into a cause-effect, or fishbone, diagram.

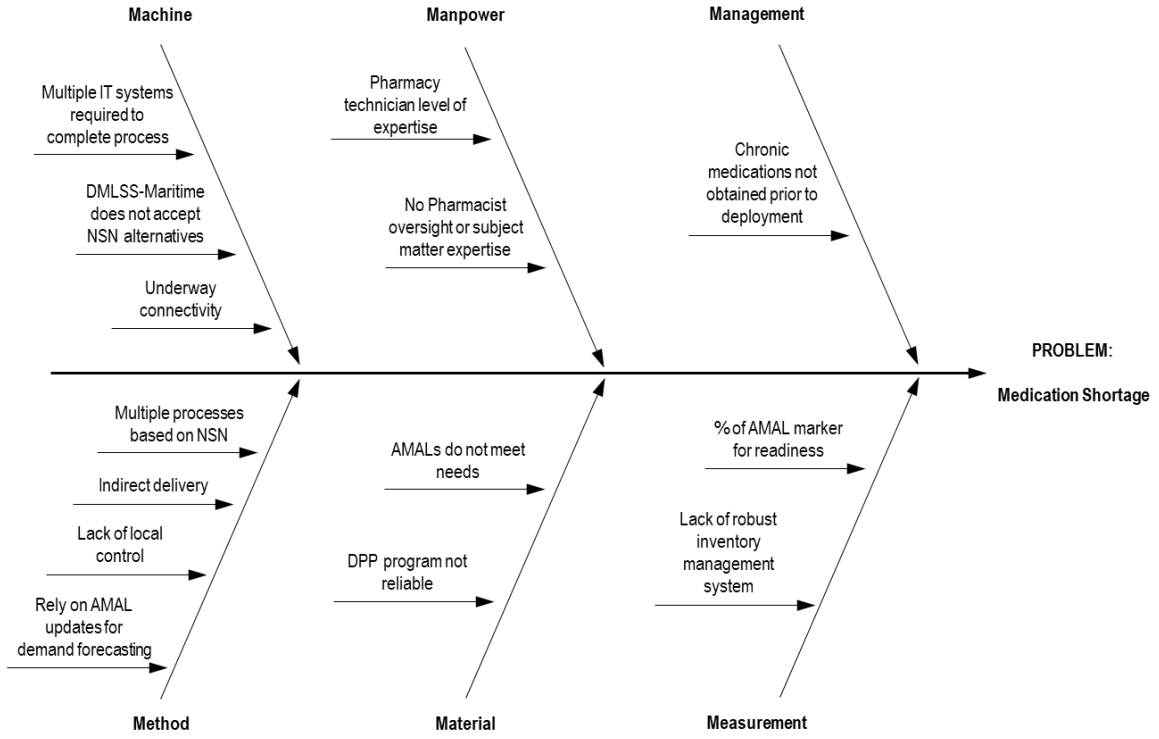

Figure 18. Cause-Effect Diagram for Medication Shortages

a. Machine

The use of multiple IT systems to procure needed pharmaceuticals adds a level of complexity that increases risk of process failure. For example, the training required for the pharmacy technician to obtain access to R-Supply is lengthy, resulting in a current gap in pharmacy ability to place orders for non-routine medications independently. Also, the "fill or kill" order policy results in obligated funds and ECAT tracking for items that the vendor has canceled. The pharmacy technician must separately maintain order cancellation information and email feedback via local offline systems to keep an accurate picture of

pipeline inventory. Similarly, because DMLSS-Maritime frequently does not accept appropriate clinical substitutes as fulfilling AMAL requirements, offline administrative procedures must track actual on-hand AMAL inventories in the case of national shortages. Finally, connectivity problems prevent order placement, as all ordering pathways are web-based.

b. Manpower

The single pharmacy technician receives all information on processes and responsibilities, including those for managing and procuring inventory, during turnover with their predecessor. There are no operational pharmacy SOPs that define pharmaceutical procurement processes to the individual task level. The expertise of the pharmacy technician is extremely significant for medication procurement.

The lack of Pharmacy Officer involvement in operational pharmacy services is systemic, with no pharmacists on any shipboard medical department or force surgeon staff. Pharmaceutical procurement is one of the essential functions of a pharmacist. The lack of this subject matter expert in both planning and implementation of pharmaceutical inventory management processes represents a significant risk for process failure.

c. Management

Crew non-compliance with policies requiring procurement of their chronic medications prior to operational deployment can put significant strain on pharmacy inventory. The intent of AMAL quantities is to provide enough supplies for acute and new onset medical problems. Expanding pharmacy services to provide chronic medications to both ship's company and embarked airwing will increase the risk of medication stock outs.

d. Method

The process for managing pharmaceutical inventory and placing replenishment orders varies based on medication type. Even for some non-controlled, non-refrigerated items the routine ordering process is insufficient, as the vendor repeatedly cancels orders for some items without explanation. In these cases, and other non-routine processes, the risk for stockout increases. Additionally, the lead time for medication orders can be

extremely variable, despite next business day delivery by the vendor to the contracted location. This is because there are several steps between the delivery destination and final receipt by the pharmacy department. As this lead time increases or becomes more variable, potential for shortages goes up. There is also a risk of product loss due to misplacement, misdirection, or theft with this delivery setup. The ability of the medical department to locally control their pharmaceutical ordering and delivery process also presents additional challenges, with communication having to flow through DSCP to and from the vendor and through Supply to and from the warehouses. Having these intermediaries can cause delays that increase shortages. Lastly, AMAL updates should be based on forecasting for medication demand. Reliance on these AMAL updates for demand forecasting introduces risk at the unit-level if they are not performed in a timely manner consistent with operational needs.

e. Material

One of the most significant risks for medication shortages occurs if the AMAL items and quantities are not appropriate or sufficient for medical needs. Because all pharmaceutical procurement is based on AMALs, an error or omission at this level will very likely result in medication shortages. In addition, for patient-specific medications needed on an ongoing basis, the reliability of the Deployment Prescription Program is essential to ensure medication shortages do not occur.

f. Measurement

The use of AMAL fill percentage to determine shipboard pharmaceutical readiness does not directly measure the potential for medications shortages in a real-life operational context. The lack of a robust pharmaceutical inventory management system, with enterprise-wide data on days of stock, lead time, and product use measures increases the risk of medication shortages, as inventory decisions are based on intermediate measures instead.

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IV. CONCLUSIONS AND RECOMMENDATIONS

This chapter provides conclusions and recommendations for potential process redesign to improve overall performance of shipboard pharmaceutical inventory management and proposes future potential research activities to further our understanding of pharmaceutical inventory management in operational units. Several factors limited this research study. First, the time limitation for data collection required binding the case to a single unit, which reduces generalizability of findings. Additionally, binding the case resulted in the disregard of external process steps that may impact recommendations and conclusions. Lastly, difficulty in acquiring quantitative data to support observations prevented triangulation of conclusions from another data source. Despite these limitations, however, this study provides a holistic view of real-life pharmaceutical inventory management processes for an operational shipboard medical department and provides foundational understanding of a problem.

