



***Validation Report for Joint
Medical Planning Tool (JMPT)
Version 7.5.6
Medical Planning Tool***

***Joint Staff
Health Services Support Division
J41***



Naval Health Research Center

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***Naval Health Research Center
140 Sylvester Road
San Diego, California 92106***

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Joint Medical Planning Tool

Joint Staff, Health Services Support Division, J41

**Validation Report for
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Version 7.5.6
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Document version 1.0

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VALIDATION REPORT EXECUTIVE SUMMARY

To ensure that the Joint Medical Planning Tool (JMPT) was fully functional and met the requirements in accordance with its current contract specifications, a verification and validation (V&V) effort was undertaken to ascertain whether this application had been consistently implemented as described in the technical documentation. Concomitantly, the data used with JMPT was also evaluated to ensure that it was correct, complete, and consistent. A successful V&V effort would support accreditation by the Force Health Protection Integrating Council for use within the Department of Defense.

A Functional Validation Working Group (FVWG) was formed with participants from the following organizations:

USPACOM	USNORTHCOM	USSOUTHCOM
USCENTCOM	USAFRICOM	USEUCOM
USTRANSCOM	USSOCOM	USN
USMC	USAF	USA
OSD	Joint Staff	

Training on JMPT and testing procedures was provided to all FVWG members during a week-long training session conducted in Huntsville, Alabama.

Testing was administered by FVWG members and the findings, results, and recommendations were briefed to the V&V Working Group at weekly Defense Connect Online calls conducted July–October 2012. The testing focused on nine critical areas:

- theater medical laydowns,
- scenario redevelopment,
- scenario execution,
- patient streams,
- care providing,
- transportation,
- reporting,
- documentation, and
- training.

Critical FVWG findings were provided to Naval Health Research Center and Teledyne Brown Engineering, Inc. for correction, and retesting was conducted by members of the FVWG in Nov 2012. The retesting of JMPT in November resulted in all critical issues being resolved.

On 7 November 2012, the FVWG was briefed on the results of the retesting and agreed

unanimously on recommending to the Strategic Analysis Working Group that JMPT be accredited for use as a joint medical planning tool.

Contents

VALIDATION REPORT EXECUTIVE SUMMARY	ii
PROBLEM STATEMENT	1
Intended Use	1
Modeling and Simulation Overview	3
M&S Application.....	3
Accreditation Scope	4
Validation Scope.....	4
M&S REQUIREMENTS AND ACCEPTABILITY CRITERIA.....	4
M&S ASSUMPTIONS, CAPABILITIES, LIMITATIONS, & RISKS/IMPACTS.....	4
M&S Assumptions.....	4
M&S Capabilities.....	5
M&S Limitations	6
M&S Risks/Impacts	6
VERIFICATION & VALIDATION TASK ANALYSIS	6
Data Verification & Validation Task Analysis	6
RESULTS	13
V&V Reporting Task Analysis	14
Results Validation Task Analysis	15
Theater medical laydown requirements.	16
Scenario development.....	16
Scenario execution.....	17
Patient streams.	17
Care providing.	17
Transportation.....	17
Reporting.....	18
Documentation.....	18
Training.....	18
V&V RECOMMENDATIONS	18
KEY PARTICIPANTS	18
Accreditation Participants.....	18
V&V Participants.....	19
V&V Facilitators	19

ACTUAL V&V RESOURCES EXPENDED	20
V&V Resources Expended	20
V&V LESSONS LEARNED.....	20
APPENDICES	20
APPENDIX A MODELING AND SIMULATION DESCRIPTION	22
APPENDIX B REQUIREMENTS TESTING.....	33
APPENDIX C BASIS OF COMPARISON.....	64
APPENDIX D ROUTING LOGIC.....	65
APPENDIX E FUNCTIONAL VALIDATION WORKING GROUP RECOMMENDATION BRIEF	74
APPENDIX F REFERENCES	78
APPENDIX G ACRONYMS	79
APPENDIX H V&V PROGRAMMATICS	81

PROBLEM STATEMENT

The Department of Defense (DoD) medical community lacks a functional and accurate means of modeling health care within the theater of operations. The tool designed to meet this need must provide the capability to model medical scenarios, generate realistic patient streams, model medical facilities (including the functional areas [FAs] that are embodied in them, the personnel that staff them, and the materials they use in providing medical care), model the provision of care, emulate the transportation of patients between medical facilities, and generate reports. Such a tool would enable analysis of the necessary medical force laydown commensurate with strategic and scenario-specific operational planning and will allow course of action analyses. Use of this tool would help inform decisions on types and quantities of medical capabilities including when and where to employ them. Additionally, this tool would help inform the decisions relative to the necessary size and capabilities of the medical force from a personnel and logistics perspective. Lacking such a tool imposes needless risk on force and medical planners by leaving them without a scientific means of examining force alternatives. Similarly, use of a tool that returned unreliable or erroneous results risks over or under estimation of capabilities with the concomitant waste of resources on the one hand or inability to provide adequate care on the other. It was proposed that the Joint Medical Planning Tool (JMPT) could address this capability gap. The function of the Accreditation Plan was to provide the framework for assessing whether or not JMPT could accurately and consistently provide the required capabilities.

Intended Use

The purpose of the JMPT is to provide the DoD medical community with the capability to generate medical laydowns within a theater of operations, generate patient streams from casualty estimates, model patient care, model demand for medical care and supplies, and model patient flow from the point of injury (POI) through evacuation from theater. JMPT simulates scenario specific medical force laydowns and is capable of characterizing medical treatment facilities (MTFs) at an appropriate level of detail across the continuum of care (i.e., first responder through theater hospitalization including evacuation from theater). The level of detail includes the location (relative or geographic) of MTFs, the FAs that comprise each MTF, their associated supplies/supply sets, and personnel. The tool has the capability to allow users to modify model objects and save tailored MTF data for future use.

To become accredited as a DoD medical planning tool, JMPT had to provide the capability to support medical systems analysis, logistics analysis, operational risk assessment, and theater medical course of action assessments.

To be accredited for these uses, JMPT had to demonstrate the ability to:

1. simulate theater medical force laydown,
2. generate patient streams based on user input,
3. provide visibility into patient treatment and routing from POI to final disposition within the theater or evacuation out of the theater,
4. simulate health care provision from first responder through theater hospitalization,
5. model patient transportation, and
6. provide a robust reporting capability.

The application had to be able to use relevant data to assess impacts on patient mortality rates due to the effects of resource constraints and other factors that affect resource utilization. It had to be capable of generating patient streams based on *International Classification of Diseases, 9th Revision (ICD-9)* based patient condition occurrence frequency (PCOF) tables from user supplied casualty estimates and user selected ICD-9 based PCOF estimates. The model had to characterize MTFs in sufficient detail to capture their capabilities. Specifically, the tool had to simulate appropriate medical FAs for each defined capability within the MTF including equipment, durable and consumable supplies, and personnel assigned. The tool had to allow users to modify, save, and export user defined MTFs. The tool had to simulate patient flow through a user definable network of MTFs; accounting for arrival, waiting, treatment, travel times, and patient disposition. The application had to prioritize treatment and evacuation of patients based on injury severity. Finally, the model had to differentiate between killed in action (KIA) and died of wounds (DOW) due to a delay in treatment as a function of time.

In addition, JMPT had to characterize the transportation network used to facilitate patient movement within the medical care network in theater. The simulation had to be capable of characterizing transportation assets, or medical evacuation specific assets, but had to also allow user modifications to the characteristics of the pre-defined transport assets and policies. The model had to provide the user with the ability to modify, save, and export transportation assets. Transportation assets had to be characterized in sufficient detail to capture their capabilities. Specifically, speed, capacity, loading/unloading times, and other time delays, had to be characterized. The transportation network had to account for the distance between MTFs and routing between them. It had to model transportation asset routing and use and be adaptable to changing tactical or operational conditions for course of action analysis.

Lastly, a robust reporting capability was required. The tool had to have the capability of writing output to a database and it had to be capable of “sharing” via file transfer or other mechanisms. Output had to be available in text, graphic, and tabular format and had to be compatible with Microsoft Office applications (i.e., Microsoft Access, Excel, Word, and PowerPoint) to enable report generation and presentation development. It had to provide pre-formatted reports that showed statistics and details for casualties, care provision, and transportation, and it had to allow the user to define ad-hoc reports tailored to the specific scenario or analysis.

Modeling and Simulation Overview

JMPT was designed to provide the DoD medical community a modeling and simulation (M&S) tool that will support medical systems analysis, operational risk assessment, and theater course of action analysis.

JMPT is a Microsoft Windows discrete event simulation that provides a systems view of the MTF network in which the facilities are integrated with transportation assets and the patients compete for medical/logistics resources (e.g., staff, equipment, supplies, and transporters). Simulations generate ICD-9 based patient streams from user input casualty estimates. The software includes a set of 336 ICD-9 codes defined by the Defense Medical Materiel Program Office (DMMPO). JMPT simulates patient flow through a user definable network of MTFs. Each MTF is composed of one or more FAs that include medical personnel, equipment, and durable and consumable supplies. These medical capabilities are exportable for sharing with colleagues. JMPT models arrival, waiting, treatment priority, treatment times, and patient disposition. The model provides insight into impacts on patient care due to resource limitations, system bottlenecks, skill limitations, patient throughput, DOW due to a delay in treatment, and other factors.

JMPT uses standardized transportation assets or user defined assets to facilitate patient movement within the medical care network. Transportation assets are exportable for sharing with colleagues. JMPT models transportation asset routing, speed, availability, scheduling, delays, prioritized loading/unloading, and capacity.

JMPT produces a large set of pre-formatted reports that detail medical system effectiveness, mortality, patient disposition, throughput, holding, resource utilization, and many others metrics. The software also allows the user to define ad hoc queries that may be saved for future use. Reports are displayed in text, graphic, and/or tabular format, and may be exported to Microsoft Office applications (i.e., Access, Excel, Word, and PowerPoint).

A Configuration Control Board (CCB) was established to adjudicate proposed enhancements to JMPT. The CCB meets regularly (currently monthly) and is composed of stakeholders who have interests in JMPT's development path forward. A configuration managed database exists that characterizes known software flaws and potential upgrades.

M&S Application

JMPT supports medical planning through:

- **Medical Systems Analysis:** JMPT provides the medical community with a tool to conduct medical systems analysis that measures the overall effectiveness of a medical network. The simulation tool presents a systems view of the expeditionary MTF network where the facilities are integrated with transportation assets and patients compete for

medical/logistics resources (e.g., staff, equipment, consumables, and transporters) as patients flow from the POI to disposition.

- **Logistics Analysis:** JMPT provides data on equipment and durable and consumable supplies that are linked to clinical tasks. This permits medical logisticians to conduct detailed analysis of supply use and shortfalls.
- **Operational Risk Assessment:** JMPT supports medical risk assessment by synchronizing medical system employment with operational plans by quantifying mortality and patient waiting time.
- **Theater Medical Course of Action Assessments:** JMPT provides the medical planner the capability to assess alternative courses of action and measure their impact.

Accreditation Scope

JMPT was accredited as a DoD medical planning tool to support medical systems analysis, logistics analysis, operational risk assessment, and theater medical course of action assessments.

Validation Scope

The validation effort primarily focused on comparing JMPT M&S outputs with generally accepted outputs and expected values by a group of subject matter experts assembled from throughout the DoD including representatives from The Office of The Secretary of Defense, the Joint Staff, the services, and the Combatant Commands. The acceptability criteria for the testing requirements were the consensus of the testing group. Testing was done at the user locations and the testing procedures and test results were briefed to the Functional Validation Working Group (FVWG) for determination of acceptability.

M&S REQUIREMENTS AND ACCEPTABILITY CRITERIA

The JMPT M&S requirements, the type of testing performed by the FVWG, and a description of the tests used to verify each of the requirements are provided in the M&S Requirement, Type of Test, and Test Description columns of the spreadsheet provided in Appendix B.

M&S ASSUMPTIONS, CAPABILITIES, LIMITATIONS, & RISKS/IMPACTS

M&S Assumptions

JMPT used a “snap shot” of the data from the Expeditionary Medical Knowledge Warehouse (EMedKW). EMedKW is a service-oriented architecture system, implemented via Web services, that is designed to protect and organize medical data in support of the Naval Health Research Center (NHRC) analysis mission. All of JMPT’s underlying data is resident in EMedKW. The data include the following: capabilities of care, FAs, personnel, personnel skill sets, patient conditions/ICD-9 codes, supplies (including weight, cube, and cost), patient treatment profiles

(including tasks, times, sequences, responsible personnel, and supplies needed), DOW due to delay, and type, speed, and capacity of transportation assets.

M&S Capabilities

JMPT's capabilities included the following:

- modeling total theater medical capability from first responder to theater hospitalization;
- building scenarios with data for MTFs, patient conditions, treatment profiles, transportation assets, and more;
- modeling multiple FAs per MTF (e.g., operating room, intensive care unit, emergency room, triage, lab, x-ray, and ward functionality);
- configuring MTFs;
- configuring transportation assets;
- moving patients to different MTFs at any level based on patient priority, distance, and capability of next MTF;
- moving patients to landing zone where they are held until evacuated;
- building scenarios with algorithms for survivability/mortality curves (vetted by a panel of physicians) and data from the Combat Trauma Registry Expeditionary Medical encounter database (EMED);
- modeling staff time, consumables required, and equipment usage times;
- modeling medical workload requirements for differing patient groups (e.g., civilians, enemy prisoners of war, and more);
- modeling occurrences of wounded in action (WIA), disease and nonbattle injury (DNBI), and combat stress;
- facilitating scenario development;
- validating checks on scenarios;
- modeling multiple runs to compare and contrast results;
- building scenarios with a simulation run casualty multiplier;
- generating charts and graphs;
- processing user defined queries;
- generating audit files;
- supporting the user with online help, tutorials, and a user support line;
- supporting the user with training;
- operating on a stand-alone capacity; and
- operating with Windows 7, Vista, and XP.

M&S Limitations

The known limitations of JMPT were as follows:

- lacks current Authority to Operate (ATO) on any DoD system (e.g., Navy Marine Corps Intranet [NMCI], Unclassified but Sensitive IP Router Network [NIPRNet], or Secret Internet Protocol Router Network [SIPRNet]);
- limited to modeling combat operations;
- limited set of service specific MTFs;
- limited transportation assets;
- lacks chemical, biological, radiological, and nuclear capability;
- lacks abbreviated care modeling capability;
- lacks multiple injuries for a single patient;
- lacks handling of blood;
- lacks resupply of consumables (currently tracks when consumables are depleted);
- lacks the ability to track En route Care System staff who boards an evacuation asset, to treat patients, and who must eventually return back to a facility;
- lacks attrition of medical staff due to many factors, including injury;
- lacks an account of treatment prior to second theater hospitalization admission;
- lacks casualty generation;
- only accepts occurrence-based casualty estimates;
- does not differentiate patient morbidity with application of specialized resources (e.g., patients treated by a general surgeon and a neurosurgeon have similar outcomes); and
- applies patient mortalities (i.e., DOW curves) to aggregate groups of ICD-9 codes considered life threatening and also grouped in low, medium, and high risk categories, and not to individual ICD-9 codes.

M&S Risks/Impacts

The tool may not have met the needs of all planners for all situations due to:

- an inability to use JMPT on NIPRNet, SIPRNet, NMCI, other DoD networks,
- an inability to model impacts of specialty care, and
- requiring trained, qualified users to operate the tool.

VERIFICATION & VALIDATION TASK ANALYSIS

Data Verification & Validation Task Analysis

The data that supports the JMPT is contained in the EMedKW. The data verification task

analysis of EMedKW was conducted in a separate effort by NHRC. The JMPT FVWG provided input from the user perspective to NHRC data validation efforts at weekly data meetings conducted by NHRC.

A systematic review of data in EMedKW was initiated in July 2012 as a part of the JMPT Verification & Validation (V&V) effort. EMedKW is a collection of Web services that abstract medical data collected and maintained by NHRC. It is a flexible database system that enables the storage, retrieval, and maintenance of virtually any customized dataset. EMedKW tracks all changes to the data for accountability. The specific data verified and validated were the data fields imported into, and used by, JMPT. The tests performed assessed whether the data contained in EMedKW were representative of real-world information and whether the data were consistent within a service, across the services, and within the roles of care.

Face validation (i.e., a subject matter expert review of simulation output for reasonableness) and inspection (i.e., an examination of the product of a particular simulation development phase) were used to validate the relational data in EMedKW. The relational data used by JMPT include tasks, task times, return to duty (RTD) percentages, minimum time to RTD, average length of stay, and equipment and supplies, which are dependent on the patient conditions and the FA where the patient is treated.

To evaluate whether the relational data are correct, a representative sample of ICD-9s available in JMPT was used. The ICD-9s were chosen from the list of 336 codes approved by the DMMPO and met at least one of these criteria: (a) the code requires a simple treatment, (b) the code requires a complex treatment, (c) it is a surgical code, (d) a non-surgical code, or (e) the code frequently occurred in the treatment records from recent combat operations. To obtain the sample of ICD-9s, first the ICD-9s were identified as surgical or nonsurgical resulting in 153 surgical and 83 non-surgical ICD-9s. Then it was determined that NHRC would review 20% of the surgical and 10% of the non-surgical ICD-9s, of which half would be selected from a high frequency of occurrence in the Theater Medical Data Store data (3-digit level ICD-9s) and half would be selected randomly. The list of ICD-9s used in the evaluation is shown in Table 1.

Table 1
List of ICD-9s Used in the Evaluation

DMMPO ICD-9	ICD-9 description	Type
883.0	Open wound of fingers without complication	Surgical
815.0	Closed fracture of metacarpal bones	Surgical
959.09	Other and unspecified injury to face and neck	Surgical
918.1	Superficial injury cornea	Surgical

DMMPO ICD-9	ICD-9 description	Type
789.00	Abdominal pain unspecified site	Surgical
959.01	Other and unspecified injury to head	Surgical
831.1	Dislocation of shoulder, open	Surgical
553.1	Umbilical hernia	Surgical
918.1	Superficial injury cornea	Surgical
608.4	Other inflammatory disorders of male genital organs	Surgical
540.9	Acute appendicitis without mention of peritonitis	Surgical
816.0	Phalanges fracture, closed	Surgical
861.10	Unspecified injury of heart w/open wound into thorax	Surgical
873.4	Open wound of face without mention of complication	Surgical
930	Foreign body on external eye	Surgical
884.0	Multiple/unspecified open wound upper limb without complications	Surgical
926	Crushing injury of trunk	Surgical
941	Burn of face, head, neck	Surgical
802.0	Closed fracture of nasal bones	Surgical
875.0	Open wound of chest (wall) without complication	Surgical
878	Open wound of genital organs (external) including traumatic amputation	Surgical
076	Trachoma	Surgical
955.0	Injury to axillary nerve	Surgical
871.5	Penetration of eyeball with magnetic foreign body	Surgical
835.1	Hip dislocation open	Surgical
876.0	Open wound of back without complication	Surgical
826.0	Closed fracture of one or more phalanges of foot	Surgical
867.3	Injury to ureter with open wound into cavity	Surgical
878	Open wound of genital organs (external) including traumatic amputation	Surgical
830.1	Open dislocation of jaw	Surgical

DMMPO ICD-9	ICD-9 description	Type
726.4	Enthesopathy of wrist and carpus	Non-surgical
840.4	Rotator cuff sprain	Non-surgical
784.7	Epistaxis	Non-surgical
726.7	Enthesopathy of ankle and tarsus	Non-surgical
726.4	Enthesopathy of wrist and carpus	Non-surgical
780.6	Fever	Non-surgical
847.3	Sprain of sacrum	Non-surgical
724.2	Lumbago	Non-surgical
724.02	Spinal stenosis of lumbar region	Non-surgical
681	Cellulitis and abscess of finger and toe	Non-surgical
877.0	Open wound of buttock without complication	Non-surgical
994.8	Electrocution and nonfatal effects of electric current	Non-surgical
008.45	Intestinal infection due to clostridium difficile	Non-surgical
381.9	Unspecified eustachian tube disorder	Non-surgical
922.1	Contusion of chest wall	Non-surgical
042	Human immunodeficiency virus (HIV) disease	Non-surgical
532	Duodenal ulcer	Non-surgical
523	Gingival and periodontal disease	Non-surgical

While 48 ICD-9s were identified for review, the data for 137 ICD-9 codes were reviewed due to some of the codes being grouped together when treatment profiles were developed and entered into the database. Table 2 contains the additional codes included in the data review.

