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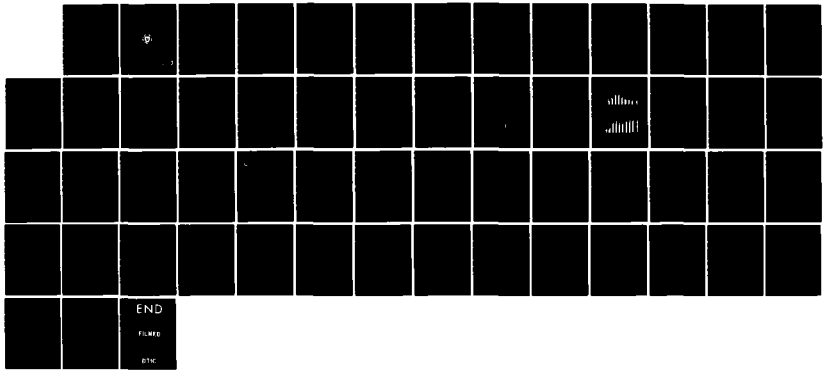

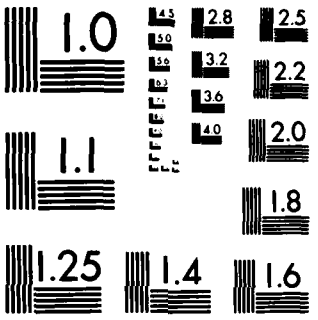

STUDY REPORT
CAA-SR-84-16

AD

AD-A149 503

IMPROVED CASUALTY ESTIMATION AND EVACUATION SYSTEM (ICEES)

MARCH 1984

PREPARED BY

FORCES DIRECTORATE

US ARMY CONCEPTS ANALYSIS AGENCY
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Bed requirements; evacuation requirements, patients, casualties, medical model, Patient Flow Model, JOPS III Medical Planning Module, evacuation delay factor, evacuation policy, communications zone, combat zone.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The scope of the study included modification of the Patient Flow Model (PFM) to allow the evacuation delay factor to be a user input and testing of the modified PFM to determine impacts on theater bed and evacuation requirements. The principal findings of the study showed that modifying the PFM resulted in significant reductions in communications zone (COMMZ) bed requirements, minimal variation in combat zone bed requirements, increases in evacuation requirements at specific time periods, more prompt evacuations out of theater and fewer COMMZ hospital requirements due to fewer COMMZ bed requirements.

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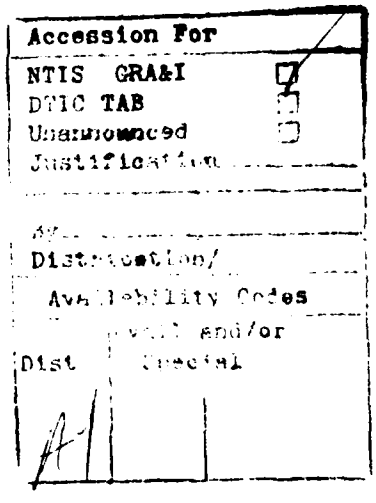
March 1984



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DEPARTMENT OF THE ARMY
US ARMY CONCEPTS ANALYSIS AGENCY
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REPLY TO
ATTENTION OF

CSCA-FOS

23 JUL 1984

SUBJECT: Improved Casualty Estimation and Evacuation System (ICEES) Study

The Surgeon General
ATTN: DASG-HCO-F
Department of the Army
Washington, DC 20310

1. Reference:

a. Letter, DASG-HCO-F, HQDA, 6 February 1984, subject as above.

b. Letter, CSCA-FOS, US Army Concepts Analysis Agency, 30 March 1984, subject as above.

2. Letter, reference 1a, directed the US Army Concepts Analysis Agency (CAA) to conduct a study to incorporate the evacuation delay factor methodology of the Joint Operations Planning System (JOPS) Medical Planning Module (MPM) into the Patient Flow Model (PFM). In response to this request, a draft study report was provided for your comments, reference 1b.

3. The ICEES Study Final Report is attached and has incorporated your comments as received. Request you advise this office of your experience using the modified PFM and any benefits derived therefrom to the Army.