A. CONCLUSION

This research presented a descriptive case study of Nimitz-class aircraft carrier, USS *Theodore Roosevelt*, based on interviews and archival documentation to answer the question, how do shipboard medical departments manage pharmaceutical procurement and inventory and what are the drivers of inefficiencies these processes? By identifying critical incidents associated with process failure and qualitatively analyzing the process design, this study provides preliminary understanding in an area of corporate knowledge deficit in Navy Pharmacy community, facilitating the development of recommendations for improvements and potential areas of future research.

B. RECOMMENDATIONS

Based on a review of critical incidents, process mapping, and qualitative process analysis, this study uncovered numerous areas for improvement of pharmaceutical inventory management processes. Recommendations for process redesign can largely be carried out at the unit level for the USS *Theodore Roosevelt*, however, additional

recommendations require systemic level changes, which should be validated against other ships before implementation.

1. Process Redesign

Qualitative analysis revealed several steps in the USS *Theodore Roosevelt*'s pharmaceutical ordering process that do not provide direct benefit to the process outcome. These include both non-value added activities that result in process delays and business value added activities that aid with performance management but do not directly impact outcomes. The increased cycle time caused by these additional steps increase the risk of medication shortages, as was experienced when pre-deployment medications were not received prior to the ship's underway period.

Process redesign includes reducing or removing non-value added process steps, evaluating process management steps, and adding new steps to meet an organizational need. The following recommendations provide options for local, unit-level increases in efficiency in pharmaceutical procurement.

a. Remove Non-value Added Activities

There are two points in the pharmaceutical ordering process that result in non-value added delays: the requirement to route a paper request form through the medical department chain of command to Supply for document number assignment and the steps between the next business day delivery of ECAT orders at the contracted destination and ultimate receipt by the pharmacy. Both represent points in the pharmaceutical ordering process that diverge significantly from fixed pharmacy department processes. Although there may be systematic differences that necessitate this difference, USS *Theodore Roosevelt* leadership should critically evaluate these non-value added steps for potential change.

The delay imposed by the routing of a microrequest form through a medical department RPPO, Division Officer, and Supply can be significantly reduced, if not eliminated. As the subject matter expert for pharmacy procurement onboard the ship, the pharmacy technician has delegated authority and responsibility for maintaining appropriate

pharmaceutical AMAL inventory per the medical department's pharmacy SOP. Incorporating a request procedure to carry out these assigned normal operations has no additional value. The medical department should consider working with Supply to remove this requirement, bringing the process in line with fixed MTF pharmacy operations, in which designated pharmacy technicians have full authority to procure medications in accordance with command formulary and guidance without such restrictions. The value added through the procedure is solely in the assignment of a document number for the order and accompanying obligation of funds. Efforts should be made to provide the pharmacy department with the ability to acquire document numbers to obligate medical department operating target funds independently, to any extent possible.

Delivery of pharmaceutical orders to the Defense Distribution Center on Naval Base San Diego not only extends lead time and increases variability, but also reduces security of pharmaceutical products, which must now pass through multiple hands before reaching their final destination. While in port, this process is non-value added. Because the PPV contract allows for pharmaceutical delivery only between the hours of 0700 and 1000 on business days, delivery at the pier to medical department personnel only should be achievable. Also, prime vendor order delivery is fully predictable, as the contract also requires next business day delivery. Changing this process, however, is the purview of DLA, who owns the Fleet Pharmaceutical Prime Vendor contract. If DLA does not authorize a delivery destination change or the change proves otherwise infeasible, the USS *Theodore Roosevelt* should work with the distribution center directly to develop processes for medical department pickup of pharmaceutical orders or other resolution that will prevent excess movement of medications and increase delivery reliability.

b. Evaluate Process Management Activities

The primary process management activities in the pharmaceutical ordering process as it currently exists are related to maintaining the local order tracking system. This system provides important information on pipeline inventory, lead time, order cancellation, and costs for both operational and managerial decision making. The pharmacy should evaluate whether other available reporting functions, such as those potentially available within

ECAT, meets the organizational need of this tracker, which will allow the removal or streamlining of these steps.

c. Additional Steps

The pharmacy may consider additional process steps if necessary to meet an organizational need. For example, although the Cardinal Health website is no longer used for placing pharmaceutical orders in favor of ECAT, access to the website remains available. Adding a routine check of inventory levels via this PPV website prior to building an order in ECAT will reduce vendor order cancellation due to "fill or kill," allow prospective identification of suitable alternatives, and prevent obligation of funds to unavailable items. The added upfront work will reduce the need for rework. If the increased workload associated with this step outweighs the avoided rework associated with cancelled orders, this change should be implemented.

2. Pharmacy Manpower and Training

Pharmacy technicians reporting to shipboard medical departments routinely fill one of one billets, necessitating a comprehensive pharmacy skillset to meet all pharmaceutical service needs, including pharmaceutical logistics. For example, critical incident analysis has shown that medication backorders can complicate the use of the AMAL system when item availability cannot be guaranteed, and the pharmacy technician must be able to mitigate these shortages using the various contingency plans developed by DLA and DHA MEDLOG in the appropriate clinical context. The Navy Pharmacy community, in conjunction with SWMI, DLA, and other relevant entities, should develop a broad training plan for preparing prospective shipboard pharmacy technicians for these responsibilities. This training plan should include thorough instruction on the various pharmaceutical procurement procedures and their associated rules, regulations, and contracts. Similarly, in the absence of a licensed Pharmacy Officer, more generalized training should be developed for the medical department officer placed in charge of the pharmacy operations to ensure compliance with federal regulation and familiarity with safe and standard practices.

In addition to a robust technician training program, Fleet Health Services directorates and BUMED should consider direct inclusion of Pharmacy Officers in the

planning and execution of shipboard pharmacy operations. This can be in the form of a position on fleet surgeon staffs, designation as fleet liaisons through billet coding, or requiring Pharmacy Officer assist visits or temporary additional duty assignments prior to deployment to assist with pharmaceutical purchasing, crewmember deployment medication procurement, and pharmacy operations. Regardless of avenue, the shipboard responsibilities of the assigned Pharmacy Officer must be prioritized over shore-based duties in support of operational need.