Table 2
Additional Codes Included in the Data Review

ICD-9	ICD-9 description
806.4	Closed fracture of lumbar spine with spinal cord injury

ICD-9	ICD-9 description
719.46	Pain in joint lower leg
724.4	Lumbar sprain (thoracic/lumbosacral) neuritis or radiculitis, unspec
806.60	Closed fracture sacrum and coccyx w/unspec. spinal cord injury
833.1	Dislocated wrist, open
834.1	Dislocation of finger, open
847.2	Sprain lumbar region
848.1	Jaw sprain
848.3	Sprain of ribs
811.0	Fracture of scapula, closed
867.5	Injury to uterus with open wound into cavity
879.6	Open wound of other unspecified parts of trunk without complication
885	Traumatic amputation of thumb (complete) (partial)
886	Traumatic amputation of other finger(s) (complete) (partial)
895	Traumatic amputation of toe(s) (complete) (partial)
920	Contusion of face scalp and neck except eye(s)
921.0	Black eye
812.00	Fracture of unspecified part of upper end of humerus, closed
950	Injury to optic nerve and pathways
956.0	Injury to sciatic nerve
807.2	Closed fracture of sternum
867.0	Injury to bladder urethra without open wound into cavity
867.2	Injury to ureter w/o open wound into cavity
867.4	Injury to uterus w/o open wound into cavity
006	Amebiasis
007.9	Unspecified protozoal intestinal disease
008.8	Intestinal infection due to other organism not classified

ICD-9	ICD-9 description
047.9	Viral meningitis
052	Varicella
057.0	Fifth disease
060	Yellow fever
061	Dengue
062	Mosq. borne encephalitis
063.9	Tick borne encephalitis
065	Arthropod-borne hemmorhagic fever
078.4	Hand, foot and mouth disease
079.99	Unspecified viral infection
098.5	Gonococcal arthritis
100	Leptospirosis
380.4	Impacted cerumen
381	Acute nonsuppurative otitis media
384.2	Perforated tympanic membrane
388.3	Tinnitus, unspecified
086	Trypanosomiasis
530.2	Ulcer of esophagus
530.81	Gastroesophageal reflux
531	Gastric ulcer
829.0	Fracture of unspecified bone, closed
553.9	Hernia nos
832.1	Dislocation elbow, open
682.0	Cellulitis and abscess of face
682.6	Cellulitis and abscess of leg except foot
719.41	Pain in joint shoulder

ICD-9	ICD-9 description
719.47	Pain in joint ankle/foot
722.1	Displacement lumbar intervertebral disc w/o myelopathy
723.0	Spinal stenosis in cervical region
724.3	Sciatica
724.5	Backache unspecified
726.10	Disorders of bursae and tendons in shoulder unspecified
726.12	Bicipital tenosynovitis
726.3	Enthesopathy of elbow region
726.5	Enthesopathy of hip region
726.6	Enthesopathy of knee
729.0	Rheumatism unspecified and fibrositis
729.5	Pain in limb
780.0	Alterations of consciousness
780.39	Other convulsions
780.5	Sleep disturbances
782.1	Rash and other nonspecific skin eruptions
782.3	Edema
783.0	Anorexia
784.0	Headache
784.8	Hemorrhage from throat
786.5	Chest pain
787.0	Nausea and vomiting
801.0	Closed fracture of base of skull without intracranial injury
813.8	Fracture unspecified part of radius and ulna closed
820.8	Fracture of femur neck, closed
825.0	Fracture to calcaneus, closed

ICD-9	ICD-9 description
836.6	Other dislocation of knee open
840.9	Sprain shoulder
843	Sprains and strains of hip and thigh
892.0	Open wound foot except toes alone w/o complication
922.2	Contusion of abdominal wall
924.1	Contusion of knee and lower leg
924.3	Contusion of toe
924.2	Contusion of ankle and foot
953.4	Injury to brachial plexus
959.7	Other and unspecified injury to knee leg ankle and foot

Queries of EMedKW were performed to review the following data elements for each ICD-9 reviewed.

Data Check 1. Minimum time to RTD and percent of patients that RTD by FA.

Data Check 2. Tasks performed by FA across the services by role of care.

RESULTS

Data Check 1

The review of the minimum time to RTD and the percentage of patients that RTDed in an FA revealed a discrepancy in the data. Users expected that if an ICD-9 had a minimum time to RTD of 3 days, then patients would be evacuated at the lower levels of care and held until the patient had been in the medical system for 3 days. But simulations showed that patients were RTD immediately after treatment at the Role 1 battalion aid station or Role 2 emergency room. This inconsistency was due to the fact that the minimum time RTD was a recently-added data element and was not developed in conjunction with determining the percentage of patients that RTD.

To fix the discrepancies in the data, two changes were made; modification of minimum time to RTD for some ICD-9s and modifying the percentage of patients RTDing, taking into account the minimum time to RTD. The Excel file titled “Gary_Min Time to RTD v2 25 Sep 2012”

highlights where there were discrepancies in the data. The Excel file titled “RTDpercent102612xlsx” displays the data current as of 26 October 2012 with discrepancies corrected.

Data Check 2.

Data Check 2 was a review of the list of tasks performed at an FA at each role of care. Excel spreadsheets containing the data from a query of EMedKW, and a pivot table used to examine the data for each role of care, are found on the portal. The spreadsheet names are as follows:

- emergency forward care is named “EFC Tasks,”
- forward resuscitative care is named “FRS Tasks,” and
- the theater hospitalization care is named “THC Tasks.”

Examples of data inconsistencies included:

- patients were sent to x-ray, but the task to interpret the x-ray was not included in the treatment profile,
- anti-embolism therapy was not performed at all wards, and
- treatment documentation was missing from some FAs.

All identified data inconsistencies were corrected and a review process was implemented to maintain data consistency within a service, across the services, and within a role of care as new data are added to EMedKW.

Additionally, an action item list was created to capture any data discrepancies or coding issues discovered by users throughout the requirements testing process. Highlights of data changes as a result of issues revealed during testing are:

- implemented changes so that patients may not RTD from non-holding areas at the theater hospital care level and patients cannot evacuate from an intensive care unit;
- a notional average length of stay (ALOS) was implemented (this is not the doctrinal ALOS for an FA, but a minimum amount of time a patient would spend in an FA before they can be evacuated to the next level of care);
- treatment profiles for all life-threatening ICD-9s were added to Self/Buddy Aid and first responder FAs so that the mortality curve worked correctly; and
- modified grouped treatment profiles to reflect one x-ray task and a 20 min task time for x-ray (instead of multiple x-ray tasks), which kept patients in x-ray for greater than 60 min and created a bottleneck in the emergency room FA.

V&V Reporting Task Analysis

The FVWG conducted validation testing of JMPT beginning on 18 July 2012 and ended in

December 2012. The testing of the validation requirements was conducted at the FVWG member's location and results were briefed to the FVWG at weekly Defense Connect Online (DCO) meetings. At the DCO meetings, the FVWG member responsible for testing each of the various requirements being presented to the group provided a description of the tests that were conducted to validate a particular requirement, the results of the test, a recommendation to the group on whether to validate the requirement, and any recommendations for future improvements to the model. The FVWG conducted DCO meetings on the following dates:

- 18 July 2012
- 25 July 2012
- 8 August 2012
- 15 August 2012
- 22 August 2012
- 29 August 2012
- 5 September 2012
- 12 September 2012
- 19 September 2012
- 26 September 2012
- 3 October 2012
- 24 October 2012
- 7 November 2012

The briefing slides, along with the testing procedures, the test results, and the FVWG decisions/recommendations are provided in a separate PowerPoint file that accompanies this report.

Results Validation Task Analysis

The JMPT testing requirements were broken down into nine major areas:

1. theater medical laydowns,
2. scenario development,
3. scenario execution,
4. patient streams,
5. care providing,
6. transportation,
7. reporting,
8. documentation, and

9. reporting.

As stated previously, the accompanying PowerPoint file contains the test information for each particular requirement, the results of the test, a recommendation to the group on whether to validate the requirement, and any recommendations for future improvements to the model. A general summary of the test results broken down by each of the nine major areas is as follows.

Theater medical laydown requirements.

The testing of each of the theater medical laydown requirements was conducted through examination and performance testing of the model. Testers did not discover any validation issues during the testing of these requirements. The FVWG noted that additional medical capabilities will need to be added to the model to ensure all service capabilities exist within the model (Requirement 1.5). The FVWG also recommended the Joint Staff lead an effort to update the transportation capability data in the model (Requirement 1.6). Finally, the FVWG recommended that future versions of the model include additional PCOF tables that would enable planners to more accurately model scenarios in the different theaters (Requirement 1.7).

Scenario development.

The testing of each of the scenario development requirements was conducted through examination and performance testing of the model. There were several requirements within the scenario development area where the FVWG encountered validation issues.

- Requirement 2.1: While users were able to model casualty flow through a network of medical capabilities, the FVWG identified issues with where the casualties could enter the network. For example, existing mortality curves do not allow casualties to initially enter the medical network at a Level 2 or higher facility without losing the mortality curve functionality. The group recommended that future versions of the model allow casualties to enter at any point in the treatment system and assign the correct mortality curve based on entry point.
- Requirement 2.2: The system allowed the user to build a medical laydown, or scenario, using Common Database objects. However, the Common Database did not include many of the service medical capabilities. Additionally, there was no way to model the synergy provided when two medical capabilities were collocated (e.g., a Shock Trauma Platoon and a Forward Resuscitative Surgical System). The FVWG recommended these features be added to future versions of the model.
- Requirement 2.7: During testing, it was discovered that there was an error in the route scheduling logic. This error was corrected by the software developer and retested by the FVWG. The requirement was met after the retest was completed.
- Requirements 2.12 and 2.22: During testing of these two requirements, the FVWG detected a flaw in the patient routing logic that the model was using. It did not accurately reflect how medical regulating would take place on the battlefield. The flaw in the routing logic was considered significant enough that the software developer had to

change the logic in the model in order for the FVWG to validate these requirements. The proposed changes, detailed in Appendix D, were presented by the software developer and accepted by the FVWG. The model was updated by the developer and retested by the FVWG. After the retest, the FVWG validated these requirements.

- Requirement 2.23: During testing of Requirement 2.23 the FVWG discovered there were issues with both the data in EMedKW and the logic that JMPT was using as it related to evacuation delay and evacuation policy. These issues were addressed by both NHRC and the software developer and corrected. The requirements were retested and validated by the FVWG.

Scenario execution.

The only comment made by the FVWG when testing these requirements was that aborting a scenario seemed to take an inordinate amount of time.

Patient streams.

The testing of each of the scenario development requirements was conducted through performance testing of the model. There were two requirements within the patient streams area with which the FVWG had validation issues or comments.

- Requirement 4.1.3: The tester commented that, while the Mass Casualty Event Simulator worked as designed, planners would have requirements to use the Event Simulator in a different manner. The FVWG recommended that a Mass Casualty Event Simulator be added to the model that would allow the user to manually enter a specific mass-casualty event into the simulation.
- Requirement 4.2: Testing discovered that the user-defined KIA ratio was not calculating the number of KIAs correctly. This was corrected by the software developer, retested, and validated by the FVWG.

Care providing.

The testing of each of the care providing requirements was conducted by data review and performance testing of the model. The most significant finding by the FVWG in this area concerned Requirement 5.4 and the queuing of patients outside an MTF. This requirement was ultimately met when the software developer implemented the routing logic changes discussed earlier in this report.

Transportation.

The testing of each transportation requirement was conducted through performance testing of the model. The only requirement identified by the FVWG as having issues was Requirement 6.31. To address this, changes were made to the data for each ICD-9 code within EMedKW and to the timing of patient disposition tasks. This was extensively retested by the FVWG and ultimately validated.

Reporting.

The testing of each reporting requirement was conducted through performance testing of the model. During testing of Requirement 7.2.4.4 an issue with negative values for time was noted. This was corrected by the software developer and retested. The FVWG validated this task after the retest. The FVWG also noted that the report generator within JMPT, while meeting the reporting requirements of the model, did not produce the necessary reports for medical planners at the Combatant Commands. The Joint Staff representatives on the FVWG are to address the reporting requirements for the Combatant Commands and the JMPT reporting capabilities at a later date.

Documentation.

The testing of each of the documentation requirements was conducted through literature review. The only issue noted by the FVWG was that the closed captioning did not function correctly.

Training.

The testing of each of the training requirements was conducted through literature review. No issues were noted during the testing.

V&V RECOMMENDATIONS

After extensive testing and retesting, the members of the FVWG recommended to the Strategic Analysis Working Group (SAWG) that JMPT be validated. The Accreditation Decision Brief is provided in Appendix E.

KEY PARTICIPANTS

Accreditation Participants

Accreditation Authority:	Force Health Protection Integration Council (FHPIC)
Accreditation Agent:	Strategic Analysis Working Group (SAWG)
Accreditation Proponent:	Joint Chiefs of Staff (JCS), J4, Health Service Support Division (HSSD)

Accreditation Team

Technical Support/DTE:	Teledyne Brown Engineering, Inc. (TBE), point of contact (POC): Johnny Brock
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Education and Training: TBE, POC:	Sherry Adlich
Data Validation: NHRC, POC:	Vern Wing
JMPT Functional Validation:	Office of the Assistant Secretary of Defense, Force Health Protection and Readiness (OASD/FHP&R) POC: Rob Syvertson
Hardware Support: FHP&R, POC:	Gary Corrick

V&V Participants

Functional Validation Working Group (FVWG):

USPACOM	CAPT Wilcox, LCDR Chandler
USNORTHCOM	William MacKay
USSOUTHCOM	Thomas Paul
USCENTCOM	CDR Villacis
USAFRICOM	LTC Manning
USEUCOM	LCDR Harmon
USTRANSCOM	LT Anderson
USSOCOM	MAJ Farley
USN	CDR Tolbert
USMC	CAPT Jeffs, LT Queen
USAF	Lt Col Sumner
USA	Dave Wehrly, Debbie Lott
OSD	Gary Corrick
Joint Staff	MAJ Lehr, LCDR Arencibia

Other Participants

Booz Allen Hamilton	Robert Syvertson
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Teledyne Brown, Inc.	Sherry Aldrich
Teledyne Brown, Inc.	Johnny Brock
Teledyne Brown, Inc.	Abigail Spencer
Naval Health Research Center	Vern Wing

ACTUAL V&V RESOURCES EXPENDED

V&V Resources Expended

Hardware: 20 laptops

Budget

Travel for Validation Team	= \$200K
NHRC—.5 FTE, + .1 MGR	= \$105K
Developer—.5 FTE + .1 MGR	= \$105K
ATO + NMCI Cert	= \$ 90K
Validation Coordinator—.5 FTE	= \$150K
Total	= \$650K

V&V LESSONS LEARNED

Lessons learned during the JMPT V&V process included:

- Requiring training on the software, as well as the testing procedures, is critical to success.
- Providing systems to ensure all users can operate the software ensures that all participants can effectively participate in the testing.
- Standardizing reports ensures all required data is recorded and collected.

APPENDICES

APPENDIX A—M&S Description

APPENDIX B—Requirements Testing

APPENDIX C—Basis of Comparison

APPENDIX D—Routing Logic

APPENDIX E—Functional Validation Working Group Recommendation Brief

APPENDIX F—References

APPENDIX G—Acronyms

APPENDIX H—V&V Programmatic

APPENDIX A

MODELING AND SIMULATION DESCRIPTION

A.1 Modeling and Simulation (M&S) Overview

The Joint Medical Planning Tool (JMPT) is a stochastic, medium resolution, standalone, discrete-event simulation designed for medical planners that permits operational risk assessments and overall medical systems analysis/operations research studies for a range of military and civilian medical logistics scenarios. JMPT has also been used to support exercises (e.g., Terminal Fury 11). JMPT supports the Integrated Medical Logistics and Common Operational and Tactical Picture–Medical mission areas.

JMPT presents a systems view of the expeditionary medical treatment facility (MTF) network where the facilities are integrated with transportation assets and compete for medical/logistics resources (e.g., staff, equipment, consumables, and transporters) as patients flow from the point of injury to definitive care.

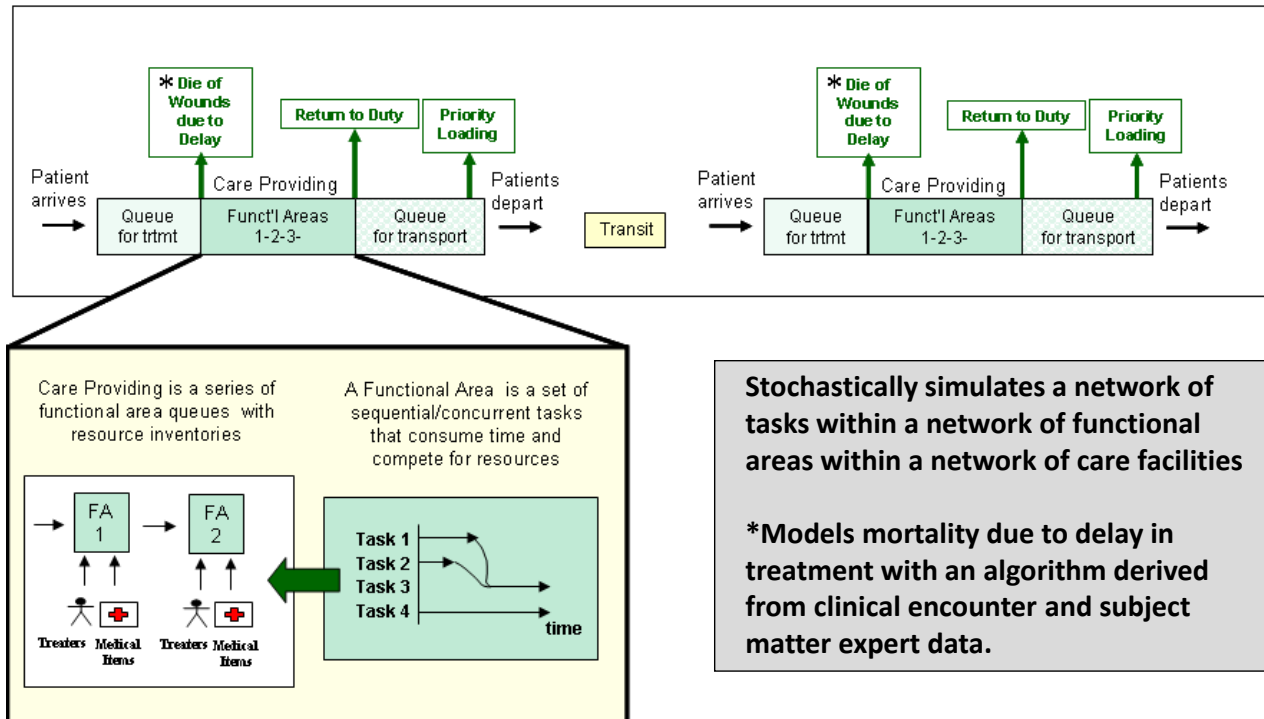
See the JMPT User Manual and JMPT Methodology Manual for details on the capabilities.