4. This Agency expresses appreciation to all activities that have contributed to this project. Questions and/or inquiries should be directed to the Assistant Director, Forces Directorate (ATTN: CSCA-FOS), US Army Concepts Analysis Agency, 8120 Woodmont Avenue, Bethesda, Maryland 20814-2797, AUTOVON 295-1582.

David C. Hardison

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DAVID C. HARDISON
Director

CAA	**IMPROVED CASUALTY ESTIMATION AND EVACUATION SYSTEM (ICEES)**	**ONE SHEET STUDY GIST CAA-SR-84-16**

THE PRINCIPAL FINDINGS of the work reported herein are as follows:

(1) Changing that portion of the Patient Flow Model (PFM) which treats evacuation dates of patients who must be returned to CONUS hospitals results in:

- more prompt evacuations out of theater,
- reductions in calculated requirements for communication zone (COMMZ) hospital beds given a JCS 15-30-60-day evacuation policy and a fixed evacuation delay user input factor,
- minimal changes in the calculated requirements for combat zone hospital beds,
- increases in evacuation requirements at specific time periods from the COMMZ to CONUS given a JCS 15-30-60-day evacuation policy and a fixed evacuation delay user input factor, and
- fewer COMMZ hospital requirements due to fewer COMMZ bed requirements.

(2) Varying the time patients are held prior to evacuation produces results consistent with intuition.

(3) The modified PFM operates with the redesigned user input evacuation delay factors.

THE PRINCIPAL LIMITATIONS of this work are:

(1) The model verification process involved only a check to ensure that patient dispositions are the same in the modified PFM as in the PFM.

(2) No attempt was made to test model validity. It was assumed that validity testing was done when the original model was developed.

(3) The impact of a more prompt patient evacuation policy on CONUS hospital workload or patient transportation requirements were not addressed in this study.

THE SCOPE OF THE STUDY was taken to include modification of the PFM to allow for the patient's time in hospital prior to evacuation (evacuation delay factor) to be a user input, and testing of the modified PFM using TAA-90 NATO Design Case data to determine impacts on theater bed and evacuation requirements.

THE STUDY PURPOSE was to incorporate the evacuation delay methodology of the Joint Operation Planning System (JOPS) Medical Planning Module (MPM) into the Patient Flow Model program.

THE BASIC APPROACH followed in doing this study can be described as: initially, a thorough examination of the PFM was made to determine the necessary coding changes. After the program was modified, the model was verified to ensure the program changes were correctly implemented. Next, sensitivity tests were run to see if the modified PFM would act in the way expected--not counter to intuition. The TAA-90 NATO Design Case was selected as the base. Three tests were run using evacuation delay factors of 6 days, 10 days, and 14 days as input to the modified PFM. In all three tests the modified PFM was executed and results were compared with the original PFM results and changes to evacuation and bed requirements documented.

THE REASON FOR PERFORMING THE STUDY was mainly as follows: an analysis of the PFM methodology revealed that the PFM data may overstate the time a patient stays in theater hospitals prior to evacuation. The Office of the Surgeon General requested that the model be modified to permit the time taken to resuscitate and stablize patients be input to the model as a specific input variable. This study was directed to address that issue.

THE STUDY SPONSOR was the Director, Health Care Operations, Office of The Surgeon General, who sponsored the work, established objectives, and monitored study activities.

THE STUDY EFFORT was directed by MAJ R. M. Anthony, Forces Directorate.

COMMENTS AND QUESTIONS may be directed to CAA, Assistant Director for Forces, ATTN: CSCA-FO, 8120 Woodmont Avenue, Bethesda, Maryland 20814.

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IMPROVED CASUALTY ESTIMATION AND EVACUATION SYSTEM (ICEES)

1. INTRODUCTION

a. A memorandum, dated 26 July 1982, from the Assistant Secretary of Defense for Health Affairs (ASD-HA) to all Services, challenged all Services to develop and implement a common methodology to determine wartime medical requirements. Each of the Services was requested to determine wartime health resource requirements based on the following criteria:

(1) Specific diagnosis clinical data base.

(2) Facilities Model, developed by the Army's Academy of Health Sciences, for determining staffing requirements.