3. Pharmacy AMAL Update

Research findings clearly suggest that current pharmaceutical AMAL inventories are insufficient for necessary medical and surgical when underway. For example, a review of critical incidents revealed the lack of standard anesthesia medications, necessitating remediation via off-AMAL procurement prior to deployment to ensure the medical department was ready to provide standard of anesthesia care. To resolve this problem, and uncover other potential deficiencies, a complete overhaul of the Pharmacy AMAL must be performed, with updated forecasting and modeling based on real-life data. This should include shipboard pharmaceutical purchasing and expiration data as well as information on medical and surgical procedures performed underway in the recent past. To ensure AMAL inventories continue to meet continuously updating standards of medical care, Navy Medicine and Fleet Forces should consider establishing a pharmacy and therapeutics committee of licensed medical, surgical, pharmacy, nursing, and physician assistant practitioners to administer the pharmaceutical AMALs in an interdisciplinary fashion, similar to the DHA's process for managing the Tricare formulary and the Joint Deployment Formulary.

C. FUTURE RESEARCH

The nature of the research methodology requires further study to validate the analysis and strengthen recommendations. Because of the qualitative nature of the study, future research should focus on quantifiable data. This research could focus on analyzing pharmaceutical purchasing and expiration data to determine actual AMAL medication usage and identify trends in non-AMAL purchasing. This analysis would support the

assertion that the current pharmacy AMAL is insufficient for medical needs. Other potential areas for future research are forecasting and modeling shipboard pharmaceutical demand to update AMAL inventories, development and validation of pharmacy technician and officer in charge training programs for shipboard operations, or additional case studies on different ships, ship classes, or Fleet Marine Forces to determine whether current research findings are generalizable or case studies that focus on the process from other functional areas, such as DLA. All of these options for future research would expand our current understanding of the shipboard pharmaceutical inventory management and ordering processes to help improve efficiency and reduce cost for the MHS.

APPENDIX. 3034 PHARMACY AMAL

NSN	Item Description	QTY
6505014622502	5% DEXTROSE AND 0.9% SODIUM CHLORIDE INJECTION, USP	5
6505009857301	ACETAMINOPHEN 325 MG TABLET 1000S	5
6505010767866	ACETAMINOPHEN 650 MG RECTAL SUPPOSITORY 12S	2
6505006640857	ACETAZOLAMIDE 250 MG TABLET 100S	1
6505007822688	ACETYLCYSTEINE 200 MG/ML (20%) SOLUTION 30ML	23
6505012828880	ACTIVATED CHARCOAL 50 GRAM/240 ML ORAL SUSPENSION 240ML	8
6505015303307	ADENOSINE 3 MG/ML INTRAVENOUS SYRINGE 2ML	1
6505001484631	AL HYD-MG TR-ALG AC-SOD BICARB 80 MG-14.2 MG CHEWABLE TABLET 100S	2
6505016493422	ALBENDAZOLE 200 MG TABLET 2S	3
6505012580960	ALBUTEROL SULFATE 2.5 MG/3 ML (0.083%) SOLUTION FOR NEBULIZATION UNIT DOSE 3MLS 25 PER PACKAGE	2
6505015436562	ALBUTEROL SULFATE HFA 90 MCG/ACTUATION AEROSOL INHALER 8.5GM	30
6505010043952	ALLOPURINOL 300 MG TABLET 100S	1
6505013624958	ALUMINUM CHLORIDE 20% TOPICAL SOLUTION 35ML (DRYSOL)	1
6505004807216	ALUMINUM HYDROXIDE GEL 320 MG/5 ML ORAL SUSPENSION 473ML	1
6505014731770	ALUMINUM-MAG HYDROXIDE-SIMETHICONE 200 MG-200 MG-25 MG CHEWABLE TABLET 100 TABLETS PER BOTTLE	6
6505015242693	AMIODARONE HCL 50MG/ML INJECTION 3ML VIAL 10 VIALS PER PACKAGE	2
6505000797453	AMITRIPTYLINE 10 MG TABLET 100S	3
6505001060875	AMMONIA INHALANT SOLUTION AROMATIC 0.333 CC AMPUL 10 PER PACKAGE	1
6505014310403	AMOXICILLIN 500MG AND CLAVULANATE POTASSIUM 125MG TABLETS USP 20 TABLETS PER BOTTLE	25
6505013535665	AMOXICILLIN 500MG CAPSULES USP 500 CAPSULES PER BOTTLE	2
6505012752568	AMPICILLIN AND SULBACTAM FOR INJECTION USP 3GM VIAL (UNASYN 3GM) 10 VIALS PER PACKAGE	3
6505014437055	AMPICILLIN SODIUM 1GM USP STERILE POWDER VIAL 10 VIALS PER PACKAGE	4
6505016129939	AMYL NITRITE INHALATION AMPUL 12 AMPULES PER PACKAGE	10
6505001538750	ASPIRIN 325 MG TABLET 1000S	1
6505011357373	ATENOLOL 50MG TABLETS USP 100 TABLETS PER BOTTLE	2
6505014919430	ATOVAQUONE AND PROGUANIL HCL 250MG-100MG TABLETS 100 TABLETS PER BOTTLE	1
6505009578089	ATROPINE 1 MG/ML INJECTION SOLUTIONML	1
6505015316869	ATROPINE SULFATE 0.1MG/ML INJECTION USP 10ML ANSYR PLASTIC SYRINGE 10 SYRINGES PER PACKAGE	1
6505014745440	ATROPINE SULFATE 0.4MG/ML INJ USP 20ML MULI-DOSE VIAL 10 VIALS PER PACKAGE	8
6505014491635	AZITHROMYCIN 250MG TABLETS 30 TABLETS PER BOTTLE	10
6505011770589	BACITRACIN OINTMENT USP 500UN/GM .87GM PACKET I.S. 144PACKETS/PG	1
6505014542526	BACITRACIN ZINC 500 UNIT/GRAM TOPICAL OINTMENT 14GM	24
6505006601798	BENZONATATE 100 MG CAPSULE 100S	6
6505011479555	BENZOYL PEROXIDE 10% TOPICAL GEL 42.5GM	25
6505007850307	BENZTROPINE 2 MG/2 ML INJECTION SOLUTION 2ML	2
6505010140894	BETAMETHASONE VALERATE 0.1% LOTION 60ML	25