A.2 M&S Development and Structure

JMPT consists of five expandable modules:

1. scenario development,
2. patient stream generation,
3. care providing,
4. network and transportation, and
5. reporting.

The graphic below illustrates how JMPT simulates a queuing network of care facilities connected by transportation assets.



JMPT uses a graphical user interface (GUI) to easily create baseline scenarios and excursions, execute scenarios, and analyze the results.

1. Creating a scenario

Creating a scenario in JMPT is like building with Lego bricks—you construct your scenario from many smaller objects such as medical facilities, transportation assets, patient streams, and more. Users drag and drop the desired medical capabilities onto either a geographical map view or a network view. The user describes the flow of patients from one medical facility to another by connecting the facilities visually with a “route link.” Medical evacuation and casualty evacuation (MEDEVAC/CASEVAC) assets are defined by copying and pasting existing assets, or creating new transportation assets from scratch. The evacuation assets then may be placed on the map view or network view by dragging and dropping. The casualties are created in a similar fashion.

The user may validate the scenario to determine whether errors exist (e.g., no route exists between first responder care and surgical care).

2. Executing a scenario

The user may “run” a single scenario or run several scenarios in batch mode. The progress of the run is displayed, and the user may abort the run at any time. In addition, JMPT contains a “convenience” feature to quickly increase (or decrease) the number of casualties flowing

through the medical laydown for a scenario.

3. Analyzing the results

JMPT produces a large set of dynamic reports that detail medical system effectiveness, mortality, patient disposition, throughput, holding, resource utilization, and many others. Reports may be displayed in a variety of formats including tabular, charts/graphs, distribution/percentile, time series, and more. Tabular data may be filtered, sorted, and exported to Excel. The user may define a report and save it as a “favorite” for later use. In addition, the user may configure “alerts” to quickly highlight data that meets user-defined criteria.

A.2.1 JMPT hardware and software specification

JMPT is a 32-bit application that runs standalone on a Microsoft Windows computer. The minimum hardware configuration for JMPT is the following:

- a 2 GHz (or faster) 32-bit (x86) or 64-bit (x64) processor,
- a 2 GB minimum RAM (4 GB recommended),
- a 1 GB of available hard-disk space for installation; additional 20 GB free space required for simulation execution (40 GB recommended), and
- no special video cards required.

In addition, software requirements include:

- JMPT executes on a Microsoft Windows XP, SP3, or Windows 7 operating system;
- JMPT requires Internet Explorer to view Web pages (HTML content);
- JMPT requires Abode Reader to view PDF files; and
- JMPT requires Adobe Flash Player to play back multimedia tutorials.

Finally, the prerequisites for JMPT are shown below. These components, if not already present, will be installed by the JMPT installer from the internet. Note that these software components are also available on a CD-ROM upon request.

- Microsoft .NET Framework 4 (Standalone Installer)
- Microsoft SQL Server Compact 3.5 SP2
- Crystal Reports for Visual Studio 2008

A.2.2 JMPT development environment:

JMPT was developed using the agile software development processes. The development team emphasizes the following best practices:

- develop iteratively,
- manage requirements,
- use component architectures,
- model visually,
- continuously verify quality, and
- manage change.

A Configuration Control Board (CCB) was established to adjudicate proposed enhancements to JMPT. The CCB meets regularly (currently monthly) and is composed of stakeholders who have interests in JMPT development path forward. Microsoft's Team Foundation Server (TFS) is used to track known software flaws and potential enhancements.

The development team was appraised to Capability Maturity Model Integration Level 2.

The JMPT development environment consists of the following major tools:

- Microsoft Visual Studio 2010,
- Microsoft.NET Framework 4.0, and
- Microsoft Team Foundation Server.

JMPT was developed using the C# and C++ programming languages.

JMPT uses the following third-party software components:

- Microsoft SQL Server Express (database);
- Infragistics NetAdvantage (GUI framework);
- ChartFx for .NET (charts and graphs);
- GoDiagram for .NET (diagramming);
- ESRI MapObjects (geographical information system); and
- Microsoft XML Parser (data format).

All components are licensed for royalty-free distribution.

A.3 M&S Capabilities and Limitations

See the JMPT User Manual and JMPT Methodology Manual for details on the capabilities and limitations.

A.4 M&S Use History

NHRC has completed 22 studies and analyses for 14 different organizations since 2004 with the aid of JMPT. Table 3 shows the studies and analysis titles and sponsor organizations. The issues

were extremely varied but generally involved improving the flow of casualties in the chain of tactical treatment and evacuation to reduce mortality and morbidity. Results typically addressed increasing the availability and efficiency of constrained medical resources through the adjustment of network operating rules, organizational and manning structures, equipment and supply levels, and facility deployments.

Table 3
Medical Studies & Analysis Initiatives by NHRC (2004–2011)

Date	Title	Organization
2004	Sea basing & high speed vehicle evacuation	Naval Warfare Development Center (NWDC)
2004	Marine Corps medical manpower study	Marine Corps Combat Development Command (MCCDC)
2005	Ship to Objective Maneuver (STOM)	Marine Corps Warfighting Lab (MCWL)
2006	Medical manpower requirements to support the Marine Corps	MCCDC
2006	Distributed operations	MCWL
2006	Strong Angel III—Pandemic flu response	Bureau of Medicine and Surgery (BUMED)
2007	Expeditionary Resuscitative Surgery (ERSS) validation	Fleet Forces Command (FFC)
2007	Medical battalion enhancement initiative	Headquarters Marine Corps
2007	Expeditionary medical facilities (EMF) throughput analysis	OPNAV N41, BUMED M5
2008	CASEVAC autonomous aircraft characteristics study	Office of Naval Research (ONR)
2009	Global Naval Expeditionary Care System (GNECS) gaps analysis	NWDC
2009	Medical battalion reorganization: Impact of SAT	1st Medical Battalion
2009	Determination of casualties for battle group engagements	WCM, N81H
2010	Determining combat casualty streams for ashore campaigns	OPNAV N81
2010	World Class Modeling (WCM) Medical Planning Cost Tool	WCM, N81H
2010	Sea base MEDEVAC support study	N81H
2010	WCM skip factor policies	WCM, N81H
2011	LHA (R) medical configuration study	Program Executive Office (PEO) Ships
2011	WCM Medical Planning Cost Tool development	WCM, N81H
2011	Adaptive force packaging & specialty team design	BUMED
2011	Automated critical care system manpower impact analysis	ONR
2011	WCM skip factor policies model enhancement implementation	WCM, N81H

The JMPT user community includes the following:

- Navy
 - Bureau of Medicine and Surgery (BUMED)
 - Office of Naval Research (ONR)
 - Naval Air Systems Command (NAVAIR)
 - Center for Naval Analyses (CNA)
 - U.S. Pacific Command (USPACOM)
 - Fleet Forces Command (FFC)
 - Navy Expeditionary Combat Command (NECC)
 - Naval Health Research Center (NHRC)
 - Naval Special Warfare Center, Carderock, MD (NSWC/CD Carderock)
 - Naval War College
 - Office of the Chief of Naval Operations (OPNAV) N41
- Marine Corps
 - Headquarters, Marine Corps (HQMC)
 - Marine Corps Combat Development Command (MCCDC)
 - Marine Corps War-fighting Laboratory (MCWL)
 - Marine Corps Systems Command (MARCORSYSCOM)
- Air Force
 - Air Force Medical Operations Agency (AFMOA)
- Army
 - U.S. Northern Command (USNORTHCOM)
 - Army Medical Department (AMEDD)
 - U.S. Army Medical Materiel Agency (USAMMA) (AMEDD)
 - U.S. Army Research, Development, and Engineering Command (RDECOM)
 - Directorate of Combat Doctrine Development (DCDD)
 - Medical Evacuation Proponency Directorate (MEPD)
 - 6th Medical Logistics Management Center (MLMC)
- U.S. Coast Guard
- Joint
 - Deputy Assistant Secretary of Defense/Health Affairs/TRICARE Management Activity (DASD/HA/TMA) (OSD)
 - Office of the Assistant Secretary of Defense for Health Affairs, Force Health Protection & Readiness (OASD(HA)/FHP&R) (OSD)
 - U.S. Transportation Command (USTRANSCOM)
 - Defense Medical Standardization Board (DMSB)
- Contractors

- Johns Hopkins University
- MITRE Corporation
- Booz Allen Hamilton, Inc.
- Science Applications International Corporation, Inc. (SAIC)
- Other Organizations
 - Department of Homeland Security (DHS)
 - U.S. Department of Health and Human Services, Washington, DC (HHS)
 - Disaster Medical Assistance Team (DMAT)

A.5 Data

A.5.1 Input data

JMPT inputs include the following:

- capabilities of care;
- functional areas (FAs);
- personnel;
- personnel skill sets;
- patient conditions/ICD-9 codes;
- supplies (including weight, cube, and cost);
- patient treatment profiles (including tasks, times, sequences, responsible personnel, and supplies needed);
- died of wounds (DOW) due to delay; and
- the type, speed, and capacity of transportation assets.

JMPT makes use of the following database and predictive tools:

- Expeditionary Medical Encounter Database (EMED). EMED is a data repository providing an objective source of clinical data from which to determine theater medical requirements. EMED data are obtained from the clinical records generated as sick or injured casualties moved through the medical chain of evacuation. These data are used to determine injuries and illnesses and estimate wounded in action (WIA) and disease and nonbattle injury (DNBI) rates. The rates and distribution of patient types serve as input to JMPT.
- Expeditionary Medical Knowledge Warehouse (EMedKW). EMedKW is a service-oriented architecture system implemented via Web services designed to protect and organize medical data in support of the NHRC analysis mission. All of JMPT's underlying data is resident in EMedKW. JMPT uses a "snap shot" of the data.
- The Ground Forces Casualty Forecasting System (FORECAS) tool. FORECAS was developed at NHRC, which uses statistical estimations based on data from previous

actual combat scenarios to project numbers of WIA, killed in action, and DNBI for a given situation. JMPT uses FORECAS in producing casualty estimates for its scenarios.

A.5.2 Output data

JMPT produces a large set of dynamic reports that detail medical system effectiveness, mortality, patient disposition, throughput, holding, resource utilization, and many others. JMPT generates basic, advanced, and “ad hoc” reports.

BASIC REPORTS

- Summary reports
- Overall summary
- Casualty statistical reports
- Casualty input
- Overall casualty statistics
- Casualty input across time
- Casualty input across MTF
- Casualties by type
- Casualties by population group
- Casualties by PC (patient condition) category
- Casualties by ICD-9 category
- Casualties by DOW mortality risk
- Casualty arrival stream by period
- Casualty output
- Casualties by final disposition
- Casualties by final disposition & MTF
- Casualty throughput across MTFs
- Casualty output by final disposition and time
- Casualty statistical assumptions
- Care providing reports
- Casualty timing reports
- Time in system (TIS) statistics by MTF
- Time in system (TIS) statistics by FA
- Casualty time in system (TIS)
- Casualty time in system (TIS) by MTF
- Casualty by MTF by time

- Casualty by FA by time
- Tasks, task time, and task delay reports
- Task time per casualty across MTF
- Tasks performed by FA
- Average casualty flow across MTFs
- Equipment, consumables, & personnel reports
- Consumables used by FA
- Equipment utilization by FA
- Personnel utilization by FA
- Weight/cube/cost details by FA
- Care providing assumptions
- Transportation reports
- Time related reports
- Transport utilization
- Requests for transport by MTF
- Transports requested by route by period
- Composition reports
- Transportation statistics by route
- Transportation details by route
- Transportation trip composition by route
- Transportation assumptions
- General reports
- Scenario graphics
- Network view
- Network view with scenario info
- Map view
- Scenario properties
- Audit
- All assumptions

ADVANCED REPORTS

- Care providing reports
- Casualty timing reports
- Casualty time from injury to care by FA
- Tasks, task time, and task delay reports

- Task delay by FA
- Number of casualties by min task wait time by FA
- Equipment, consumables, & personnel reports
- Personnel utilization by period
- Supply and personnel effectiveness
- Transportation reports
- Time related reports
- Transportation asset one way travel time
- Casualty one way travel time & delay
- General reports
- User defined query

A.6 Configuration Management

Microsoft's TFS provides configuration management of JMPT documentation and source code. TFS provides version control and seamless integration with Visual Studio. It supports teams doing parallel development and includes many features like atomic check-ins, branching and merging, shelving, labeling, concurrent check-outs, check-in policies, and the association of check-ins with work items.

The following JMPT documentation is under configuration management:

- JMPT source code
- JMPT release notes
- JMPT user's manual
- JMPT methodology manual
- JMPT reports guidance
- JMPT data dictionary
- JMPT assumptions
- JMPT training material
- Overview tutorial (multimedia)
- Scenario building tutorial (multimedia)
- Reports tutorial (multimedia)
- Syllabus introduction to JMPT
- Syllabus advanced JMPT training
- Instructor-led introductory training course
- Instructor-led advanced JMPT training

- Technical reports
- Modeling dynamic casualty mortality curves in JMPT
- Simulating dynamic mortality within the military medical chain of evacuation and treatment
- JMPT: Modeling operational risk assessment
- The development of the Joint Medical Planning Tool (JMPT)
- Studies
- Operations in complex and distributed environments: A case study using JMPT
- Using JMPT to validate the Expeditionary Resuscitative Surgical System

APPENDIX B

REQUIREMENTS TESTING

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
Theater medical laydowns					
1	General				
1.1	The system shall be populated with NHRC data from the Expeditionary Medical Knowledge Warehouse (EMedKW). This data shall be read-only.	Examination	User will directly observe Joint Medical Planning Tool (JMPT) input data to determine whether the data has been imported from EMedKW (using an EMedKW data dictionary for comparison). Users will verify that data input from EMedKW is read-only.	The data used by JMPT is populated with data from EMedKW.	
1.2	The system shall allow the user to view all underlying data (i.e., the Common Database). The Common Database shall include medical capabilities, transportation capabilities, patient condition frequencies, assumptions, and more.	Examination	User will examine the Common User Database. At a minimum, information will include medical capabilities, transportation capabilities, patient condition frequencies, assumptions, and more.	The user is able to view the EMedKW data using the Common Database function.	
1.3	The system shall allow users to modify the common data objects by copying.	Performance test	User will test the ability to copy and modify objects in the Common User Database. Testers will verify the modification of the data makes appropriate changes in the model output.	Users are able to modify objects in the Common Database by copying and see results reflecting the changes made to the objects.	
1.4	The system shall allow users to export and import objects in the Common Database for sharing purposes.	Performance test	User will test the ability to import and export objects in the Common User Database. Testers will verify the objects have imported and exported successfully by exchanging various objects (e.g., medical treatment facilities [MTFs], transportation assets, patient condition occurrence frequency [PCOF] tables, and more) with other testers (via email and via Portal), and comparing results.	Users are able to export modified objects from the Common Database and exchange those objects with other users and obtain the same results.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
1.5	The system shall present the medical capability data as including one or more functional areas (FAs), personnel, personnel assignments, personnel skill levels, tasks, task sequences, task times, required personnel to perform tasks, and supplies and equipment at the National Stock Number (NSN) level.	Examination	Users will examine each MTF to verify availability of the following datasets: FAs, personnel, personnel assignments, personnel skill levels, tasks, task sequences, task times, required personnel to perform tasks, and supplies and equipment at the NSN level. Users will verify, at a minimum, that appropriate FAs, personnel assignments and levels, supplies and equipment (when appropriate) are inputted from EMedKW in accordance with appropriate authorization documents.	The system effectively presents the medical capability data as including one or more FAs, personnel, personnel assignments, personnel skill levels, tasks, task sequences, task times, required personnel to perform tasks, and supplies and equipment at the NSN level.	Need to add additional medical capabilities to ensure all service capabilities can be modeled.
1.6	The system shall present the transportation capability data as including speed, capacity, loading and unloading times, pre-mission delays, post-mission delays, and ground wait time.	Examination	Users will examine each transportation asset to verify availability of the following datasets: speed, capacity, loading and unloading times, pre-mission delays, post-mission delays, and ground wait time. Users will verify, at a minimum, that speed, capacity, loading and unloading times, pre-mission delays, post-mission delays, and ground wait time are in accordance with appropriate service doctrine.	The system effectively presents the transportation capability data as including speed, capacity, loading and unloading times, pre-mission delays, post-mission delays, and ground wait time. There are several assets that need minor changes and some assets that need to be added/deleted.	Need to verify transportation data with services.
1.7	The system shall use Patient Condition Frequency data, which includes probabilities of a casualty type occurring for a specific theater.	Examination	User will examine the JMPT PCOF tables to determine whether it includes probabilities of a casualty type occurring for a specific theater.	(1) Definite differences when different theater PCOFs were used. (2) Future requirement to add theater specific as well as PCOFs for different scenarios.	Routing graphics changed when saved scenarios are reopened.
1.8	The system shall allow the user to view the assumptions for each major area (e.g., casualty generation, care providing, and transportation).	Examination	User will validate the assumptions for each major area (e.g., casualty generation, care providing, and transportation).	Users can effectively view assumptions for major areas (e.g., casualty generation, care providing, and transportation).	
2	Scenario Development				

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
2.1	The system shall model casualty flow through a network of medical capabilities.	Performance test	User will develop a medical network and observe casualty/patient flow through the network. JMPT will effectively model casualty/patient flow through various medical networks that include various combinations of MTFs and transportation assets as well as a variable number of casualties input in to the system.	The system modeled casualty flow through a network of medical capabilities (both ashore and afloat).	<p>Existing mortality curves:</p> <p>Do not allow casualties to enter anywhere within the system.</p> <p>Entry at Role 2 or higher.</p> <p>Can overcome this with the use of additional Icons.</p> <p>Overly busy.</p> <p>Tedious.</p> <p>Recommendation: Allow casualties to enter at any point in the treatment system and assign the correct mortality curve based on entry point.</p>
2.2	The system shall allow the user to build a medical laydown, or scenario, using Common Database objects.	Performance test	User will ensure JMPT is able to effectively build a medical laydown, or scenario, that allows users to effectively model appropriate medical scenarios.	The system allowed the user to build a laydown or scenario using Common Database objects.	<p>Additional recommendations:</p> <p>Add capability multiplier to the MTF to represent Navy facilities.</p> <p>Build an appropriate icon and associated mortality curve to represent the Shock Trauma Platoon/Forward Resuscitative Surgical System when used in combination. There may be other circumstances as well (e.g., Fleet Surgical Team and brigade support medical company) where capabilities can be deployed separately or together.</p>