(3) Joint Operation Planning System (JOPS III) Medical Planning Module (MPM) for determining aggregate workload-based requirements for medical personnel and beds.

b. In response to ASD-HA's request, the Office The Surgeon General (OTSG) requested that an excursion be conducted t ne Total Army Analysis FY 1986-1990 to assess the impacts on the Army's suppor force structure of using JOPS III MPM accumulation and disposition facto as inputs to the Force Analysis Simulation of Theater Administrative and Logistics Support (FASTALS) Model instead of the Patient Flow Model (PFM) input factors. Although there are model differences, the only change was the evacuation delay factor (patient stabilization time, plus evacuation time) used for computing patient accumulation and disposition factors. The results of the excursion, using a fixed (10-day) evacuation delay factor, resulted in a 6 percent reduction in medical support force requirements.

c. A detailed assessment of the MPM and PFM methodologies revealed that the PFM is a better analytical tool for use by the Army in support of force structuring because it produces a more dynamic portrayal of the total patient flow process. However, the assessment revealed a potential weakness of the PFM methodology. The PFM data base may overstate theater bed requirements for certain evacuation policies (policies greater than 15 days) because it holds patients longer than the minimum time needed for resuscitation and stabilization prior to evacuation.

d. As a result of this assessment of a weakness in PFM, the OTSG requested that the US Army Concepts Analysis Agency (CAA) modify the PFM to better reflect the patient evacuation process.

2. PURPOSE. The purpose of this study is to incorporate the evacuation delay factor methodology of the MPM into the PFM program.

3. TASKS. The study tasks are as follows:

a. Modify the PFM program logic and data base to allow for the patient's time in hospital prior to evacuation (evacuation delay factor) to be user input.

b. Test the output of the modified PFM, using the TAA-90 Design Case as the Base Case and vary the evacuation delay factors and the theater evacuation policies.

c. Document the results by providing an updated PFM User's Manual and a report describing the test results.

4. METHODOLOGY

a. A thorough examination of the PFM was made to determine the necessary program changes.

(1) The time required for hospitalization before evacuating a patient (evacuation delay) in the PFM was changed to be an user input. In the current PFM the evacuation delay factor is not an input, rather the model determines when patients are evacuated based on an historical data base in the model. This was the only change made.

(2) Table 1 shows at key time periods (corresponding to times when the evacuation policy changes) the average evacuation delay for the PFM and the fixed evacuation delay for the modified PFM for each of the tests discussed in paragraph 4c, below. In the case of the PFM, there is a range of evacuation delay factors; an average is used so the same factors, and the result of those factors, can be compared to the fixed evacuation delay factors in the three tests of the modified PFM. The tests will be discussed further in paragraph 7, Test Results.

Table 1. Patient Time (days) in Hospital Before Evacuation

Days of combat	Evac policy	Time before evacuation			
			Modified PFM (fixed)		
		PFM (avg)	Test 1	Test 2	Test 3
D-day - D+30	15	9.5	10	6	14
D+31 - D+60	30	15.6	10	6	14
D+61 - D+180	60	24.8	10	6	14

(3) The force structure implication of the patient stablization times is that the longer patients stay in theater hospitals, the greater the bed requirements, thus more force structure is required to support them.

b. After program logic changes were made, the model was run to verify that the program changes were correctly implemented. Notional data, provided by the author, was used to verify the viability of the model. These inputs were limited to eight 10-day time periods.

c. Following the verification process, actual TAA-90 NATO Design Case data were utilized to test the sensitivity of the model. During all sensitivity runs, the model was executed for the entire 180-day war. These sensitivity tests were run to see if the modified PFM would act in the way expected--not counter to intuition. In other words, as the evacuation delay factor increases, bed requirements increase and vice versa, as the evacuation delay factor decreases, bed requirements decrease. Three tests were run. In Test 1, an evacuation delay factor of 10 days , as specified by OTSG, was entered into the modified model. In Tests 2 and 3 the OTSG 10-day delay was decreased and increased by 40 percent. In all three tests, the modified PFM was executed and the results were compared with the PFM and changes to evacuation and bed requirements were documented. The medical evacuation policy used for all tests is included in Table 1. The medical evacuation policy is a command decision indicating the length in days that patients may be held within the command for treatment. Patients who, in the opinion of responsible medical officers, cannot be returned to duty status within the prescribed period are evacuated to the next level of care by the first available means, provided the travel involved will not aggravate their disabilities. For example, on D+31, if a patient cannot be returned to duty within 30 days, the patient is evacuated out of theater immediately following surgery and stabilization.