NSN	Item Description	QTY
6505001182759	BISACODYL 5MG TABLETS USP INDIVIDUALLY SEALED 100 TABLETS PER BOX	1
6505014437607	BISMUTH SUBSALICYLATE CHEWABLE TABLETS SUGAR FREE INDIVIDUALLY SEALED 30 TABLETS PER PACKAGE	30
6505011277946	BUPIVACAINE HCL 0.5% INJECTION USP 30ML VIAL 10 VIALS PER PACKAGE	2
6505014983167	BUPROPION HCL 150MG SUSTAINED RELEASE TABLETS 60 TABLETS PER BOTTLE	10
6505012191084	BUTALBITAL-ACETAMINOPHEN-CAFFEINE 50 MG-325 MG-40 MG TABLETS 100 TABLETS PER BOTTLE	2
6505014568889	CALAMINE LOTION 8%-ZINC OXIDE 180ML	100
6505015333369	CALCIUM ACETATE-ALUMINUM 952 MG-1,347 MG TOPICAL POWDER IN PACKET 12S	250
6505015740482	CALCIUM CARBONATE 600 MG TABLETS 60 TABLETS PER BOTTLE	1
6505014558428	CALCIUM CHANNEL BLOCKER VERAPAMIL HCL 2.5MG/ML 2ML AMPULE	25
6505015037386	CALCIUM CHLORIDE 100MG/ML INJECTION USP 10ML SYRINGE 10 SYRINGES PER PACKAGE	1
6515015645875	CANISTER SODA LIME ANESTHESIA MACHINE REUSABLE	2
6505011841250	CARBAMIDE PEROXIDE 6.5% EAR DROPS 15ML	15
6505010156456	CARBOXYMETHYLCELLULOSE SODIUM 1% EYE LIQUID GEL DROPS 15ML	1
6505014802501	CEFAZOLIN 1GM INJECTION USP 10ML VIAL 25 VIALS PER PACKAGE	3
6505011046393	CEFOXITIN SODIUM 2GM VIAL INJECTABLE USP 25 VIALS PER PACKAGE	4
6505012293149	CEFTRIAXONE 2 GRAM SOLUTION FOR INJECTIONS	1
6505012277028	CEFTRIAXONE SODIUM 250MG USP STERILE VIAL 10 VIALS PER PACKAGE	15
6505001656545	CEPHALEXIN 250 MG CAPSULE 100S	1
6505010453255	CHLORHEXIDINE GLUCONATE 4% TOPICAL LIQUID 946ML	4
6505016427374	CHLOROPROCAINE (PF) 30 MG/ML (3%) INJECTION SOLUTION 20ML	1
6505013366179	CIPROFLOXACIN 400MG/200ML IN 5% DEXTROSE FOR INJECTION 200ML BAG 24 BAGS PER PACKAGE	1
6505013334154	CIPROFLOXACIN 500MG TABLETS USP 100 TABLETS PER BOTTLE	1
6505015323362	CIPROFLOXACIN HCL 0.3% AND DEXAMETHASONE 0.1% OTIC SUSPENSION 7.5ML BOTTLE	12
6505013519272	CIPROFLOXACIN HCL 0.3% OPHTHALMIC SOLUTION 5ML BOTTLE	1
6505015054632	CITALPRAM HYDROBROMIDE 20MG TABLETS 100 TABLETS PER BOTTLE	5
6505011875540	CLINDAMYCIN 150MG/ML INJECTION USP 6ML VIAL 25 VIALS PER PACKAGE	1
6505001594892	CLINDAMYCIN HCL 150 MG CAPSULE 100 CAPSULES PER BOTTLE	4
6505011165655	CLINDAMYCIN PHOSPHATE 1% TOPICAL SOLUTION USP 60ML BOTTLE	25
6505010301647	CLONIDINE HCL 0.1 MG TABLET 100S	1
6505010235011	CLOTRIMAZOLE 1% TOPICAL CREAM 15GM	200
6505006874053	COLCHICINE 0.6 MG TABLET 100S	1
6505014493698	CROMOLYN 5.2 MG/SPRAY (4%) NASAL SPRAY 26ML	1
6505010628010	CYCLOBENZAPRINE 10 MG TABLET 100S	5
6505010914838	CYCLOPENTOLATE HCL 1% OPHTHALMIC SOLUTION USP 5ML BOTTLE	1
6505016531569	DANTROLENE 250 MG INTRAVENOUS SUSPENSIONS	6
6505015225164	DEXAMETHASONE SODIUM PHOSPHATE 4MG/ML INJECTION USP 30 ML VIAL	10
6505014622984	DEXTROSE 5% AND SODIUM CHLORIDE 0.45% INJECTION USP 1000ML BAG 14 BAGS PER PACKAGE	6
6505015015408	DEXTROSE 50% INJECTION USP 50 ML SYRINGE 10 SYRINGES PER PACKAGE	6
6505013318941	DEXTROSE INJECTION 5% 250ML BAG 24 BAGS PER PACKAGE	1

NSN	Item Description	QTY
6505003697289	DICLOXACILLIN 250 MG CAPSULE 100S	20
6505001167750	DIGOXIN 0.25MG TABLETS USP 100 TABLETS PER BOTTLE	1
6505005317761	DIGOXIN 250 MCG/ML INJECTION SOLUTION 2ML	1
6505015054619	DILTIAZEM 120MG EXTENDED-RELEASE CAPSULES USP 90 CAPSULES PER BOTTLE	1
6505015055281	DILTIAZEM HCL 5MG/ML INJECTION 10 ML VIAL 10 VIALS PER PACKAGE	1
6505010514831	DIMERCAPROL 100 MG/ML INTRAMUSCULAR SOLUTION 3ML	2
6505005824867	DIPHENHYDRAMINE 25 MG CAPSULE 1000S	1
6505015182962	DIPHENHYDRAMINE HCL 50MG/ML INJECTION USP 1ML CARPUJECT 10 CARPUJECTS PER PACKAGE	3
6505014917667	DOBUTAMINE 12.5MG/ML INJECTION USP 20ML VIAL 10 VIALS PER PACKAGE	1
6505001637656	DOCUSATE SODIUM 100 MG CAPSULE UNIT DOSE 100S	20
6505011494089	DOPAMINE HCL 40MG/ML INJECTION USP 5ML VIAL 25VIALS PER PACKAGE	2
6505015167604	DOXYCYCLINE 100MG FOR INJECTION USP VIAL 10 VIALS PER PACKAGE	1
6505016421190	DOXYCYCLINE HYCLATE 100 MG TABLET 1000S	13
6505015733574	DROSPIRENONE 3 MG-ETHINYL ESTRADIOL 0.02 MG TABLET 28S	6
6505016185356	EMTRICITABINE 200MG AND TENOFOVIR 300 MG TABLETS 30 TABLETS PER BOTTLE	2
6505013771444	ENOXAPARIN 30MG/0.3ML INJECTION 10 SYRINGES PER PACKAGE	1
6505015975633	EPHEDRINE SULFATE 50 MG/ML INJECTION SOLUTIONML	10
6505015273957	EPINEPHRINE 0.1 MG/ML INJECTION SYRINGE 10ML	5
6505016674146	EPINEPHRINE HCL (PF) 1 MG/ML (1 ML) INJECTION SOLUTIONML	7
6505006041223	ERYTHROMYCIN 250 MG TABLET,DELAYED RELEASE 100S	16
6505012348144	ERYTHROMYCIN OPHTHALMIC OINTMENT USP 5MG/GM 0.5% UNIT DOSE 1GM TUBE 50 TUBES PER PACKAGE	1
6505015027737	ESMOLOL HCL 10MG/ML INJECTION STERILE 10ML VIAL 25 VIALS PER PACKAGE	1
6505015334392	ETOMIDATE 2MG/ML INJECTION 20ML SINGLE DOSE VIAL 10 VIALS PER PACKAGE	1
6505015735796	ETONOGESTREL-ETHINYL ESTRADIOL 0.12 MG -0.015 MG/24 HR VAGINAL RINGS	1
6505011138580	FERROUS SULFATE 325 MG (65 MG IRON) TABLET UNIT DOSE 100S	2
6505015057721	FEXOFENADINE HCL 180MG TABLETS 100 TABLETS PER BOTTLE	1
6505013953039	FLUCONAZOLE 150MG TABLETS INDIVIDUALLY SEALED 12 TABLETS PER PACKAGE	10
6505013548591	FLUMAZENIL 0.1MG/ML INJECTION 10ML VIAL 10 VIALS PER PACKAGE	1
6505010674850	FLUOCINONIDE 0.05% TOPICAL CREAM 15GM	25
6505015032390	FLUORESCEIN SODIUM 1MG OPHTHALMIC STRIPS USP STERILE 100 STRIPS PER PACKAGE	6
6505013974313	FLUOXETINE HCL 10MG CAPSULES 100 CAPSULES PER BOTTLE	2
6505015326924	FLUTICASONE PROPIONATE 110MCG INHALATION AERSOL HFA 12GM 120DOSES	5
6505015326922	FLUTICASONE PROPIONATE 220MCG INHALATION AERSOL HFA 12GM 120 DOSES	5
6505014107226	FLUTICASONE PROPIONATE 50MCG/ACTUATION NASAL SPRAY 16GM, 120 ACTUATIONS	24
6505015250326	FUROSEMIDE 10MG/ML INJECTION USP10 ML VIAL 25 VIALS PER PACKAGE	2
6505012139514	GENTAMICIN SULFATE 40MG/ML INJECTION USP 2ML VIAL 25 VIALS PER PACKAGE	4