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
2.3	The system shall allow the user to specify casualty arrival patterns/KIA (killed in action) probability, MTF locations (relative or geographic), transportation assets, evacuation routes, routing rules, evacuation policies, scenario length, number of replications, output options, classification, and more.	Performance test	User will examine the following properties: casualty arrival patterns/KIA probability, MTF locations (relative or geographic), transportation assets, evacuation routes, routing rules, evacuation policies, scenario length, number of replications, output options, classification, and more. Users will develop scenarios to test that change to each property causes appropriate changes in the model output.	Users are able to specify casualty arrival patterns/KIA probability, MTF locations (relative or geographic), transportation assets, evacuation routes, routing rules, evacuation policies, scenario length, number of replications, output options, classification, and more.	
2.4	The system shall allow the user to specify the type of casualty: wounded in action (WIA), non-battle injury (NBI), disease (DIS), and/or battle fatigue (BF), as well as theater (Southwest Asia [SWA], Northeast Africa [NEA], Europe, Operation Iraqi Freedom [OIF]).	Performance test	User will determine whether JMPT allows users to specify the following types of injuries: WIA, NBI, DIS, and/or BF, as well as theater (e.g., SWA, NEA, Europe, and OIF). Testers will develop appropriate tests to determine whether the model accurately generates the types of casualties in accordance with appropriate user inputs.	User is able to specify the type of casualty: WIA, NBI, DIS, and/or BF.	
2.5	The system shall allow the user to specify the patient condition frequency for a patient stream in an identified theater.	Performance test	User will observe that appropriate PCOF tables exist for identified theaters. Testers will develop test scenarios to determine that patient streams are generated in accordance with user specified patient occurrence frequencies.	User is able to specify a patient condition frequency for a patient stream.	As discussed in Requirement 1.7, there is a need for additional PCOF tables.
2.6	The system shall allow the user to assign point of injury (POI), or MTF where casualty enters simulation) probabilities.	Performance test	User will verify that the system allows users to assign probabilities at the POI to determine at which MTF casualties enter the system. Testers will develop scenarios to determine whether user assigned probabilities at the POI are accurately reflected in model output.	Users are able to assign POI probabilities to MTFs and, when running the scenario, get the probabilities selected. Validated by using the casualty time in system by MTF and casualty time in system reports. There were 50	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
				replications run to achieve results.	
2.7	The system shall allow the user to define schedules (availability) for deployed MTFs, transports, or evacuation routes.	Performance test	User will verify that JMPT allows the user to effectively establish schedules (availability) for deployed MTFs, transports, or evacuation routes. Testers will develop scenarios to ensure JMPT allows users to model schedules (availability) for deployed MTFs, transports, or evacuation routes and results change in accordance with user expectations.	Users are able to set schedule availability to MTF and transportation assets. Validated by using casualty by MTF by time report and by casualty one way travel time and delay reports. Re-Test: The Re-test for 2.7 demonstrates that JMPT functions as required with regard to evacuation routes.	Setting a schedule on route has a bug. When I tried to set the schedule for a route to the EMF, the schedule only worked for first part of schedule. However, when switched route schedule to Surgical Company (SC) from the battalion aid station (BAS), it was validated using the transportation details by route report.
2.8	The system shall allow the user to model maneuver.	Performance test	User will verify that JMPT effectively models the movement of objects during a scenario. Testers will develop scenarios to ensure JMPT allows users to model the movement of objects within a scenario and results change in accordance with user expectations.	Users are able to set a maneuver table and validated by using the transportation asset one way travel time report. Time travel varies due to distance set in maneuver table.	
2.9	The system shall allow the user to assign priorities for transports and/or evacuation routes.	Performance test	User will verify that the the system allows the user to assign priorities for transports and/or evacuation routes. Testers will develop scenarios to determine whether priorities for transportation assets and/or evacuation routes function in accordance with user inputs.	The user is able to effectively prioritize evacuation routes and transportation assets.	
2.10	The system shall allow the user to assign a probability of transport failure.	Performance test	User will verify the system allows the user to assign a probability of transport failure to each transportation asset. Testers will develop scenarios to determine whether transportation assets fail in accordance with user inputs.	Users are able to effectively model transportation failure.	Ability to model availability/unavailability may also be useful (medical evacuation available during Phase 1 of operation).

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
2.11	The system shall allow the user to classify a transport as designated or lift of opportunity (LOO).	Performance test	User will verify the system allows them to designate transportation assets as dedicated or lifts of opportunity. Test scenarios will be developed that include both dedicated evacuation assets and lifts of opportunity and the results examined to ensure the model output is as expected.	Results are as expected.	(1) User's Manual lacks detail in explanation of capability. (2) There should also be a feature that addresses asset availability (for example, an aircraft is chopped for patient evacuation during daylight hours).
2.12	The system shall allow the user to model detached or attached transportation pools.	Performance test	User will develop scenarios using both attached and detached transportation pools and ensure transportation assets behave in accordance with established criteria.	Attached and Detached Pools work in accordance with expectations.	(1) Apparent disconnect with Summary Report and detailed reports. (2) Model logic when casualties are at MTF but arrival exceeds the MaxWaiting? Casualties request new transport, don't enter facility, even if queue empties. Casualties with higher priority for treatment could arrive but not "bump" lower priority casualty in MaxWaiting.
2.13	The system shall allow the user to designate patients that can request/load a specific transport.	Performance test	User will develop scenarios during which specific patient types (i.e., <i>International Classification of Diseases</i> , 9th Revision [ICD-9] code, type, and mortality risk) request specific transportation assets and ensure model output is in accordance with established criteria.	JMPT is working correctly and providing useful output to show the user can designate patients that can request/load a specific transport.	
2.14	The system shall allow the user to implement evacuation routes between MTFs.	Performance test	User will develop scenarios that create evacuation routes between facilities and see that patients are appropriately evacuated along the established evacuation routes.	JMPT is working correctly and providing useful output to show the user can implement evacuation routes between MTFs.	
2.15	The system shall allow the user to define a ground distance multiplier on specified routes.	Performance test	User will develop a scenario and compare outputs of runs that use a ground multipliers on routes (including air, ground, and sea) to ensure appropriate distances/times are reflected in results.	JMPT is working correctly and providing useful output to show that the user can define a ground distance multiplier for specified routes and that the simulation uses the ground distance multiplier correctly.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
2.16	The system shall allow the user to select the option to model the evacuation of deceased patients.	Performance test	User will develop scenarios that require deceased patients to be evacuated and ensure model outputs are in accordance with user expectations.	JMPT is working correctly and providing useful output to show that in the tool, a user is able to select an option to evacuate deceased patients and the simulation does then evacuate died of wounds (DOW) and KIA patients.	
2.17	The system shall allow the user to set route distances to random for the purpose of modeling variations in travel time.	Performance test	User will develop a scenario and compare outputs of runs that use random distances on routes (including air, ground, and sea) to ensure appropriate distances/times are reflected in results.	Results are as expected.	
2.18	The system shall allow the user to set a route as divert.	Performance test	User will develop a scenario and compare outputs of runs that use divert routes (including air, ground, and sea) to ensure the use of appropriate assets/distances/times are reflected in results.	Results are as expected.	
2.19	The system shall allow the user to set a transport as divert capable.	Performance test	User will develop a scenario and compare outputs of runs that use diverted transportation assets (including air, ground, and sea) to ensure the use of appropriate assets/distances/times are reflected in results.	Results are as expected.	
2.20	The system shall allow the user to turn on the Audit Report (which outlines every event and outcome occurring within the simulation).	Examination	User will develop a scenario and observe the audit report for the scenario.	The Audit Report provides Users a powerful tool to analyze how the model is simulating the medical network by providing a detailed listing of all events and their outcomes that occur within the simulation.	
2.21	The system shall allow the user to view and/or run sample scenarios.	Examination	User will examine the sample scenarios and verify they are executable.	Results are as expected.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
2.22	The system shall allow the user to define when an MTF is busy.		Users will create a scenario and establish busy policies for the MTFs.	The user has the ability to define when an MTF is busy and the outputs met expectations in terms of the user defined inputs.	<p>(1) Real-world medical regulating is not reflected in the model when two Priority 1 routes are established. In the model, as long as some criteria (MaxInFA and MaxWaiting) is not exceeded, all the causalities will flow along the Priority 1 route established first. In the real-world, casualties would most likely be more evenly distributed between the two facilities.</p> <p>(2) As previously noted, the MaxWaiting logic may need to change. For example, a CH-53E with 24 litter patients (max capacity) arrives at a SC with triage MaxInFA = 6 and MaxWaiting queue = 12. Eighteen of the 24 casualties would be treated at the SC but the remaining six would request an evacuation asset and not be treated at the SC. Another evacuation could arrive with a high priority casualty and that casualty would not “bump” a low priority casualty from the waiting queue.</p>
2.23	The system shall allow the user to define an evacuation policy for Forward Resuscitative Care and Theater Hospitalization as it pertains to casualties who return to duty (RTD).		Verify that the user is able to establish evacuation policies within the simulation and that the evacuation policies are appropriately implemented.	The model appears to perform evacuation policy correctly with the data sets given. Re-Test: (1) There are still concerns regarding data elements (consistency, accuracy) as they pertain to evacuation decisions. (2) There seems to be a software bug that impacts the	Disconnect between Minimum RTD times and Evacuation Decision (Task 278). All ICD-9 data needs to be reconciled for evacuation and RTD decision processing. Treatment and holding times do not meet expected values at FRC and TH based on Min RTD times.

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
				effective application of evacuation delay.	
2.24	The system shall allow the user to define conditions for determining skip-eligible casualties and select which routes the Non-skip and Skip casualties will take. Skip conditions are defined for a specified MTF.		Verify that the user is able to establish skip policies within the simulation and that the skip policies and associated routing are appropriately implemented.	The system works as expected.	
2.25	They system shall allow the user to set Evacuation Unavailability for specified transports. Current data only available for C-17 & C-5.		Users will create a scenario and verify the ability to set Evacuation Unavailability for specified transports.	In this scenario the system functioned as predicted. In the simulations run; when evacuation unavailability was set to "False," the assets did not have any maintenance issues and were employed for the duration of the scenario. In the simulations run; when evacuation unavailability was set to "True" and the critical failure/mission capable rates were increased the assets did encounter maintenance issues and as a result the system made the assets unavailable for employment. JMPT passed objective 2.25, based on this assessment.	
3	Scenario Execution				
3.1	The system shall allow the user to execute (run) the scenario.	Performance test	User will build a scenario and verify the scenario will execute.	Users have the ability to execute a scenario.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
3.2	The system shall allow the user to increase or decrease the output of all casualty generators using casualty multipliers.	Performance test	User will develop a scenario and compare outputs of runs that use a casualty multiplier to ensure an appropriate number of casualties are reflected in results.	Users are able to apply casualty multipliers to casualty generators.	
3.3	The system shall allow the user to batch execution of scenarios.	Performance test	User will generate multiple scenarios and ensure the scenarios can be run as a batch.	Users have the ability to execute multiple scenario concurrently.	
3.4	The system shall allow the user to abort a run.	Performance test	User will verify that a scenario can be aborted after starting the run.	Users have the ability to abort a scenario.	Aborting a scenario seems to take an inordinate amount of time.
Patient streams					
4	Patient Streams				
4.1	The system shall generate patient streams by four methods.	See 4.1.1, 4.1.2, 4.1.3, 4.1.4			
4.1.1	The system shall generate patient streams at a constant rate according to an assumed Poisson process ("Rate").	Performance test	User will design a scenario that generates an expected # of casualties, at the correct time, with the correct type of injuries and patient condition using a rate and verify the expected values are produced in the output results.	The system generated patient streams at a constant rate consistently The Poisson cumulative distribution function (CDF) is pictured below (reference Wikipedia), the graph of the JMPT patient arrivals mimics the Poisson CDF at the rate tested. The requirement does meet the intent to generate constant patients with a Poisson arrival rate.	
4.1.2	The system shall generate patient streams at different rates across a collection of time intervals according to an assumed Poisson Process ("Table").	Performance test	User will design a scenario that generates an expected # of casualties, at the correct time, with the correct type of injuries and patient condition using a table and verify the expected values are produced in the output results.	The system generated patient streams at different rates as specified in the table in the scenario. As in Requirement 4.1.1, the graph of the JMPT patient arrivals mimics the Poisson CDF at the rate tested. The requirement meets the	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
				intent to generate casualties at different rates according to the input table using Poisson rates.	
4.1.3	The system shall generate patient streams as casualty events involving multiple casualties arriving at a single time, across a collection of time intervals. The number of events shall be a Poisson random variable and the number of casualties shall be a geometric random variable ("Mass Casualty Event").	Performance test	User will design a scenario that generates an expected # of casualties, at the correct time, with the correct type of injuries and patient condition using a mass casualty table and verify the expected values are produced in the output results.	<p>The system generated Mass Casualty Event patient streams.</p> <p>The events themselves were generated randomly when users will have requirements to generate them for planning purposes manually. There is no guarantee that you will get the event you planned with the current Mass Casualty generator.</p> <p>Recommend there be a manual input for this function.</p> <p>Undetermined whether the number of events generated follow a Poisson random variable and the number of casualties follow a geometric variable, HOWEVER, the mean number of casualties and the mean number of events were equal to the inputs on all replications that were run.</p> <p>Further testing is needed to determine whether the casualties generated follow the distributions required and can be done in the next weeks of the verification & validation (V&V).</p>	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
4.1.4	The system shall allow the user to generate patient streams with user-defined time, POI, injury type, and patient condition ("User Defined").	Performance test	User will design a scenario with a user-defined KIA ratio that generates an expected # of casualties, at the correct time, with the correct type of injuries and patient condition using a user defined patient generator and verify the expected values are produced in the output results.	The system allowed the user to generate patient streams with user defined inputs. The system fulfilled the requirement as stated.	
4.2	The system shall determine initial patient disposition (i.e., KIA) of a WIA casualty using a Bernoulli trail with success probability equal to the user-defined KIA ratio.	Performance test	User will design a scenario with a user-defined KIA ratio and verify that initial patient disposition (i.e., KIA) of each WIA casualty uses a Bernoulli trail with success probability equal to the user-defined KIA ratio.	The system allowed the user to change the KIA ratio and generate output. The system provided correct outputs of KIAs when the KIA to WIA ratio was set to a number larger than 0. The parameter was correct when the KIA ratio was assumed to be a fraction rather than a ratio. For example, when you enter for a KIA Ratio - Number KIA: 1, Number WIA: 4, JMPT interprets that as $\frac{1}{4}$ (.25). More correctly, a 1KIA:4WIA KIA ratio would be reflected as $\frac{1}{5}$ (.20), 1 of the 5 casualties is KIA, the remainders are WIA. The KIA ratio parameter is working as intended, but is not properly defined as a fraction or percentage versus a ratio. Re-Test: "Immediate" KIAs are calculated correctly based on user inputs. KIA percentage works as expected.	
4.3	The system shall randomly assign patients to POIs based on set probabilities.	Performance test	User will design a scenario with multiple points of injury and verify that the system randomly assigns patients to POIs based on probabilities input by the user.	The system allowed the user to randomly assign patients to POIs based on set probabilities. The system fulfilled the requirements as stated.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
Care providing					
5	Care Providing				
5.1	The system shall allow MTFs to accept patients only when said MTFs are available.	Performance test	Users will design a scenario with multiple MTFs with varying availabilities. Users will verify that casualties flow only to MTFs that are available when the patient movement request is made.	JMPT is working correctly and providing useful output to show that in its simulation, MTFs accept patients only when they are "available."	
5.2	The system shall provide treatment to patients as a series of medical tasks based on the casualty's patient code.	Performance test/data review	Users will examine the EMedKW data for multiple ICD-9 codes and verify that treatment to patients consists of series of medical tasks based on the casualty's patient code. Users will create a scenario with patients of varying ICD-9 codes and verify that treatment to patients consists of series of medical tasks based on the casualty's patient code within the simulation.	JMPT is working as expected. It treated the patients using the prescribed tasks for each ICD-9 patient condition.	
5.3	The system shall allow patients with the same patient code to be treated differently (via task performed probabilities).	Performance test/data review	Users will examine the EMedKW data for multiple ICD-9 codes and verify that patients with the same patient code are treated differently (via task performed probabilities). Users will create a scenario with patients of varying ICD-9 codes and verify that patients with the same patient code are treated differently (via task performed probabilities) within the simulation.	JMPT is working as expected. It used probabilities to treat patients differently based on the probabilities listed in the common data.	
5.4	The system shall model patient treatment based on treatment priority.	Performance test	Users will create a scenario with multiple patients and verify that the patients are evacuated/treated in accordance with the treatment priorities.	JMPT did not properly prioritize the patients that arrived at the BSMC for treatment. Three of the highest priority patients and three of the medium priority patients were evacuated directly to the next level of care without treatment. Eight of the lowest priority patients were treated in the BSMC. Expected to see the highest priority patients treated first. The low priority patients could tolerate waiting for treatment with evacuation on to the next level of care.	The model should not simply evacuate patients when an MTF reaches its maximum. The excess patients should queue and the model should report the backlog.

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
				Had there been no “patient overflow”, JMPT would have treated in the correct priority order.	
5.4	UPDATED				
5.5	The system shall model tasks sequentially using the Generic Task Sequence (GTS).	Performance test/data review	Users will examine the EMedKW data for multiple ICD-9 codes and examine the GTS. Users will create a scenario with patients of varying ICD-9 codes and verify that treatment to patients uses the GTS casualty’s within the simulation.	JMPT is performing as expected. It treated patients sequentially in the order of treatment described in the GTS.	
5.6	Simulate the task treatment time based upon an exponential distribution using the mean task time given for the task and casualty’s patient code.	Performance test	Users will create a scenario with patients of varying ICD-9 codes and verify that the task treatment time is based upon an exponential distribution using the mean task time given for the task and casualty’s patient code.	JMPT is working as expected. Task times, when averaged over 10 replications, were very close to the mean task time given for each task in the common data.	
5.6.1	The system shall bound task times by a lower and upper limit.	Performance test/data review	Users will create a scenario with patients of varying ICD-9 codes and verify that there is an upper and lower task treatment time for each task	JMPT is performing as expected. The common data includes mean task times with upper and lower task time limits. Over 10 replications the upper and lower limits were never exceeded	
5.7	The system shall not allow a task to begin if equipment or personnel are unavailable.	Performance test	Users will create a scenario with patients of varying ICD-9 codes and verify that treatment is stopped if the proper resources (staff or equipment) are unavailable.	JMPT is performing as expected. Equipment and personnel unavailability did prevent tasks from beginning.	The JMPT reports do not clearly identify personnel and equipment shortfalls. I had to use the Audit report to find the shortfalls. Recommend that future versions include specific personnel and equipment shortfall reports.