NSN	Item Description	QTY
6505014667505	GLUCAGON FOR INJECTION USP 1 MG UNIT FOR EMERGENCY USE	2
6505012045417	GLYBURIDE 5 MG TABLET 100S	1
6508010197181	GLYCERIN-BENZYL ALCOHOL-WT PET LOTION 240ML	40
6505015887369	GLYCOPYRROLATE 0.2 MG/ML INJECTION SOLUTIONML	1
6505015603527	GUAIFENESIN 600MG AND DEXTROMETHORPHAN HYDROBROMIDE 30MG EXTENDED-RELEASE 12 HOUR TABLET 20 TABLETS PER PACKAGE	1
6505013405446	GUAIFENESIN EXTENDED-RELEASE 600MG TABLETS 500 TABLETS PER BOTTLE	1
6505010509382	HALOPERIDOL 2 MG TABLET UNIT DOSE 100S	1
6505002688530	HALOPERIDOL LACTATE 5 MG/ML INJECTION SOLUTIONML	4
6505015273464	HEPARIN SODIUM 10000UNITS/ML INJECTION USP 1ML VIAL 25 VIALS PER PACKAGE	1
6505013770444	HEPARIN SODIUM 50UN/ML IN SODIUM CHLORIDE 0.45% INJECTION 500ML BAG 24 BAGS PER PACKGE	1
6505007644011	HOMATROPINE HYDROBROMIDE 5% OPHTHALMIC SOLUTION USP 5ML BOTTLE	1
6505016726046	HUMAN PAPILLOMAVIRUS VACCINE,9-VALENT (PF) 0.5 ML IM SUSPENSION 0.5ML (GARDASIL)	1
6505015544306	HYDROCHLOROTHIAZIDE 25 MG TABLET 100S	10
6505015296094	HYDROCORTISONE 1% & ACETIC ACID 2% OTIC SOLUTION USP 10ML PLASTIC DROPPER BOTTLE	15
6505009262095	HYDROCORTISONE 1% TOPICAL CREAM 28.35GM	100
6505012816758	HYDROCORTISONE ACETATE AND PRAMOXINE HYDROCHLORIDE RECTAL CREAM 1OZ	18
6505001538480	HYDROGEN PEROXIDE 3% SOLUTION 473ML	25
6505015997373	HYDROXOCOBALAMIN 5 GRAM INTRAVENOUS SOLUTIONS	1
6505015303334	HYDROXYZINE 25 MG TABLET 100S	5
6505015198897	HYDROXYZINE HCL 50MG/ML INJECTION USP 1ML VIAL 25 VIALS PER PACKAGE	1
6505001288035	IBUPROFEN 400 MG TABLET 500S	18
6505012149062	IBUPROFEN 800MG TABLETS USP 500 TABLETS PER BOTTLE	20
6505015803505	IMIQUIMOD 5 % CREAM 24 SINGLE USE PACKETS PER PACKAGE	4
6505009262154	INDOMETHACIN 25 MG CAPSULE 100S	10
6505013146681	INOTROPE DOPAMINE HCL/D5W 3.2MG/ML 250ML PLASTIC BAG	1
6505012154825	INSULIN HUMAN REGULAR INJECTION USP 100UN/ML 10ML MULTIPLE DOSE VIAL	10
6505012171244	INSULIN HUMAN ISOPHANE SUSPENSION USP 100UN/ML 10ML MULTIPLE DOSE VIAL	1
6505001326904	ISONIAZID 300MG TABLETS USP 100 TABLETS PER BOTTLE	1
6505013865254	ITRACONAZOLE 100MG CAPSULES 30 CAPSULES PER BOTTLE	2
6505012729401	KETOCONAZOLE 2% TOPICAL CREAM 15GM	10
6505014821064	KETOROLAC TROMETHAMINE 30MG/ML INJECTION USP 1ML CARTRIDGES 10 CARTRIDGES PER PACKAGE	1
6505012447982	LABETALOL HCL 5ML/ML INJECTION USP 20ML VIAL	2
6505013306267	LACTATED RINGERS INJECTION USP 1000ML BAG 12 BAGS PER PACKAGE	75
6505014407641	LATANOPROST SOLUTION 0.005% OPHTHALMIC SOLUTION 2.5 ML BOTTLE	1
6505015427929	LEVOFLOXACIN 25 MG/ML INTRAVENOUS SOLUTION 30ML	10
6505014446632	LEVOFLOXACIN 500MG TABLETS 50 TABLETS PER BOTTLE	2

NSN	Item Description	QTY
6505015493510	LEVONORGESTREL 0.1MG AND ETHINYL ESTRADIOL 20MCG TABLETS USP 28 TABLETS PER CYCLE 6 CYCLES (168 TABLETS) PER PACKAGE	3
6505015954781	LEVONORGESTREL 1.5MG TABLET 1 TABLET PER CARTON	15
6505015964435	LEVOTHYROXINE 100 MCG TABLET 90S	1
6505015984560	LIDOCAINE 1% AND EPINEPHRINE 1:100,000 INJECTION USP 20ML MULTI-DOSE VIAL 25 VIALS PER PACKAGE	30
6505015225340	LIDOCAINE HCL 1% (10MG/ML) INJECTION USP 5ML SYRINGE 10 SYRINGES PER PACKAGE	4
6505014478094	LIDOCAINE HCL 1% INJECTION USP 50ML MULTI-DOSE VIAL 25 VIALS PER PACKAGE	1
6505000636197	LIDOCAINE HCL 2% TOPICAL SOLUTION USP 100 ML BOTTLE	2
6505013563879	LISINOPRIL 10MG TABLETS USP 1000 TABLETS PER BOTTLE	1
6505012826327	LISINOPRIL 20MG TABLETS 100 TABLETS PER BOTTLE	4
6505010666568	LOPERAMIDE 2 MG CAPSULE 100S	15
6505015391079	LOPINAVIR 200MG - RITONAVIR 50MG TABLET 120 TABLETS PER BOTTLE	1
6505015785988	LORATADINE TABLETS 10MG BT 90S	6
6505014975663	MAGNESIUM SULFATE 4 MEQ/ML (50%) INJECTION SOLUTION 2ML	1
6505014409134	MAGNESIUM SULFATE USP CRYSTAL FORM (EPSOM SALT) 16 OZ CONTAINER	1
6505011253253	MANNITOL 25% INJECTION USP 50ML SINGLE DOSE VIALS 25 VIALS PER PACKAGE	2
6505009262111	MECLIZINE 25 MG CHEWABLE TABLET 100S	10
6505015295618	MEDROXYPROGESTERONE 150 MG/ML INTRAMUSCULAR SYRINGEML	20
6505012762029	MEDROXYPROGESTERONE ACETATE 2.5MG TABLETS USP 100 TABLETS PER BOTTLE	1
6505014139610	METFORMIN HCL 500MG TABLETS 100 TABLETS PER BOTTLE	2
6505006601601	METHOCARBAMOL 500 MG TABLET 500S	1
6505012850165	METHYLCELLULOSE USP 2GM POWDER FORM ORANGE FLAVOR 16OZ	18
6505011315619	METHYLPREDNISOLONE 4MG TABLETS USP (MEDROL DOSEPAK) INDIVIDUALLY SEALED 21 TABLETS PER PACKAGE	5
6505012321987	METHYLPREDNISOLONE SODIUM SUCCINATE 2GM INJECTION USP 50ML VIAL	12
6505015887658	METHYLPREDNISOLONE SODIUM SUCCINATE 1GM PER 8ML INJECTION (125MG/ML) SINGLE DOSE VIAL WITH DILUENT IN UPPER COMPARTMENT	1
6505011309358	METOCLOPRAMIDE 10 MG TABLET 100S	5
6505012683738	METOCLOPRAMIDE 5 MG/ML INJECTION 2ML	1
6505016151537	METOPROLOL TARTRATE 1MG/ML INJECTION USP 5ML SINGEL DOSE VIAL 10 VIALS PER PACKAGE	1
6505010906797	METOPROLOL TARTRATE 50MG TABLETS 100 TABLETS PER BOTTLE	3
6505008901840	METRONIDAZOLE 250 MG TABLET 250S	2
6505011394931	METRONIDAZOLE 5MG/ML INJECTION USP STERILE 100ML BAG 24 BAGS PER PACKAGE	3
6505010498881	MICONAZOLE NITRATE 2% VAGINAL CREAM 45GM	10
6505012971448	MISOPROSTOL 200 MCG TABLET 100S	1
6505015049756	MONTELUKAST SODIUM 10MG TABLETS 30 TABLETS PER BOTTLE	2
6505015090677	MOXIFLOXACIN HCL 0.5% OPHTHALMIC SOLUTION 3ML BOTTLE	1
6505014805678	MUPIROCIN 2% TOPICAL OINTMENT 22GM	10
6505013026664	NAFCILLIN 1GM INJECTION USP 10 VIALS PER PACKAGE	15
6505015334126	NALOXONE HCL 0.4MG/ML INJECTION 1ML VIAL 10 VIALS PER PACKAGE	5