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
5.8	The system shall allow concurrent tasks (tasks with the same sequence) to be done in random order.	Performance test/data review	Users will create a scenario with patients of varying ICD-9 codes and verify that concurrent tasks (tasks with the same sequence) are done in random order within the simulation.	JMPT is functioning as expected. Concurrent tasks were implemented in random order.	
5.9	The system shall allow two concurrent tasks (default value) to be performed at the same time if resources are available.	Performance test	Users will create a scenario with patients of varying ICD-9 codes and verify that concurrent tasks (tasks with the same sequence) can be performed at the same time if resources are available within the simulation.	JMPT is working as expected. Concurrent tasks were performed simultaneously.	
5.10	The system shall check for available <i>default</i> medical personnel before acquiring other personnel.	Performance test/data review	Users will create a scenario with patients of varying ICD-9 codes and verify the first staff resource requested by the simulation to perform a task is the default resource. Users will verify that the alternate staff resource is used in the simulation only if the primary staff member is unavailable.	JMPT is working as expected. It did check for available default medical personnel before acquiring other personnel to complete the task.	
5.11	The system shall check for minimum skill level personnel required for a task if default personnel is not available and shall check increasing skill levels until personnel is acquired.	Performance test/data review	Users will create a scenario with patients of varying ICD-9 codes and verify that the staff resource requested by the simulation meets the minimum skill level required to perform the task and the resource selected is the highest skill level available in the simulation.	JMPT is working as expected. It checked the list of possible treaters from most capable to least capable until it found the most capable treater that was available to conduct the task.	
5.12	The system shall release personnel upon completion of a continuous task, but shall hold equipment assigned until the patient leaves the FA or dies.	Performance test	Users will create a scenario with patients of varying ICD-9 codes and verify that the staff resource requested by the simulation is released to perform other tasks in the simulation when tasks are completed and that the system holds equipment for the patient until the patient leaves the FA or dies.	JMPT is functioning as expected. Personnel were released on the completion of a continuous task and the equipment was held until the patient left the FA or the patient DOW.	
5.13	The system shall make casualties wait for treatment at a medical facility if required resources are unavailable.	Performance test	Users will create a scenario with patients of varying ICD-9 codes and verify that treatment is stopped if the proper resources (staff or equipment) are unavailable.	JMPT is working as expected. Patients waited for treatment when resources (both personnel and equipment) were unavailable.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
5.14	The system shall continue modeling treatment even when consumable medical supplies are exhausted.	Performance test	Users will create a scenario with patients of varying ICD-9 codes and verify that consumable supplies are used and properly accounted for (decremented) during treatment. The user will ensure enough casualties are generated to cause the consumption of all consumable supplies. The user will verify that treatment continues even if the supplies are exhausted (but result is captured in reports).	JMPT is working as expected. It tracks consumable supplies used. When supplies are exhausted it provides negative numbers to show how many were used, but treatment continues without delays.	
5.15	The system shall record and decrement expended consumable supplies.	Performance test	Users will create a scenario with patients of varying ICD-9 codes and verify that consumable supplies are used and properly accounted for (decremented) during treatment.	JMPT is working as expected. It records and decrements expended consumable supplies.	
5.16	The system shall employ a Monte Carlo method to simulate patient losses (mortality) due to treatment delays.	Performance test	Users will create a scenario with patients of varying ICD-9 codes and verify treatment delays are modeled and that patient losses occur (using the Monte Carlo method) due to treatment delays.	JMPT is working as expected. It simulated mortality due to treatment delays and produced random mortalities.	
5.17	The system shall simulate death at any point during the simulation (treatment, waiting, en route, and more.)	Performance test/data review	Users will examine the EMedKW data for mortality information for multiple ICD-9 codes. Users will create a scenario and examine patient flow between FAs for casualties. Users will verify that for ICD-9 codes with a probability of death that death can occur at any point in the simulation.	JMPT is working as expected. It simulates death at any point during the simulation.	
5.18	The system shall require casualties to wait if the first FA in an MTF is at capacity.	Performance test	Users will create a scenario that generates a sufficient number of casualties that will exceed the capacity of the first FA within the/an MTF(s). Users will verify that the casualty waits for treatment if the first FA at the MTF is at its maximum capacity.	JMPT is working as expected. Casualties did wait at the first FA when it was full.	
5.19	The system shall handle reserved bed transfers to subsequent FAs by decrementing capacity prior to transfer.	Performance test	Users will verify that the system has reserved a bed in the next FA before final disposition from the FA the patient is currently in.	JMPT is working as expected. It simulates reserved beds correctly.	
5.20	The system shall schedule the tasks that should be repeated in the first 24 hours based on the initial repeat value.	Performance test	Users will verify that repeating tasks are scheduled every 24 hours (or as appropriate) based upon the ICD-9 code until the patient is properly discharged from the FA.	JMPT is working as expected. It simulates the schedule for tasks that should be repeated in the first 24 hours and in subsequent days based on the	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
				initial repeat value.	
5.21	The system shall schedule the tasks that should be repeated in subsequent 24 hours based on the recurring repeat value.	Performance test/data review	Users will verify that repeating tasks occur every 24 hours (or as appropriate) based upon the ICD-9 code until the patient is properly discharged from the FA.	JMPT is working as expected. It simulates the schedule for tasks that should be repeated in the first 24 hours and in subsequent days based on the initial repeat value.	
5.22	The system shall determine the routing of the patient based on disposition tasks in each FA.	Performance test/data review	Users will examine the EMedKW data for routing information and disposition tasks for multiple ICD-9 codes. Users will create a scenario and examine patient flow between FAs for casualties. Users will verify that each casualty flows between FAs according to appropriate data.	JMPT is working as expected. It simulates routing of the patient based on disposition tasks in each FA. It also determines a disposition for each casualty.	
5.23	The system shall determine a disposition for each casualty.	Performance test	Users will create a scenario and examine the dispositions of each casualty. Users will verify that each casualty generated in the simulation has a final disposition.	JMPT is working as expected. It simulates routing of the patient based on disposition tasks in each FA. It also determines a disposition for each casualty.	
5.24	The system shall label a casualty as KIA if the casualty dies prior to receiving treatment at a facility with a physician.	Performance test	Users will create a scenario and examine the points/locations in the simulation where a casualty dies. Users will verify that all casualties that die at a facility without a physician is categorized as KIA.	The simulation correctly categorized casualties as WIA or DOW.	
5.25	The system shall label a casualty as DOW if the casualty dies after being treated by a physician.	Performance test	Users will create a scenario and examine the points/locations in the simulation where a casualty dies. Users will verify that all casualties that die at a facility with a physician is categorized as DOW.	The simulation correctly categorized casualties as WIA or DOW	In the case where the physician was removed from the BAS, there was still DOW and KIA (simulation treated PA as a physician?). In the case where the physician and the PA were removed, patients became hung up at the BAS.

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
5.26	The system shall stop treatment when the casualty is loaded onto the transportation asset.	Performance test	Users will create a scenario and examine treatment tasks during the loading of an evacuation asset. Users will verify that treatment tasks are discontinued during the loading of the evacuation asset.	Treatment stopped just prior to the patient being loaded on to the transportation asset.	
Transportation					
6	Transportation				
6.1	The system shall model detached transportation pools as a means of evacuation to any number of MTFs.	Performance test	Users will create a scenario using detached transportation polls and verify the evacuation assets perform as described in the software documentation.	JMPT met the requirement. The system defaults to the detached transportation pool to move casualties to the next level in the continuum of care.	
6.2	The system shall model attached transportation pools as a means of evacuation to an assigned MTF.	Performance test	Users will create a scenario using attached transportation polls and verify the evacuation assets perform evacuation missions between the attached MTFs and MTFs/casualty sources with connecting evacuation routes.	JMPT met the requirement. The attached transportation pool evacuated the patients from the assigned MTF through continuum of care.	
6.3	The system shall simulate a request for transportation when evacuation tasks occur.	Performance test	Users will verify that evacuation requests are generated when a patient evacuation mission is required.	JMPT met the requirement. The system simulates a request for transportation when the MTF evacuation task was requested.	
6.4	The system shall stop loading transportation assets when capacity is reached or a user-defined maximum time at the facility has elapsed.	Performance test	Users will verify that the simulation ceases to load patients onto the evacuation asset when the user-defined maximum time at the facility is reached.	JMPT met the requirement. The system was able to stop loading a transport when it reached its capacity or a user defined maximum time at a facility has elapsed.	
6.5	The system shall load and unload patients based on the treatment priority upon transport arrival.	Performance test	Users will verify the loading and unloading of patients onto/off of an evacuation asset takes place according to transportation priorities in a user created scenario.	JMPT met the requirement. The system was able to load and unload patients based on their treatment priority upon transport arrival.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
6.6	The system shall limit litter patients to litter seats on a transport, but allow ambulatory patients to fill litter or ambulatory seats.	Performance test	Users will create a scenario with both litter and ambulatory patients and verify the correct distribution of ambulatory and litter patients aboard an evacuation asset according to that evacuation assets patient capacity for litter and ambulatory patients.	JMPT met the requirement. The system allows ambulatory patients to fill litter or ambulatory seats. Also, analysis proves that litter patients may not occupy ambulatory seats.	
6.7	The system shall calculate loading and unloading time based on casualty type (i.e., ambulatory or litter).	Performance test	Users will create a scenario with both litter and ambulatory patients and examine the loading and unloading times of each type of patient to ensure the model is correctly accounting for the differences in time it takes to load/unload each type of patient	JMPT is working as required. The system was able to calculate loading and unloading time based on casualty type (i.e., ambulatory and litter).	
6.8	The system shall select transportation assets with the fastest empty speed when priorities are equal.	Performance test	Users will create a scenario with several transportation types to ensure the simulation selects the fastest transportation type available when all other factors (priority) are equal.	JMPT met the requirement. When given a choice between three separate methods of transport with the same priority, the system chose the asset with the fastest empty speed.	
6.9	The system shall model routes that do not require transportation assets (i.e., walk routes).	Performance test	Users will create scenarios with walk routes and verify casualty flow along routes so designated.	JMPT met the requirement. The system successfully modeled “walk routes” between MTFs.	
6.10	The system shall select the route that offers the shortest travel time when two routes have the same priority.	Performance test	Users will create scenarios with evacuation routes to several different MTFs and verify the simulation selects the route with the shortest travel time (assuming same priorities).	JMPT met the requirement. All properties being equal, when given the choice between routes and transport assets, the system selected the quickest route.	Note 1: The requirement should be modified to state, “The system shall select the route that transports the patient to the most appropriate MTF, in terms of capability/capacity.” Note 2: Need to validate transportation capabilities for airspeed, range, and more (e.g., CH46 range = 139 km?).
6.11	The system shall randomly generate the time to arrive for pickup for LOO transports based on the user-defined or default probability table.	Performance test	Users will create scenarios with using LOO assets for patient evacuation and examine pickup (arrival) times using both default and user defined probability tables to verify the correct timing of evacuation missions.	JMPT performs as expected in that the system randomly generates time to arrive for pickup for LOO transports based on user-defined or default probability table.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
6.12	The system shall restrict transports to only allow loading/requesting patients that are specified in the transport properties.	Performance test	Users will create scenarios and specify specific transportation priorities and verify requests and loading by/of patients is in accordance with the established criteria.	JMPT functioned as expected and allows for the restriction of transports to only allow loading/requesting patients that are specified in the transport properties.	
6.13	The system shall calculate the distance between two geographic points as the straight line great circle distance.	Performance test	Users will create a scenario and establish the distance between points in the scenario. Distances will be calculated using the straight line great circle distance and verified in the model.	JMPT met the requirement. The system accurately calculated the distance between two geographic points using a great line circle distance.	
6.14	The system shall calculate the distance of a route with a ground distance multiplier as the distance of the route times the multiplier (only applies to ground transports).	Performance test	Users will test the functionality of the ground distance multiplier to ensure distances within the simulation accurately reflect user specified multipliers.	JMPT met the requirement. The system allowed the planner to selectively apply a ground distance multiplier, which affected only ground transportation assets.	
6.15	The system shall model evacuation of patients according to the user defined routing policies (by PC [patient condition], type, FA visited, or mortality).	Performance test	Users will create scenarios with user defined routing policies (by PC, type, FA visited, or mortality) and verify patients are evacuated in accordance with user established policies.	JMPT functioned as expected by modeling evacuation of patients according to the user defined routing policies (by PC, type, FA visited, or mortality).	
6.16	The system shall re-route casualties to the next MTF on the network if the receiving MTF is busy upon arrival.	Performance test	Users will create scenarios with MTFS with assigned busy policies and ensure patients are rerouted to alternate facilities when the busy policy criteria is reached.	JMPT meets Requirement 6.16 in that the system re-routes casualties to the next MTF in the network if the receiving MTF is busy upon arrival.	
6.17	The system shall classify assets assigned to the receiving MTF and en route, awaiting assignment, or not scheduled for downtime as available assets.	Performance test	Users will verify the system classifies assets assigned to the receiving MTF and en route, awaiting assignment, or not scheduled for downtime as available assets.	JMPT functions as expected and meets Requirement 6.17 in that the system classifies assets assigned to the receiving MTF and en route, awaiting assignment, or not scheduled for downtime as available assets.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
6.18	The system shall commence pre-mission delay time upon request for the evacuation asset.	Performance test	Users will create a scenario with evacuation assets with user defined pre-mission delay times and verify the simulation appropriately delays the mission response time according to the user defined delay times.	JMPT meets Requirement 6.18 as the system shall commence pre-mission delay time upon request for the evacuation asset.	
6.19	The system shall commence post-mission delay time upon completion of a mission.	Performance test	Users will create a scenario with evacuation assets with user defined post-mission delay times and verify the simulation appropriately delays the mission response time according to the user defined delay times.	JMPT meets Requirement 6.19 in that the system shall commence post-mission delay time upon completion of a Mission.	
6.20	The system shall allow more severe patients to claim a seat that was reserved for a less severe patient.	Performance test	Users will verify the simulation allows more severe patients to claim a seat that was reserved for a less severe patient.	JMPT functions as required for Requirement 6.20 in that the system shall allow more severe patients to claim a seat that was reserved for a less severe patient.	
6.21	The system shall calculate random distances on routes using the defined random offset.	Performance test	Users will verify the simulation generates random distances on routes using the defined random offset.	JMPT met the requirement. The system allowed the planner to designate a random offset for a particular route, which resulted in random distances within a predictable range.	
6.22	The system shall generate a LOO asset anytime one is required.	Performance test	Users will verify appropriate LOO assets are generated by the system when required.	JMPT performs as expected in that the system generates a LOO asset anytime one is required.	
6.23	The system shall select transportation pools by priority.	Performance test	Users will create a scenario with various transportation pools, which are assigned different transportation priorities and ensure assets from the transportation pools are selected in accordance with user defined priorities.	JMPT performs as expected in that the system selects transportation pools by priority.	
6.24	The system shall restrict divert transportation such that an MTF is never visited more than once per trip.	Performance test	The user will verify that the system restricts divert transportation such that an MTF is never visited more than once per trip.	JMPT performs as expected in that the system restricts divert transportation such that an MTF is never visited more than once per trip.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
6.25	The system shall model a transport's failure as the catastrophic loss of the vehicle and any casualties in the vehicle.	Performance test	Users will create a scenario with evacuation assets with a user defined failure probability and ensure both the evacuation asset and the patients aboard that asset when it fails are removed from the scenario. Results are recorded in reports as appropriate.	JMPT performs as expected in that the system models a transport's failure as the catastrophic loss of the vehicle and any casualties in the vehicle.	
6.26	The system shall assign casualties who die as the result of vehicle crashes with a final disposition of "KIA Crash."	Performance test	Users will create a scenario with evacuation assets with a user defined failure probability and ensure patients being evacuated aboard an asset that fails as designated as KIA Crash in the scenario reports.	JMPT performs as expected in that the system shall assign casualties who die as the result of vehicle crashes with a final disposition of "KIA CRASH."	
6.27	The system shall model failure of a designated vehicle such that it becomes unavailable for the rest of the scenario (in that replication).	Performance test	Users will create a scenario, which allows the failure of an evacuation asset and examined results to ensure any evacuation asset that fails during the scenario is unavailable for the remainder of the scenario.	JMPT performs as expected in that the system models failure of a designated vehicle such that it becomes unavailable for the rest of the scenario (in that replication).	
6.28	The system shall allow a transport, which is called to evacuate a patient, to continue the mission even if the requesting patient dies.	Performance test	Users will create a scenario and verify that a transport, which is called to evacuate a patient, continues the mission even if the requesting patient dies.	JMPT performs as expected in that the system allows a transport, which is called to evacuate a patient, to continue the mission even if the requesting patient dies.	
6.29	The system shall discontinue any treatment tasks in progress at load time.	Performance test	Users will create a scenario and examine treatment tasks during the loading of an evacuation asset. Users will verify that treatment tasks are discontinued during the loading of the evacuation asset.	JMPT performs as expected in that the system discontinues any treatment tasks in progress at load time.	
6.3	The system shall continue modeling casualties that die en route until they reach the next MTF and are pronounced dead.	Performance test	Users will create a scenario and verify that casualties that die en route to an MTF continued to be modeled until they reach the next MTF and are pronounced dead and are correctly accounted for in the casualty statistics reporting.	JMPT performs as expected in that the system continues modeling casualties that die en route until they reach the next MTF and are pronounced dead.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
6.31	The system shall determine when a patient evacuates from theater based on the user defined evacuation policy.	Performance test	Users will create a scenario with a designated evacuation policy and verify patients are evacuated/returned to duty according to the designated evacuation policy.	The model appears to perform evacuation policy correctly with the data sets given.	Disconnect between Minimum RTD times and Evacuation Decision (Task 278). All ICD-9 data needs to be reconciled for evacuation and RTD decision processing. Treatment and holding times do not meet expected values at FRC and TH based on Min RTD times. All ICD-9s need a treatment brief at every level of care to capture assessments, holding, and more for the pending evacuation.
Reporting					
7	Reporting				
7.1	The system shall generate basic, advanced, and ad hoc reports.	Performance test	Users will create a scenario and produce results. Users will examine the ability of JMPT to produce basic, advanced and ad hoc reports.	JMPT met the requirement. System generates basic, advanced, and ad hoc reports.	
7.2	The system shall categorize the reports into five areas: summary, casualty statistical, care providing, transportation, and general.	Performance test	Users will create a scenario and generate reports. Reports should include at a minimum five areas: summary, casualty statistical, care providing, transportation, and general.	JMPT met the requirement. System generated & categorized the reports into five areas: summary, casualty statistical, care providing, transportation, and general.	
7.2.1	The system shall generate an overall summary report in the Summary section of reporting.	Performance test	Users will create a scenario and produce results. Users will examine the ability of JMPT to produce an overall summary report.	JMPT met the requirement. System generated an overall summary report in the Summary section of reporting.	
7.2.2	The system shall generate three subsections of reporting in the Casualty Statistical Reports section: Casualty Input, Casualty Output, and Casualty Statistical Assumptions.	Performance test	Users will create a scenario and generate reports. The Casualty Statistical Report section must include Casualty Input, Casualty Output, and Casualty Statistical Assumptions.	JMPT met the requirement. System generated three subsections of reporting in the Casualty Statistical Reports section.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
7.2.2.1	The system shall generate the basic reports Overall casualty statistics, Casualty input across time, Casualty input across MTF, Casualties by type, Casualties by population group, Casualties by PC category, Casualties by ICD-9 category, Casualties by DOW mortality risk, and Casualty arrival stream by period in the Casualty Input subsection.	Performance test	Users will create a scenario and generate reports. Basic reports must include Overall casualty statistics, Casualty input across time, Casualty input across MTF, Casualties by type, Casualties by population group, Casualties by PC category, Casualties by ICD-9 category, Casualties by DOW mortality risk, and Casualty arrival stream by period in the Casualty Input subsection.	JMPT met the requirement. The exception is there was no report for casualties by ICD-9 category.	
7.2.2.2	The system shall generate the basic reports Casualties by final disposition, Casualties by final disposition & MTF, Casualty throughput across MTFs, and Casualty output by final disposition and time in the Casualty Output subsection.	Performance test	Users will create a scenario and generate reports. Basic reports must include Casualties by final disposition, Casualties by final disposition & MTF, Casualty throughput across MTFs, and Casualty output by final disposition and time in the Casualty Output subsection.	JMPT met the requirement. System generated basic reports in the Casualty Output subsection.	
7.2.2.3	The system shall generate the basic report Casualty Statistical Assumptions in the Casualty Statistical Assumptions subsection.	Performance test	Users will create a scenario and generate reports. Basic reports must include Casualty Statistical Assumptions in the Casualty Statistical Assumptions subsection.	JMPT met the requirement. System generated basic reports in the Casualty Output subsection.	
7.2.3	The system shall generate four subsections of reporting in the Care Providing Reports section of reporting: Casualty Timing Reports; Tasks, Task time, and Task Delay Reports;	Performance test	Users will create a scenario and generate reports. Subsections of reporting in the Care Providing Reports section of reporting must include Casualty Timing Reports; Tasks, Task time, and Task Delay Reports; Equipment, Consumables, & Personnel Reports; and Care Providing Assumptions.	JMPT met the requirement. System generated the basic report Casualty Statistical Assumptions in the Casualty Statistical Assumptions subsection.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
	Equipment, Consumables, & Personnel Reports, and Care Providing Assumptions.				
7.2.3.1	The system shall generate the basic reports Time in system (TIS) statistics by MTF, Time in system (TIS) statistics by FA, Casualty time in system (TIS), Casualty time in system (TIS) by MTF, Casualty by MTF by time, and Casualty by FA by time in the Casualty Timing Reports subsection.	Performance test	Users will create a scenario and generate reports. Basic reports must include Time in system (TIS) statistics by MTF, Time in system (TIS) statistics by FA, Casualty time in system (TIS), Casualty time in system (TIS) by MTF, Casualty by MTF by time, and Casualty by FA by time in the Casualty Timing Reports subsection.	JMPT met the requirement. System generated basic reports as required by MTF and FA.	
7.2.3.2	The system shall generate the basic reports Task time per casualty across MTF, Tasks performed by FA, and Average casualty flow across MTFs in the Tasks, Task time and Task Delay Reports subsection.	Performance test	Users will create a scenario and generate reports. Basic reports must include Task time per casualty across MTF, Tasks performed by FA, and Average casualty flow across MTFs in the Tasks, Task time and Task Delay Reports subsection.	JMPT met the requirement. System generated basic tasks reports as required by MTF and FA.	
7.2.3.3	The system shall generate the basic reports consumables used by FA, Equipment utilization by FA, Personnel utilization by FA, and weight/cube/cost details by FA in the Equipment, Consumables & Personnel Reports subsection.	Performance test	Users will create a scenario and generate reports. Basic reports must include consumables used by FA, Equipment utilization by FA, Personnel utilization by FA, and weight/cube/cost details by FA in the Equipment, Consumables & Personnel Reports subsection.	JMPT met the requirement. System generated basic tasks reports as required for consumables.	However it is worth noting for future development that these reports don't build the Timed Phased Class 8A Requirements part of Annex Q (JOPES Vol 2). The same issue applies to blood.

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
7.2.3.4	The system shall generate the basic report care providing assumptions in the Care Providing Assumptions subsection.	Performance test	Users will create a scenario and generate reports. Basic reports must include care providing assumptions in the Care Providing Assumptions subsection.	JMPT is working as expected. It produced care providing assumptions in the simulation reports as required.	
7.2.3.5	The system shall generate the advanced report Casualty time from injury to care by FA in the Care Providing Reports subsection.	Performance test	Users will create a scenario and generate reports. Advanced reports must include Casualty time from injury to care by FA in the Care Providing Reports subsection.	JMPT met the requirement. System generated the advanced report Casualty time from injury to care by FA.	
7.2.3.6	The system shall generate the advanced reports Task delay by FA and Number of casualties by min task wait time by FA in the Tasks, Task time and Task Delay reports subsection.	Performance test	Users will create a scenario and generate reports. Advanced reports must include Task delay by FA and Number of casualties by min task wait time by FA in the Tasks, Task time and Task Delay reports subsection.	JMPT met the requirement. System generated task delay by FA and number of casualties by minimum task wait time by FA reports.	
7.2.3.7	The system shall generate the advanced reports Personnel utilization by period and Supply and personnel effectiveness in the Equipment, Consumables & Personnel Reports subsection.	Performance test	Users will create a scenario and generate reports. Advanced reports must include Personnel utilization by period and Supply and personnel effectiveness in the Equipment, Consumables & Personnel Reports subsection.	Personnel utilization by period seemed to be the same report requirement as Personnel utilization by FA by period (7.2.3.3). Did not find the supply and personnel effectiveness report in the Equipment, Consumables & Personnel Reports subsection. Will have to revisit the report.	
7.2.4	The system shall generate three subsections of reporting in the Transportation Reports section of reporting: Time Related Reports, Composition Reports, and Transportation Assumptions.	Performance test	Users will create a scenario and generate reports. Basic reports in the Transportation Section must include Time Related Reports, Composition Reports, and Transportation Assumptions.	The JMPT generated the appropriate three subsections of reporting in the Transportation Reports section.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
7.2.4.1	The system shall generate the basic reports transport utilization, Requests for transport by MTF, and transports requested by route by period in the Time Related Reports subsection.	Performance test	Users will create a scenario and generate reports. Basic reports must include transport utilization, requests for transport by MTF, and transports requested by route by period in the Time Related Reports subsection.	The system generated the basic reports transport utilization, requests for transport by MTF, and transports requested by route by period in the Time Related Reports subsection.	
7.2.4.2	The system shall generate the basic reports Transportation statistics by route, Transportation details by route, and Transportation trip composition by route in the Composition Reports subsection.	Performance test	Users will create a scenario and generate reports. Basic reports must include Transportation statistics by route, Transportation details by route, and Transportation trip composition by route in the Composition Reports subsection.	The system generated the basic reports transportation statistics by route, transportation details by route, and transportation trip composition by route in the Composition Reports subsection.	
7.2.4.3	The system shall generate the basic report Transportation Assumptions in the Transportation Assumptions subsection.	Performance test	Users will create a scenario and generate reports. Basic reports must include Transportation Assumptions in the Transportation Assumptions subsection.	The system generated the basic report transportation assumptions in the Transportation Assumptions subsection.	
7.2.4.4	The system shall generate the advanced reports Transportation asset one way travel time and Casualty one way travel time & delay in the Time Related Reports subsection.	Performance test	Users will create a scenario and generate reports. Advanced reports must include Transportation asset one way travel time and Casualty one way travel time & delay in the Time Related Reports subsection.	The system generated the advanced reports transportation asset one way travel time and casualty one way travel time & delay in the Time Related Reports subsection. Re-Test: The Re-test for 7.2.4.4 demonstrates that JMPT functioned as required for with regard to transportation.	The system generated the appropriate report for one way travel time. I did note that the values on the scatter chart for one way travel time & delay were negative values. I re-ran the scenario several times and every time the scatter chart yielded negative values. I recommend retesting this objective with the new version of JMPT.
7.2.5	The system shall generate the basic reports Scenario graphics, Scenario properties, Audit, and All assumptions in the	Performance test	Users will create a scenario and generate reports. Basic reports must include Scenario graphics, Scenario properties, Audit, and All assumptions in the General Reports section.	The system generated the basic reports scenario graphics, scenario properties, audit, and all assumptions in the General Reports section.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
	General Reports section.				
7.2.6	The system shall generate the advanced report User Defined Query in the General Reports section.	Performance test	Users will create a scenario and generate reports. Advanced reports must include User Defined Query in the General Reports section.	The system generated the advanced report User Defined Query in the General Reports section.	
7.2.6.1	The system shall allow the user to design custom reports from the underlying output data tables/fields through the User Define Query report.	Performance test	Users will create a scenario and generate reports. Users will design custom reports from the underlying output data tables/fields through the User Define Query report and examine results.	The system allowed the user to design custom reports from the underlying output data tables/fields through the User Define Query report.	
7.3	The system shall allow the user to sort and filter reports displayed in a table.	Performance test	Users will create a scenario and generate reports. Users will test the ability to sort and filter reports displayed in a table.	The system allowed the user to sort and filter reports displayed in a table.	
7.4	The system shall allow the user to print reports.	Performance test	Users will create a scenario and generate reports. Users will test the ability to print reports.	Users were able to print reports.	
7.5	The system shall allow the user to copy and paste reports into other applications such as Microsoft Office tools.	Performance test	Users will create a scenario and generate reports. Users will test the ability to copy and paste reports into other applications such as Microsoft Office tools.	Users were able to effectively copy and paste reports into other applications.	
7.6	The system shall allow the user to export reports in formats suitable for use in other applications (e.g., .csv, .bmp).	Performance test	Users will create a scenario and generate reports. Users will test the ability to export reports in formats suitable for use in other applications (e.g., .csv, .bmp).	Users were able to effectively export reports into other applications.	
7.7	The system shall allow the user to save reports to the Favorites list.	Performance test	Users will create a scenario and generate reports. Users will test the ability to save reports to the Favorites list.	Users were able to add a report to the Favorites List. The report can then be quickly accessed by double clicking the report in the Favorites list.	
7.8	The system shall allow the user to set report alerts.	Performance test	Users will create a scenario and generate reports. Users will test the ability to set report alerts	Users were able to create a report alert using user defined criteria.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
7.9	The system shall allow the user to compare some reports across different scenario results.	Performance test	Users will create a scenario and generate reports. Users will test the ability to compare some reports across different scenario results.	Users were able to compare some reports between scenarios.	May be useful to include in the User's Guide a listing of reports that can be compared.
7.10	The system shall allow the user to create consolidated reports, or a collection of reports for a single simulation run. Consolidated reports provide a quad-chart type view, displaying data in a presentation format.	Performance test	Users will create a scenario and generate reports. Users will test the ability to create consolidated reports, or a collection of reports for a single simulation run.	Users were able to create consolidated reports.	
7.11	The system shall allow the user to modify properties for individual reports such as title, chart parameters, and report type.	Performance test	Users will create a scenario and generate reports. Users will test the ability to modify properties for individual reports such as title, chart parameters, and report type.	Users were able to modify report properties.	
7.12	The system shall allow the user to specify report preferences such as setting default report, viewing advanced reports, report navigation style, time formats, and data table features (e.g., column pinning, column summaries, & filtering).	Performance test	Users will create a scenario and generate reports. Users will test the ability to specify report preferences such as setting default report, viewing advanced reports, report navigation style, time formats, and data table features (e.g., column pinning, column summaries, & filtering).	Users were able to specify report preferences.	
Documentation					
8	Documentation				
8.1	The system shall provide a methodology manual.	Literature review	Users will examine the methodology manual developed to support JMPT training.	The system shall provide a methodology manual. Yes, PDF format 7.5 Version.	
8.2	The system shall provide a user's manual.	Literature review	Users will examine the User Manual developed to support JMPT training.	The system shall provide a user's manual. Yes, PDF format 7.5 Version.	

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
8.3	The system shall provide release notes.	Literature review	Users will examine release notes and the process to provide these to JMPT users.	The system shall provide release notes. Yes, PDF format 7.5 Version, not a how-to but an info document only that did not add any assistance to the user. Not sure why it would be needed in the help menu once program is complete.	Not a how-to but an info document only that did not add any assistance to the user. Not sure why it would be needed in the help menu once program is complete.
8.4	The system shall provide the technical report on mortality modeling.	Literature review	Users will examine all material on mortality modeling developed to support JMPT training/use.	The system shall provide the technical report on mortality modeling. Yes, PDF format (not listed within the Help Center with manuals, tutorials, and release notes).	Not listed within the Help Center with manuals, tutorials and release notes.
8.5	The system shall provide a help file within the application.	Performance test	Users will examine the help features within the software and its effectiveness in supporting JMPT training/use.	The system shall provide a help file within the application. Yes, Help tab linked to each subject by single click (that is in the PDFs and tutorials).	
8.6	The system shall provide guidance for reports.	Literature review/performance test	Users will examine report guidance both in documentation and within the software.	The system shall provide guidance for reports. Yes, through the Help Menu and as an Adobe Flash Player.	
8.7	The system shall provide multimedia tutorials covering overview, scenario building, and reports.	Performance test	Users will examine all multimedia tutorials covering overview, scenario building, and reports to support JMPT training/use.	The system shall provide multimedia tutorials covering overview, scenario building, and reports. Yes, each is clear and understandable; however, the Close Caption function did not work. Also could not view anything else on the screen at the same time.	Close Caption function did not work. Could not view anything else on the screen at the same time.
Training					
9	Training				
9.1	Instructor-led training materials shall be developed.	Literature review	Users will examine all instructor-led training materials developed to support JMPT training.	Sufficient training materials have been developed to meet this requirement.	Coordinate with Director, JMPC to develop further training materials as JMPT becomes more widely used by

Step	M&S requirement	Test type	Test description	Findings/results	Comments/recommendations
					medical planners in the Joint community.
9.2	Introductory training materials shall be developed.	Literature review	Users will examine all introductory training materials developed to support JMPT training.	Sufficient training materials have been developed to meet this requirement.	Coordinate with Director, JMPC to develop further training materials as JMPT becomes more widely used by medical planners in the Joint community.
9.3	Advanced training materials shall be developed.	Literature review	Users will examine all advanced training materials developed to support JMPT training.	Sufficient training materials have been developed to meet this requirement.	Coordinate with Director, JMPC to develop further training materials as JMPT becomes more widely used by medical planners in the Joint community.

APPENDIX C

BASIS OF COMPARISON

Various methods were used as a basis of comparison during the verification and validation testing of the Joint Medical Planning Tool (JMPT). Comparison techniques, depending on the functionality being tested, included:


- **JMPT output versus actual system outputs.** The most definitive test of a simulation's validity is establishing that its output data closely resemble the output data that would be observed from the actual system. An example of this type of comparison test would be to analyze average operating room times required to treat a particular *International Classification of Diseases, 9th Revision* patient code with actual operating room time requirements observed in real world operations (e.g., Operation Enduring Freedom/Operation Iraqi Freedom).
- **Comparing JMPT outputs to results from existing systems.** In some cases, processes that take place within JMPT can be replicated in existing systems. For example, the entering of ship movement data into JMPT and resulting distances between ships can be compared with movement data and ship distances generated in another simulation tool, such as STORM. If the above comparison is successful, then it has the additional benefit of providing credibility for the use of simulation.
- **Consulting subject matter experts.** Whether or not there is an existing system, analysts and subject matter experts should review simulation output (e.g., numerical results, animations, and more.) for reasonableness. Face validation is used to determine if simulation results are consistent with perceived system behavior. However, care should be taken in performing this exercise, since if one knew exactly what output to expect there would be no need for a simulation.

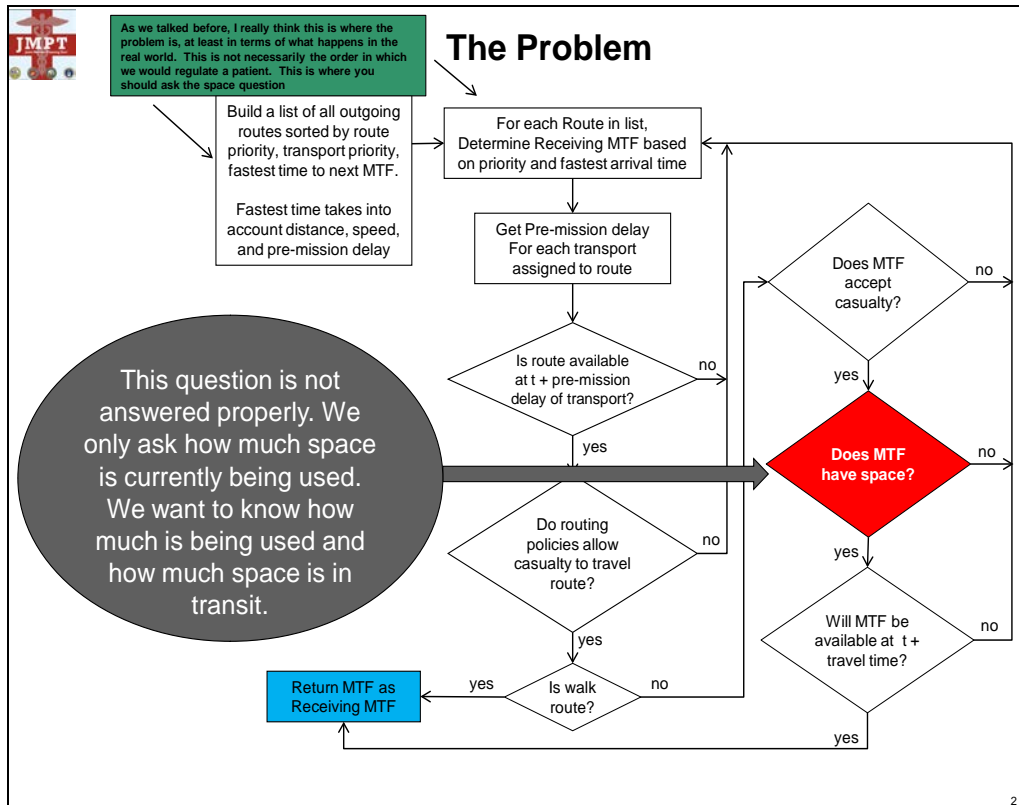
APPENDIX D ROUTING LOGIC

Joint Medical Planning Tool (JMPT)

Casualty Routing Design Review

September 25, 2012





The Proposed Solution

1. Reserve Space in the Receiving MTF

1. Reserve space at the same time the seat is reserved.
2. Release space
 1. When casualty gets “bumped” from a seat for a higher priority casualty.
 2. **When casualty enters the first FA or the outside waiting queue at the Receiving MTF.**
 3. When transport crashes before pickup of casualty.
 4. When transport crashes after pickup of casualty and enroute to Receiving MTF.
 5. When casualty dies waiting for transport to arrive.
 6. When casualty dies while enroute to Receiving MTF.

2. Check Receiving MTF Busy Factoring in Reserved Space

1. Check if space available outside the MTF
 - Compare “Total Number of Casualties Inside First FA, Outside, and Reserved” to the “Total Number of Casualties Allowed Inside First FA and Outside”
2. Check if space available in First FA
 - Compare “Total Number of Casualties Inside and Reserved” to the “Maximum Number of Casualties Allowed Inside”
3. Check if space available in First FA if Busy Policies pass
 - If the Busy Policy passes, check if space is available in First FA. If no space is available in First FA, check if space is available outside

3



What this design will do

- Reduce the number of casualties sent to an MTF that has a high chance of being busy when the casualty arrives due to a large number of casualties being generated in a mass casualty event.
 - Reduce the number of “Evac No Treatment” casualties due to this situation.