NSN	Item Description	QTY
6505015331574	NAPHAZOLINE HCL 0.025% AND PHENIRAMINE MALEATE 0.3% OPHTHALMIC SOLUTION USP 15ML BOTTLE	4
6505012002474	NAPROXEN 500MG TABLETS USP 100 TABLETS PER BOTTLE	1
6505015984571	NICOTINE (POLACRILEX) 4 MG GUM 50S	1
6505014813146	NICOTINE POLACRILEX 2MG CHEWING GUM USP STARTER KIT 110 PIECES	1
6505014464897	NICOTINE TRANSDERMAL SYSTEM 14 MG FOR 24 HOURS 7 PER PACKAGE	1
6505014464896	NICOTINE TRANSDERMAL SYSTEM 21 MG FOR 24 HOURS 7 PER PACKAGE	1
6505014464900	NICOTINE TRANSDERMAL SYSTEM 7 MG FOR 24 HOURS 7 PER PACKAGE	1
6505011263842	NIFEDIPINE 10MG CAPSULES USP 100 CAPSULES PER BOTTLE	1
6505013523884	NITROFURANTOIN 100MG EXTENDED-RELEASE CAPSULES 100 CAPSULES PER BOTTLE	1
6505013432489	NITROGLYCERIN 0.2MG/ML IN DEXTROSE 5% INJECTION 250ML BOTTLE 12 BOTTLES PER PACKAGE	1
6505010083401	NITROGLYCERIN 2% TRANSDERMAL OINTMENT 60GM	2
6505014860542	NITROGLYCERIN LINGUAL AEROSOL 0.4MG PER SPRAY 200 SPRAYS PER BOTTLE	3
6505016503823	NORELGESTROMIN 150 MCG-E.ESTRADIOL 35 MCG/24 HR WEEKLY TRANSDERM PATCH 3S	6
6505013652363	NORETHINDRONE-ETHINYL ESTRADIOL 1 MG-35 MCG TABLET 28 TABLETS PER CYCLE 6 CYCLES (168 TABLETS) PER PACKAGE	18
6505011479542	NORGESTREL-ETHINYL ESTRADIOL 0.3 MG-30 MCG TABLET 28 TABLETS PER CYCLE 6 CYCLES (168 TABLETS) PER PACKAGE	3
6505002165051	NYSTATIN 100,000 UNIT/ML ORAL SUSPENSION 60ML	1
6505012109506	NYSTATIN AND TRIAMCINOLONE ACETONIDE CREAM 15GM TUBE	12
6505014153580	OMEPRAZOLE 20MG EXTENDED-RELEASE CAPSULES 1000 CAPSULES PER BOTTLE	2
6505015786170	ONDANSETRON HCL (PF) 4 MG/2 ML INJECTION SOLUTION 2ML	10
6505015226420	OSELTAMIVIR PHOSPHATE 75MG CAPSULES 10 CAPSULES PER PACKAGE	20
6505008694177	OXYMETAZOLINE 0.05% NASAL SPRAY 15ML	100
6505015050773	OXYTOCIN 10UNITS/ML INJECTION USP 1 ML VIAL 25 VIALS PER PACKAGE	1
6505013718322	PAROXETINE HCL 20MG TABLETS 100 TABLETS PER BOTTLE	8
6505011561722	PENICILLIN G BENZATHINE SUSPENSION STERILE USP 4ML UNIT 10S	1
6505008902172	PENICILLIN G POTASSIUM 20 MILLION UNIT SOLUTION FOR INJECTIONS	20
6505001490139	PENICILLIN V POTASSIUM 500 MG TABLET 100S	1
6505013218812	PERMETHRIN 5% TOPICAL CREAM 60GM	20
6505012564972	PERMETHRIN CREAM RINSE 1% 2FL OZ PLASTIC SQUEEZE BOTTLE	20
6505001388461	PHENAZOPYRIDINE 100 MG TABLET 100S	4
6505011534451	PHENYLEPHRINE 0.25% NASAL SPRAY 15ML	2
6505001169325	PHENYTOIN SODIUM 100 MG CAPSULES USP EXTENDED RELEASE 100 CAPS PER BOTTLE	1
6505013329024	PHENYTOIN SODIUM 50MG/ML INJECTION USP 5ML VIAL 25 VIALS PER PACKAGE	1
6505014667522	PHYSOSTIGMINE SALICYLATE 1MG/ML INJECTION USP 2ML AMPULE 10 AMPULES PER PACKAGE	1
6505000684925	PHYTONADIONE 10MG/ML INJECTION USP 1ML AMPUL 25 AMPULS PER PG	2
6505005824679	PILOCARPINE 2% EYE DROPS 15ML	1
6505013384710	PODOFILOX 0.5% TOPICAL SOLUTION 3.5ML	1
6505016648837	POLYETHYLENE GLYCOL 3350 (MIRALAX) 17 GRAM ORAL POWDER PACKET 100S	1

NSN	Item Description	QTY
6505013539837	POLYETHYLENE GLYCOL AND ELECTROLYTES FOR ORAL SOLUTION BOTTLE 4 LITERS	3
6505009617486	POLYVINYL ALCOHOL 1.4% EYE DROPS 15ML	25
6505012578457	POTASSIUM CHLORIDE 1500MG (20MEQ) EXTENDED-RELEASE TABLETS USP 100 TABLETS PER BOTTLE	1
6505010801988	POTASSIUM CHLORIDE CONCENTRATE 2MEQ/ML FOR INJECTION USP 20ML VIAL 25 VIALS PER PACKAGE	2
6505011684445	PRAZIQUANTEL 600MG TABLETS 6 TABLETS PER BOTTLE	2
6505001335843	PREDNISOLONE ACETATE 1% EYE DROPS,SUSPENSION 5ML	1
6505011460539	PREDNISONE 10MG TABLETS USP 500 TABLETS PER BOTTLE	1
6505016323900	PRENATAL VITS 96-FERROUS FUMARATE 27 MG IRON-FOLIC ACID 800 MCG TABLET 100S	3
6505007540374	PREP SOLUTION PVP IODINE 1GAL	5
6505013482465	PRIMAQUINE PHOSPHATE 26.3MG (15MG BASE) TABLETS USP 100 TABLETS PER BOTTLE	10
6505012408703	PROCAINAMIDE HCL 100MG/ML INJECTION USP 10ML VIAL 25 VIALS PER PACKAGE	1
6505015813994	PROCHLORPERAZINE EDISYLATE 10 MG/2 ML (5 MG/ML) INJECTION SOLUTION 2ML	1
6505007615640	PROCHLORPERAZINE MALEATE 5 MG TABLET 100S	5
6505000654214	PROMETHAZINE 25 MG RECTAL SUPPOSITORY 12S	1
6505013648557	PROMETHAZINE HCL 25MG TABLETS USP 100 TABLETS PER BOTTLE	1
6505007539902	PROPARACAINE 0.5% EYE DROPS 15ML	1
6505014348619	PROPOFOL 10 MG/ML INTRAVENOUS EMULSION 100ML	1
6505016189132	PROPOFOL 10 MG/ML INTRAVENOUS EMULSION 20ML	5
6505011637906	PROPRANOLOL ER 80 MG CAPSULE,24 HR,EXTENDED RELEASE 100S	1
6505015037425	PROTAMINE 10 MG/ML INTRAVENOUS SOLUTION 5ML	1
6505014737775	PSEUDOEPHEDRINE HCL 60MG TABLETS USP 100 TABLETS PER BOTTLE	60
6505001384995	PYRIDOXINE 50MG TABLET 100 TABLETS PER BOTTLE (VITAMIN B6)	10
6505008646298	QUINIDINE GLUCONATE 80 MG/ML INJECTION SOLUTION 10ML	5
6505016218317	RALTEGRAVIR 400MG TABLETS 60 TABLETS PER BOTTLE	2
6505011607702	RANITIDINE 150MG TABLETS USP 60 TABLETS PER BOTTLE	30
6505012085955	RANITIDINE 50 MG/2 ML (25 MG/ML) INJECTION SOLUTION 2ML	8
6505011947266	REGIONAL OR LOCAL ANESTHESIA LIDOCAINE HCL/D5W 8MG/ML 250ML IV SOLUTION	1
6505001656575	RIFAMPIN 300 MG CAPSULE 100S	5
6505013932144	ROCURONIUM BROMIDE 10MG/ML INJECTION 5ML VIAL 10 VIALS PER PACKAGE	1
6505015094292	SALMETEROL XINAFOLATE 50MCG INHALATION POWDER BLISTER 60 BLISTERS PER PACKAGE	3
6505014562380	SCOPOLAMINE TRANSDERMAL SYSTEM 1.5MG 4 PER PACKAGE	25
6505002998671	SELENIUM SULFIDE 2.5% TOPICAL SUSPENSION 120ML	20
6505015356108	SERTRALINE 100 MG TABLET UNIT OF USE 30S	27
6505014979961	SEVOFLURANE LIQUID FOR INHALATION 250 ML BOTTLE	6
6505002999672	SILVER NITRATE APPLICATORS 6 INCH 100S	5
6505005607331	SILVER SULFADIAZINE 1% TOPICAL CREAM 400GM	25
6505013544544	SIMVASTATIN 10 MG TABLET 90S	10
6505001415000	SODIUM BICARBONATE (BULK) POWDER 454GM	1
6505002165370	SODIUM BICARBONATE 8.4% (1 MEQ/ML) IV SYRINGE 50ML	1