4



What this design will NOT do

- Evenly distribute casualties across multiple MTFs at the same level.
 - MTFs will still fill to capacity before sending casualties to the next priority MTF.
- A busy policy set for other FAs (besides the First FA) in the Receiving MTF will not look at when casualties will transfer into this FA.
 - For example:
 - Busy Policy on SC: OR (Max 2 Casualties) AND WARD (Max 3 Casualties)
 - Cas 1 checks busy policy before leaving MTF1
 - OR (1) AND WARD (2). Pass.
 - Cas 1 leaves MTF1 and travels to SC
 - Cas X enters OR (at SC) and reserves bed in WARD.
 - New Count: OR (2) And WARD (3)
 - Cas 1 arrives at SC. Checks Busy Policy.
 - Busy Policy FAILS.
 - Cas 1 evacuates without treatment.

I guess this is dependent on how the user sets the busy policies. If the busy policy uses Triage, this wouldn't be the case. It would not make sense real world to have an OR busy, maybe no one in triage, and then let an arriving casualty evac no treatment with an empty triage area.

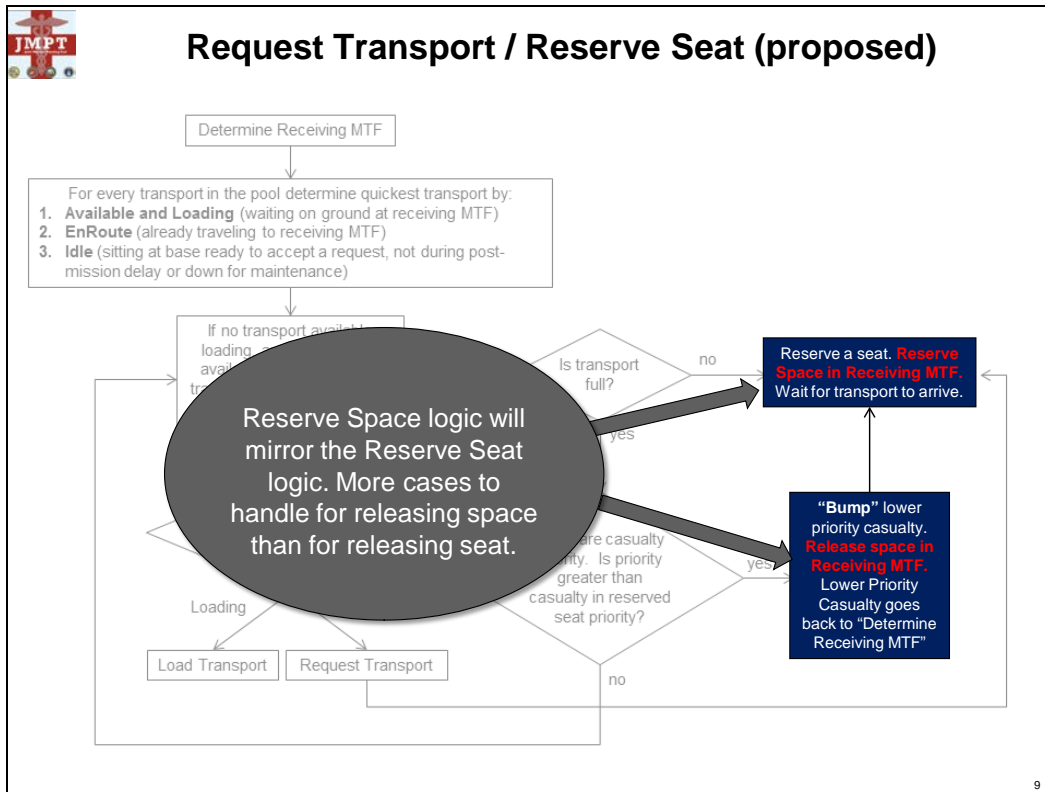
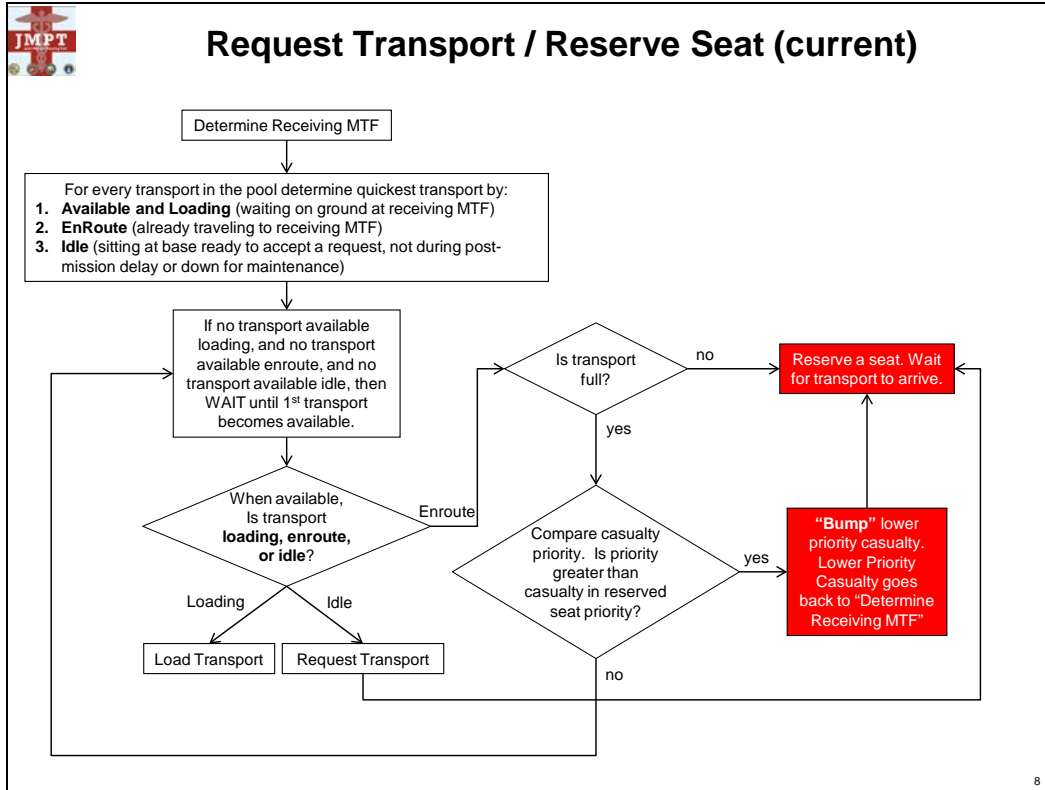
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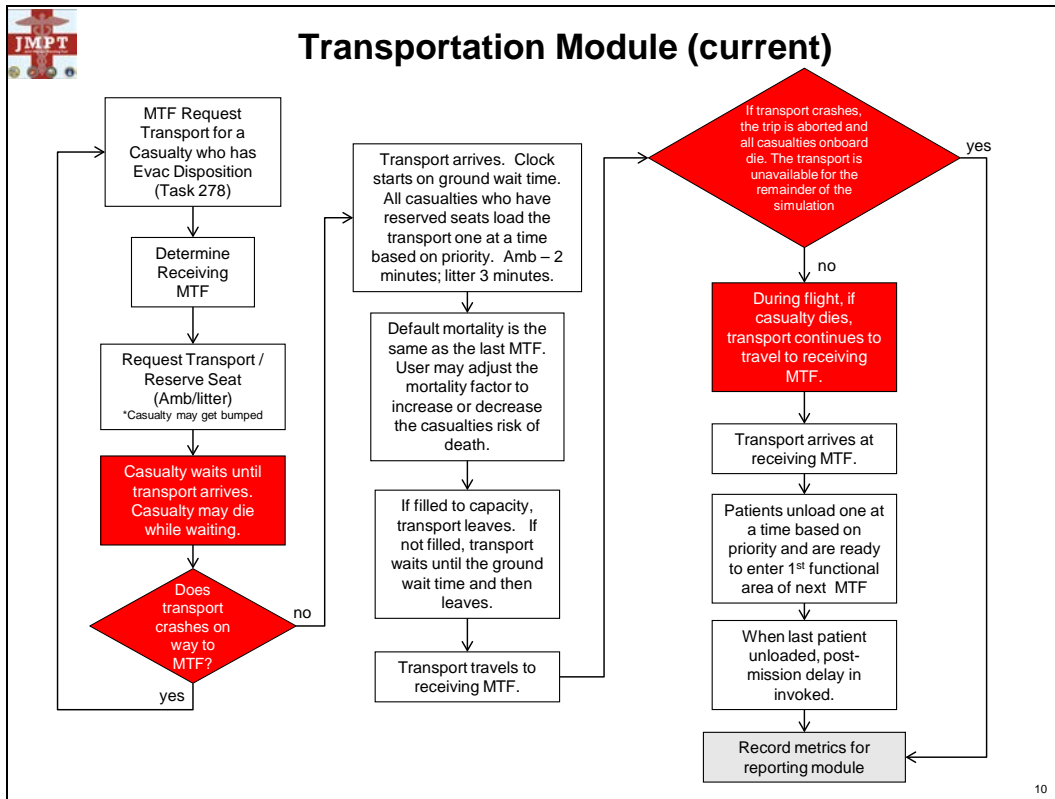


Estimates

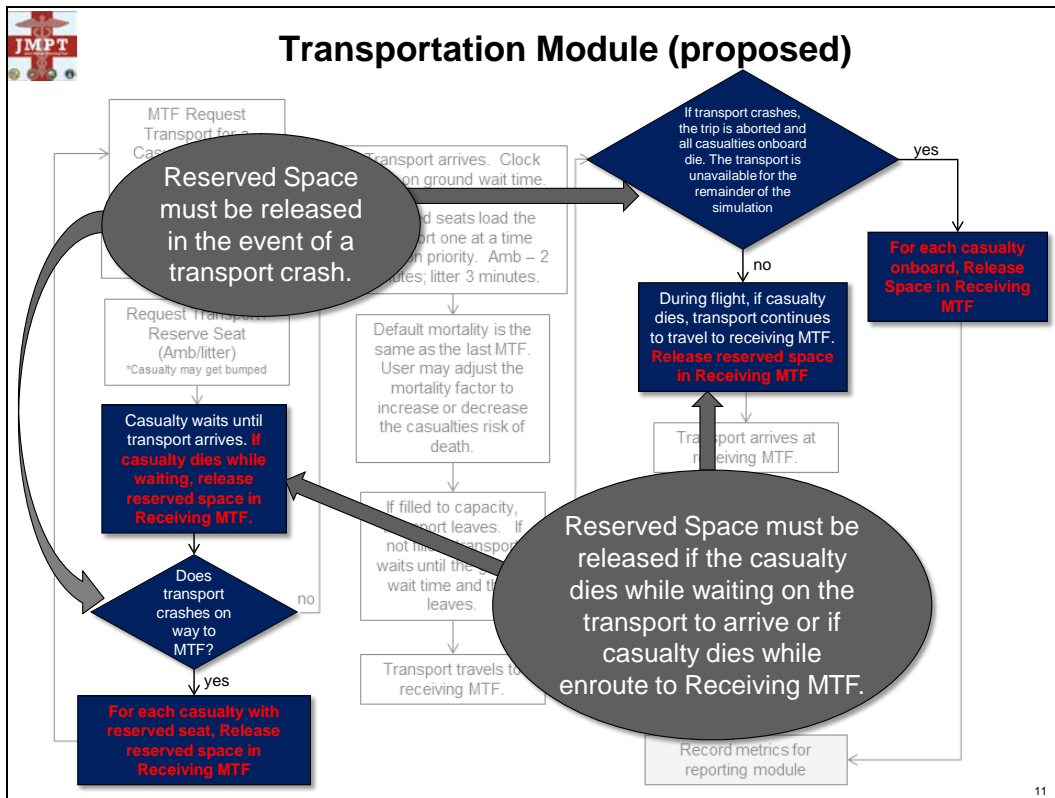
- Development Time: 2 weeks
 - Scenario Development
 - Implementation of logic
 - Documentation Updates
 - Investigation of impact to other modules
 - Unit Testing
- Testing Time: 2 weeks
 - Validation Testing
 - Regression Testing

6

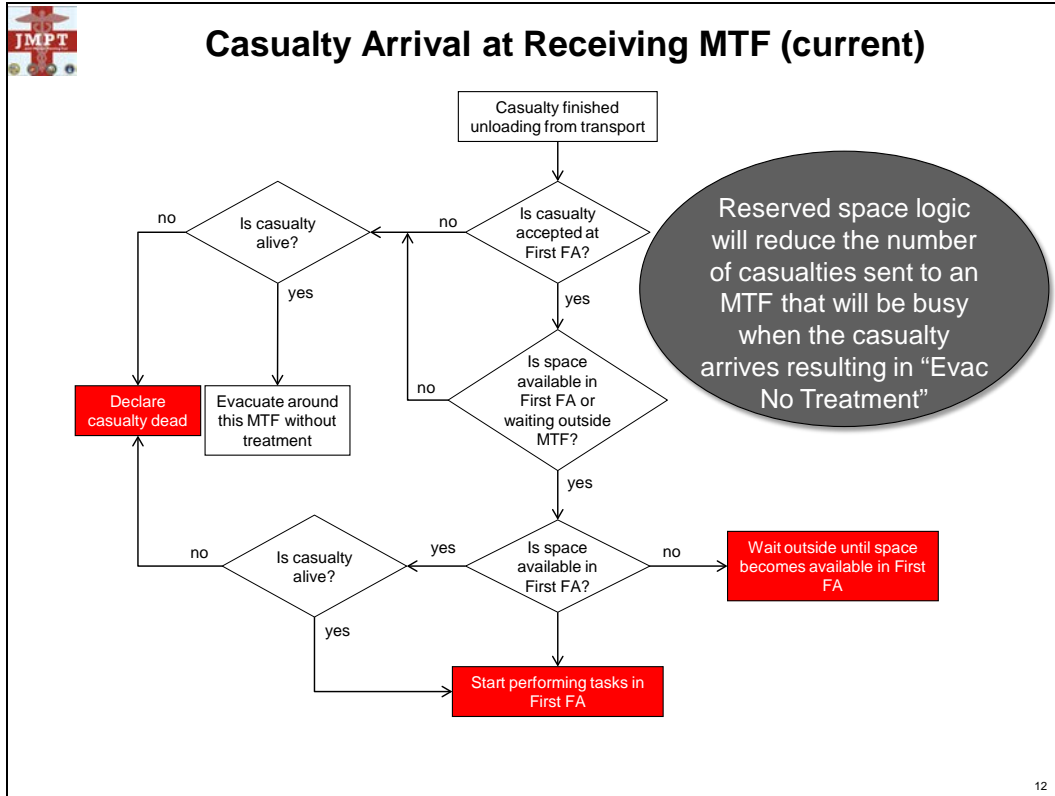




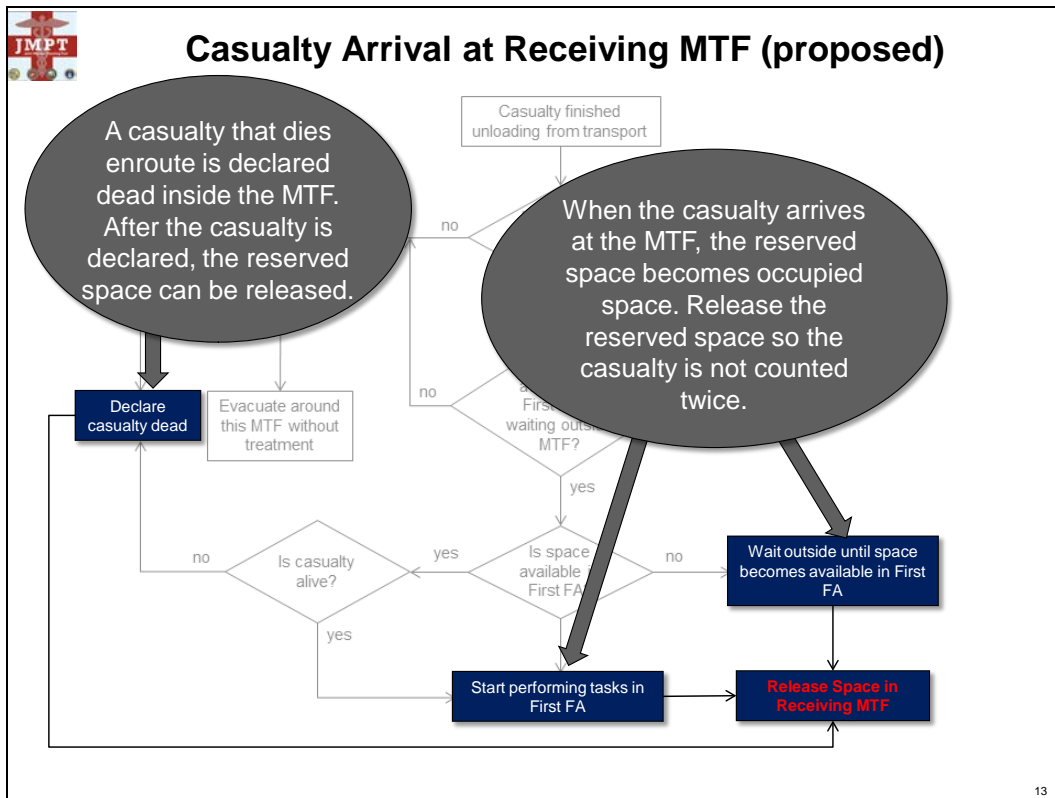
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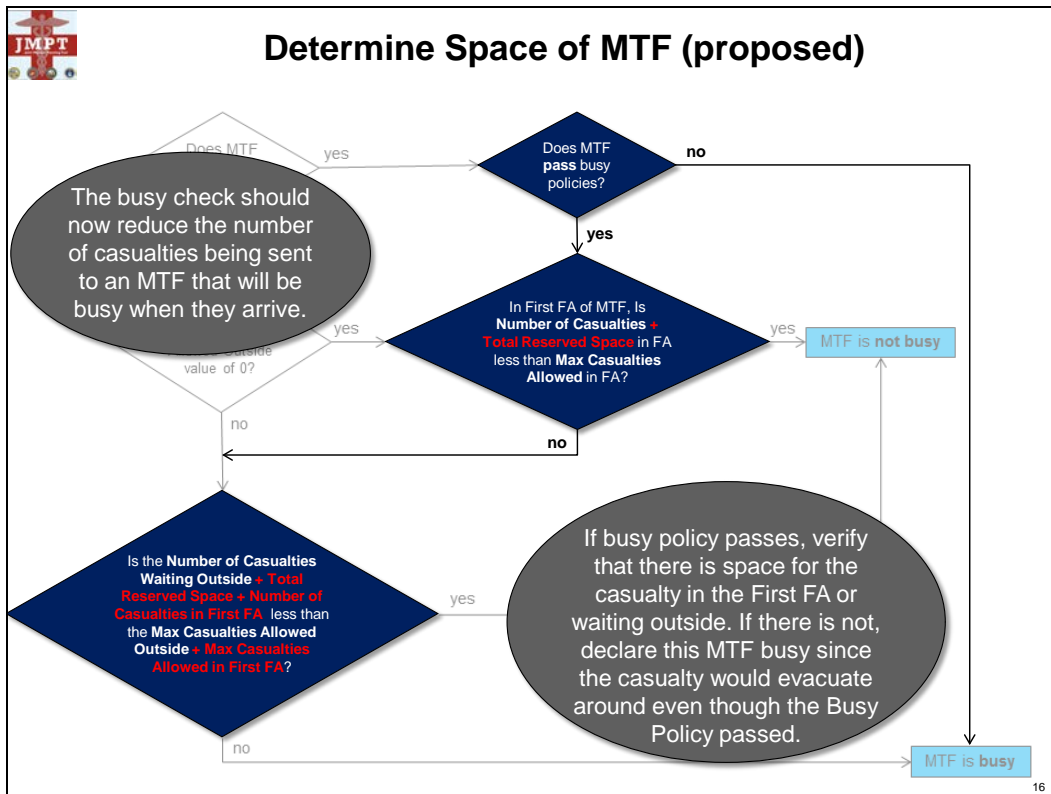
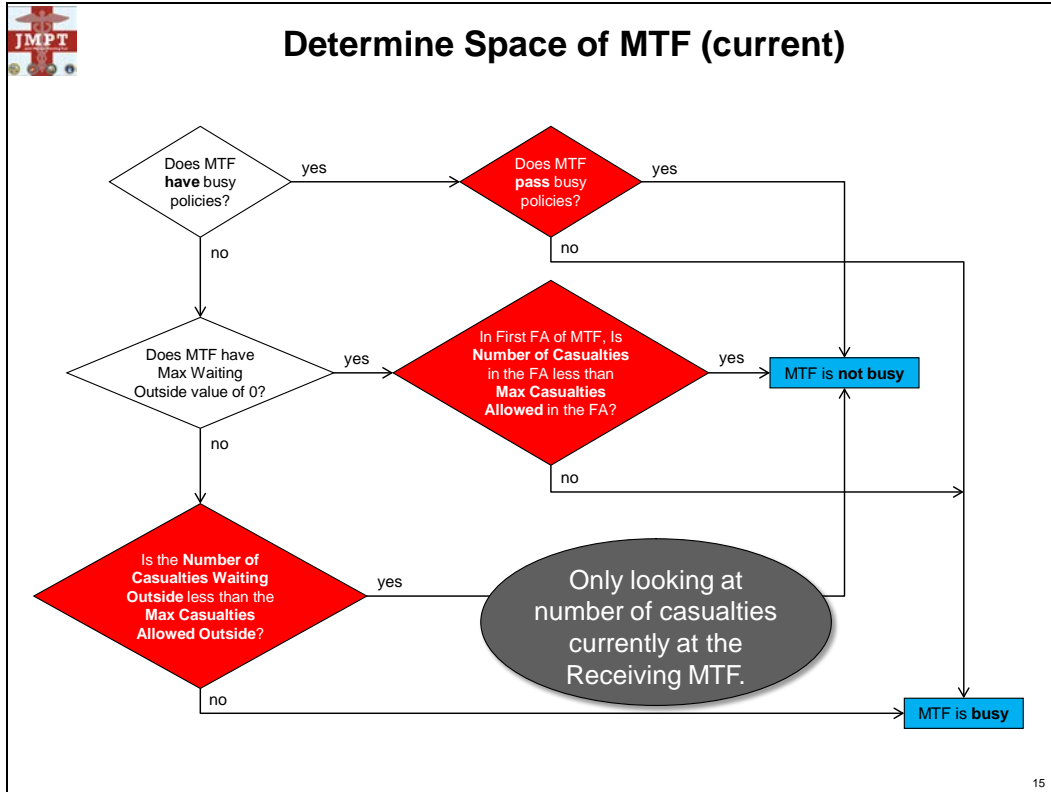