NSN	Item Description	QTY
6505014622122	SODIUM CHLORIDE 0.45% INJECTION USP 1000 ML BAG 14 BAGS PER PACKAGE	1
6505012870626	SODIUM CHLORIDE 0.9% INJECTION USP 10ML VIAL 25 VIALS PER PACKAGE	6
6505014624194	SODIUM CHLORIDE 0.9% IRRIGATION USP1000 ML BOTTLE 12 BOTTLES PER PACKAGE	8
6505013306269	SODIUM CHLORIDE INJECTION USP 0.9% 1000ML BAG 12 BAGS PER PACKAGE	20
6505013308924	SODIUM CHLORIDE INJECTION USP 0.9% 100ML BAG 64 BAGS PER PACKAGE	10
6505013318945	SODIUM CHLORIDE INJECTION USP 0.9% 250ML BAG 24 BAGS PER PACKAGE	2
6505013306268	SODIUM CHLORIDE INJECTION USP 0.9% 500ML BAG 24 BAGS PER PACKAGE	1
6505010974766	SODIUM CITRATE AND CITRIC ACID (BICITRA) ORAL SOLUTION USP 473ML BOTTLE	2
6505016571391	SODIUM NITROPRUSSIDE 25 MG/ML INTRAVENOUS SOLUTION 2ML	5
6505006198215	SODIUM PHOSPHATES 19 GRAM-7 GRAM/118 ML ENEMA 133ML	12
6505011932830	SODIUM POLYSTYRENE SULFONATE SUSPENSION USP 500ML BOTTLE	2
6505010750679	SOLUTION IRRIGATION STERILE WATER 1000ML BOTTLE	1
6505013306252	SOLUTION IV DEXTROSE/WATER 5% 1000ML	2
6510016527215	STERI-STRIP BENZOIN TINCTURE COMPOUND, 40S	1
6505014171254	SUCCINYLCHOLINE CHLORIDE 20MG/ML INJECTION USP 10ML VIAL 25 VIALS PER PACKAGE	4
6505011224330	SULFAMETHOXAZOLE 400 MG-TRIMETHOPRIM 80 MG/5 ML INTRAVENOUS SOLUTION 5ML VIAL 10 VIALS PER PACKAGE	3
6505010161470	SULFAMETHOXAZOLE 800 MG-TRIMETHOPRIM 160 MG TABLET 100S	10
6505016724394	SUMATRIPTAN 6 MG/0.5 ML SUBCUTANEOUS PEN INJECTOR 0.5ML	1
6505015319924	SUMATRIPTAN SUCCINATE 100MG TABLETS INDIVIDUALLY SEALED 9 TABLETS PER PACKAGE	4
6508014360607	SUNBLOCK LIP BALM	8
6505015859155	SURGICAL LUBRICANT 4.25OZ TUBE 12 TUBES PER PACKAGE	2
6505016109718	TENECTEPLASE 50 MG INTRAVENOUS KITS	1
6505012812852	TERAZOSIN HCL 1MG CAPSULE 100 TABLETS PER BOTTLE	1
6505014338677	TERBINAFINE HCL 250MG TABLETS 30 TABLETS PER BOTTLE	8
6505010392808	TERBUTALINE 5 MG TABLET 100S	1
6505015296047	TERBUTALINE SULFATE 1MG/ML INJECTION USP 1ML VIAL 10 VIALS PER PACKAGE	1
6505016690909	TETRACAINE HCL (PF) 0.5% EYE DROPS 4ML	2
6505015094411	THIAMINE HCL 100MG/ML INJECTION USP 2ML VIAL 25 VIALS PER PACKAGE	1
6505001472618	THIAMINE HYDROCHLORIDE TABLETS USP 50MG 100 TABLETS PER BT	1
6505001612950	THROMBIN (BOVINE) 5,000 UNIT TOPICAL SOLUTIONS	5
6505010696519	TIMOLOL MALEATE 0.5% OPHTHALMIC SOLUTION USP 5ML BOTTLE	1
6505014807897	TOLNAFTATE 1% TOPICAL POWDER 45GM	30
6505015544389	TOLTERODINE TARTRATE 4MG EXTENDED-RELAEASE CAPSULES 90 CAPSULES PER BOTTLE	1
6505011374627	TRAZODONE 50 MG TABLET 100S	4
6505014584666	TRETINOIN 0.05% CREAM USP 20 GRAM TUBE	30
6505014629897	TRETINOIN 1% CREAM USP 20 GRAM TUBE	20
6505009268913	TRIAMCINOLONE ACETONIDE 0.1% DENTAL PASTE 5GM	18
6505006828194	TRIAMCINOLONE ACETONIDE 0.1% TOPICAL CREAM 15GM	25
6505012104472	TRIAMCINOLONE ACETONIDE 40MG/ML INJECTABLE SUSP USP 5ML VIAL	3

NSN	Item Description	QTY
6505011428314	TRIFLURIDINE 1% OPHTHALMIC SOLUTION 7.5ML BOTTLE	6
6505013200234	TRIMETHOPRIM AND POLYMIXIN B SULFATES 1MG-10,000UN/ML OPHTHALMIC SOLUTION 10ML	8
6505008718289	TROPICAMIDE 1% EYE DROPS 15ML	2
6505015436545	VALACYCLOVIR 1 GRAM TABLET 30S	1
6505012478801	VANCOMYCIN 1 GM VIALS 10 VIALS PER PACKAGE	3
6505012580983	VECURONIUM BROMIDE 10MG FOR INJECTION 10ML VIAL 10 VIALS PER PACKAGE	2
6505009824230	WARFARIN SODIUM 2MG TABLETS USP 100 TABLETS PER BOTTLE	2
6505005825079	WATER FOR INJECTION, STERILE 20ML PER VIAL PRESERVATIVE FREE 25 VIALS PER PACKAGE	10
6505001501990	ZINC OXIDE 20% TOPICAL OINTMENT 28.35GM	10
6505015230353	ZOLMITRIPTAN 2.5MG ORAL RAPID DISINTEGRATING TABLETS INDIVIDUALLY SEALED 6 TABLETS PER BOX	1

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