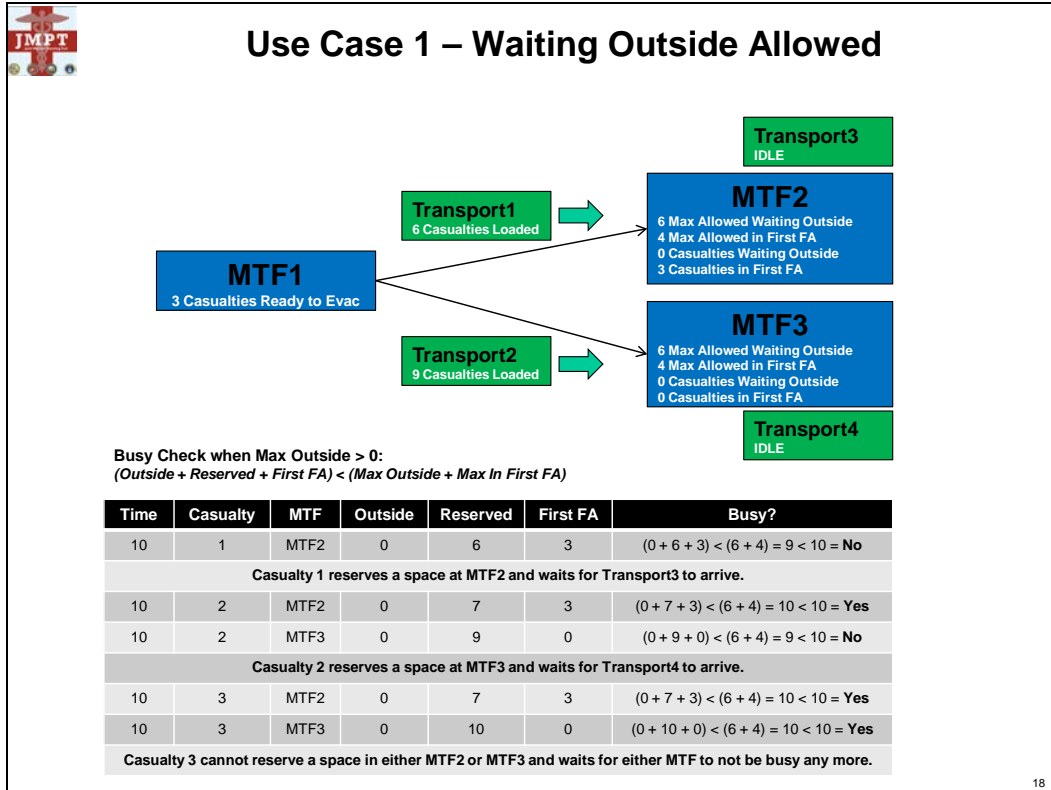
Reserved space logic will reduce the number of casualties sent to an MTF that will be busy when the casualty arrives resulting in "Evac No Treatment"



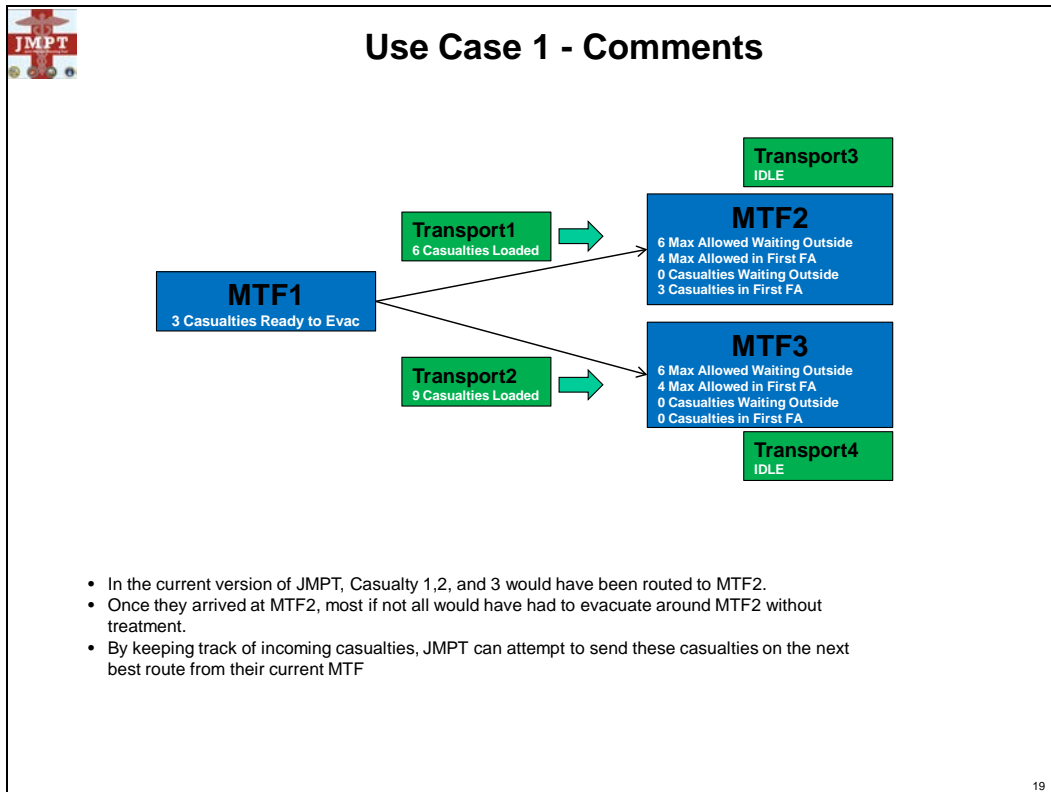
A casualty that dies enroute is declared dead inside the MTF. After the casualty is declared, the reserved space can be released.

When the casualty arrives at the MTF, the reserved space becomes occupied space. Release the reserved space so the casualty is not counted twice.





18



19

Use Case 2 – No Waiting Outside Allowed

MTF1
2 Casualties Ready to Evac

Transport1
2 Casualties Loaded

Transport2
3 Casualties Loaded

MTF2
0 Max Allowed Waiting Outside
4 Max Allowed in First FA
0 Casualties Waiting Outside
2 Casualties in First FA

MTF3
0 Max Allowed Waiting Outside
4 Max Allowed in First FA
0 Casualties Waiting Outside
0 Casualties in First FA

Transport3
IDLE

Transport4
IDLE

Busy Check when Max Outside == 0:
(Reserved + First FA) < Max In First FA

Time	Casualty	MTF	Outside	Reserved	First FA	Busy?
10	1	MTF2	0	2	2	(2 + 2) < 4 = 4 < 4 = Yes
10	1	MTF3	0	3	0	(3 + 0) < 4 = 3 < 4 = No
Casualty 1 reserves a space at MTF3 and waits for Transport4 to arrive.						
10	2	MTF2	0	2	2	(2 + 2) < 4 = 4 < 4 = Yes
10	2	MTF3	0	4	0	(4 + 0) < 4 = 4 < 4 = Yes
Casualty 2 cannot reserve a space in either MTF2 or MTF3 and waits for either MTF to not be busy any more.						

20

Use Case 3 – Busy Policy

MTF1
3 Casualties Ready to Evac

Transport1
1 Casualties Loaded

MTF2
0 Max Allowed Waiting Outside
4 Max Allowed in First FA
0 Casualties Waiting Outside
2 Casualties in First FA
1 Casualty in OR
2 Casualties in Ward

Busy Policy
2 Max Allowed in OR
AND
3 Max Allowed in Ward

Transport3
IDLE

Busy Check in First FA:
(Reserved + First FA) < Max In First FA

Busy Check for Waiting Outside:
(Outside + Reserved + First FA) < (Max Outside + Max In First FA)

Time	Casualty	MTF	OR	Ward	Busy Policy?	Outside	Reserved	1st FA	Busy 1st FA?	Busy Outside?	Busy MTF?
10	1	MTF2	1	2	(1 < 2) AND (2 < 3) = Pass	0	1	2	(1+2) < 4 = 3 < 4 = No	N/A	No
Casualty 1 reserves a space in MTF2 and waits for Transport3 to arrive											
10	2	MTF2	1	2	(1 < 2) AND (2 < 3) = Pass	0	2	2	(2+2) < 4 = 4 < 4 = Yes	(0+2+2) < (0+4) = 4 < 4 = Yes	Yes
Casualty 2 passed the Busy Policy, but found there would be no room in the First FA or Waiting Outside of MTF2. Wait on MTF2 to not be busy any more.											
11	A casualty enters OR and reserves a bed in the Ward.										
12	3	MTF2	2	3	(2 < 2) AND (3 < 3) = Fail	N/A	N/A	N/A	N/A	N/A	Yes
Casualty 3 fails the Busy Policy. Wait on MTF2 to not be busy any more.											

21

APPENDIX E
FUNCTIONAL VALIDATION WORKING GROUP RECOMMENDATION BRIEF

**Joint Medical Planning Tool (JMPT)
Accreditation Decision Brief**



AGENDA

- Purpose
- The Joint Medical Planning Tool
- Verification and Validation Working Group
- Test Summary
- Recommendation



PURPOSE

To present the findings and recommendations of the Joint Medical Planning Tool (JMPT) Verification and Validation Working Group and obtain SAWG approval for the presentation of the Working Group's results to the Force Health Protection Integrating Council for an accreditation decision.



The Joint Medical Planning Tool

- **JMPT supports medical systems analysis, logistics analysis, operational risk assessment, and theater medical course of action assessments.**
- **JMPT provides the medical planner:**
 - The capability to simulate theater medical force laydown
 - Generate patient streams
 - Visibility into patient treatment and routing from POI to disposition
 - The ability to simulate health care provision from First Responder through Theater Hospitalization
 - The ability to simulate patient transportation from First Responder through Theater Hospitalization
 - Robust reporting capabilities
- **JMPT generates patient streams based on ICD-9 based Patient Condition Occurrence Frequency (PCOF) from user supplied casualty estimates and user selected ICD-9 based PCOF estimates.**
- **Simulates appropriate medical functional areas for each defined capability within the MTF including the equipment, durable and consumable supplies, and personnel assigned.**
- **Prioritizes treatment and evacuation of patients based on injury severity and differentiates between Killed in Action and Died of Wounds due to delays in treatment as a function of time.**



JMPT VV&A Working Group Members

Voting Members

- Joint Staff
- OSD (HA)
- Army
 - Center for AMEDD Strategic Studies
 - Center for Army Analysis
- Navy
- Air Force
- Marine Corps

Voting Members

- PACOM
- CENTCOM
- EUCOM
- SOUTHCOM
- AFRICOM
- NORTHCOM
- TRANSCOM
- SOCOM



Test Summary

- Training was provided on the Joint Medical Planning Tool and testing procedures to all Working Group members during a week long training session.
- Testing was conducted by Working Group members and findings, results and recommendations were briefed to the group on weekly DCO calls conducted Jul-Oct 2012.
- Testing focused on 5 critical areas:
 - Theater Medical Laydowns
 - Patient Streams
 - Care Providing
 - Transportation
 - Reporting
- Critical Working Group findings were provided to NHRC and TBE for correction and retested by members of the Working Group in Nov 2012.
- Retesting of JMPT in Nov resulted in all critical issues being resolved
- On 7 Nov 12 the Working Group was briefed on the results of the retesting and agreed unanimously on recommending to the SAWG that JMPT be accredited for use as a joint medical planning tool.



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APPENDIX F

REFERENCES

1. Department of Defense. (2008). *Department of Defense standard practice: Documentation of verification, validation, and accreditation (VV&A) for Models and Simulations* (MIL-STD-3022). Washington, DC: Author.
2. Joint Chiefs of Staff. (2004). *Joint Staff Instruction: Verification, validation, and accreditation of joint models and simulations* (Joint Staff Instruction 8104.01A). Washington, DC: Author.

APPENDIX G ACRONYMS

ALOS	average length of stay
ATO	Authority to Operate
BAS	battalion aid station
BF	battle fatigue
CASEVAC	casualty evacuation
CCB	Configuration Control Board
CDF	cumulative distribution function
DCO	Defense Connect Online
DIS	disease
DMMPO	Defense Medical Materiel Program Office
DNBI	disease and nonbattle injury
DoD	Department of Defense
DOW	died of wounds
EMED	Expeditionary Medical Encounter Database
EMedKW	Expeditionary Medical Knowledge Warehouse
FA	functional area
FORECAS	Ground Forces Casualty Forecasting System
FVWG	Functional Validation Working Group
GTS	generic task sequence
GUI	graphic user interface
ICD-9	<i>International Classification of Diseases, 9th Revision</i>
JMPT	Joint Medical Planning Tool
KIA	killed in action
LOO	lift of opportunity
M&S	modeling and simulation
MEDEVAC	medical evacuation
MTF	medical treatment facilities
NBI	nonbattle injury
NEA	Northeast Africa
NHRC	Naval Health Research Center
NIPRNet	uNclassified but Sensitive Internet Protocol Router Network
NMCI	Navy Marine Corps Intranet
NSN	National Stock Number

OIF	Operation Iraqi Freedom
OSD	Office of the Secretary of Defense
PC	patient condition
PCOF	patient condition occurrence frequency
POC	point of contact
POI	point of injury
RTD	Return to duty
SC	Surgical Company
SIPRNet	Secret Internet Protocol Router Network
SWA	Southwest Asia
TBE	Teledyne Brown Engineering, Inc.
TFS	Microsoft's Team Foundation Server
TIS	time in system
USA	U.S. Army
USAF	U.S. Air Force
USAFRICOM	U.S. Africa Command
USCENTCOM	U.S. Central Command
USEUCOM	U.S. European Command
USMC	U.S. Marine Corps
USN	U.S. Navy
USNORTHCOM	U.S. Northern Command
USPACOM	U.S. Pacific Command
USSOCOM	U.S. Special Operations Command
USSOUTHCOM	U.S. Southern Command
USTRANSCOM	U.S. Transportation Command
V&V	verification and validation
WIA	Wounded in action

APPENDIX H
V&V PROGRAMMATICS

Planned resource allocations and funding

Accreditation activity	Required resources	Funding source	FY/Q/\$K
Travel for validation team	\$200K	JCS, J41	FY12/Q2/200
NHRC	\$105K	JCS, J41	FY12/Q2/105
Developer	\$105K	JCS, J41	FY12/Q2/105
ATO + NMCI Cert	\$ 90K	JCS, J41	FY12/Q2/90
Validation coordinator	\$150K	JCS, J41	FY12/Q2/150
Total	\$650K		

REPORT DOCUMENTATION PAGE

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6. AUTHORS Joint Staff, Health Services Support Division, J41	
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Commanding Officer Naval Health Research Center 140 Sylvester Rd San Diego, CA 92106-3521	8. PERFORMING ORGANIZATION REPORT NUMBER 14-8H
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13. SUPPLEMENTARY NOTES

14. ABSTRACT To ensure that the Joint Medical Planning Tool (JMPT) was fully functional and met its current contract specifications, a verification and validation (V&V) effort was undertaken. Concomitantly, the data used with JMPT was evaluated to ensure that it was correct, complete, and consistent. A successful V&V effort would support accreditation by the Force Health Protection Integrating Council for use within the Department of Defense. A Functional Validation Working Group (FVWG) was formed. Training on JMPT and testing procedures was provided to all FVWG members during a week-long training session conducted in Huntsville, Alabama. Testing was administered by FVWG members and the findings, results, and recommendations were briefed to the Verification and Validation Working Group at weekly Defense Connect Online calls conducted July–October 2012. Critical FVWG findings were provided to the Naval Health Research Center and Teledyne Brown Engineering, Inc. for correction. Retesting was conducted by members of the FVWG in Nov 2012, which resulted in all critical issues being resolved. On 7 November 2012, the FVWG was briefed on the results of the retesting and agreed unanimously on recommending to the Strategic Analysis Working Group that JMPT be accredited for use as a joint medical planning tool.
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15. SUBJECT TERMS Joint Medical Planning Tool, JMPT, verification and validation, V&V, Functional Validation Working Group, FVWG
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16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UNCL	18. NUMBER OF PAGES 86	18a. NAME OF RESPONSIBLE PERSON Commanding Officer
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