5. ESSENTIAL ELEMENTS OF ANALYSIS. The study team devised the following essential elements of analysis for the study:

a. Were the logic changes to the modified PFM methodology implemented correctly?

b. What is the impact on theater evacuation requirements?

c. What is the impact on theater bed requirements?

6. VERIFICATION OF MODIFIED PFM

a. This paragraph describes the verification process used in the study. A sample patient population of 10,000 was selected for the verification process. Conceptually, the dispositions of these 10,000 patients should be the same for both models. In comparing the two models, the modified PFM should reflect more prompt evacuation of casualties out of theater with parallel effects on bed requirements. All other dispositions (return to duty and died in hospital) between the two models should not change.

b. Three verification runs were devised using three separate evacuation policies, i.e., constant 15 days, constant 30 days, and constant 60 days (versus the JCS evacuation policy discussed earlier). Using a constant evacuation policy in each run simplified the verification process.

c. Next, a fixed evacuation delay factor of 10 days was input only to the modified PFM and both models were executed and the number of dispositions for each were compared, i.e., number of returns to duty, died in hospital, and evacuees out of theater. If the number of dispositions by type were not equal, the modified PFM was debugged and the program error was corrected and the modified PFM was rerun. (Once the model changes were correctly implemented for the first evacuation policy, no further program changes were required.) If the number of dispositions were equal and there were more evacuation policies in both PFMs to assess, the above process was repeated. When all evacuation policies were assessed, the verification process was completed.

d. Figures 1 through 3 show the time-phased cumulative distribution of evacuees for each evacuation policy for each version of the model for WIA admissions only. As the charts show, the number of evacuees in each version of the model for a given medical evacuation policy is the same (i.e., the number of patients evacuated is the same for both models, regardless of length of stay in theater). However, the timing of when patients are evacuated is different, especially for the 30 and 60 day evacuation policies. The number of patients evacuated, however, decreases as the evacuation policy increases. These charts show that the modified PFM evacuates patients out of theater faster than the PFM when a 10-day evacuation delay is used, i.e., there is a more prompt evacuation of patients. The verification process was run for disease and nonbattle injury (DNBI) patients as well and showed similar results (not shown).

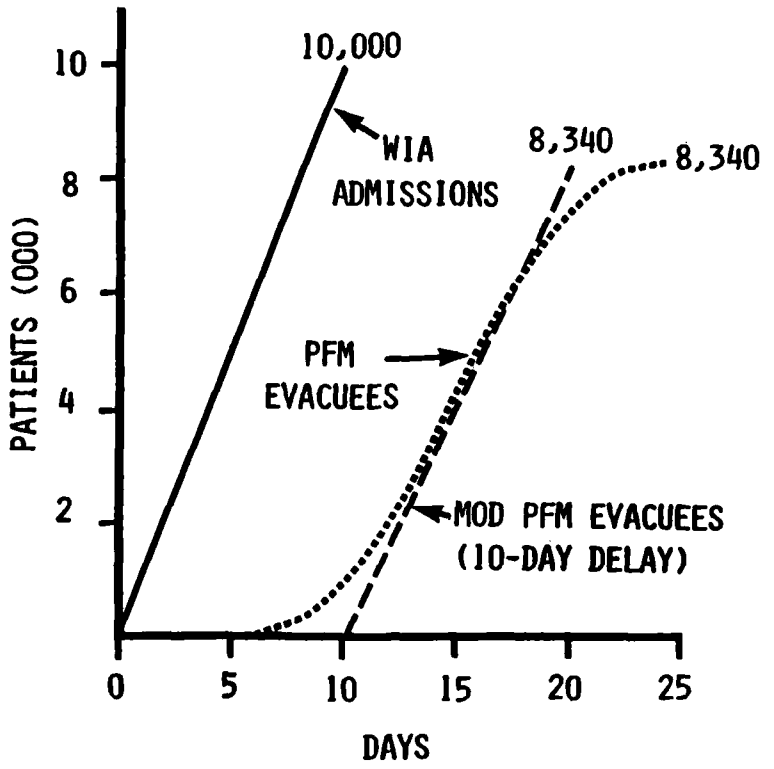

Figure 1. Verification of Evacuation Distribution (15-day evac policy)

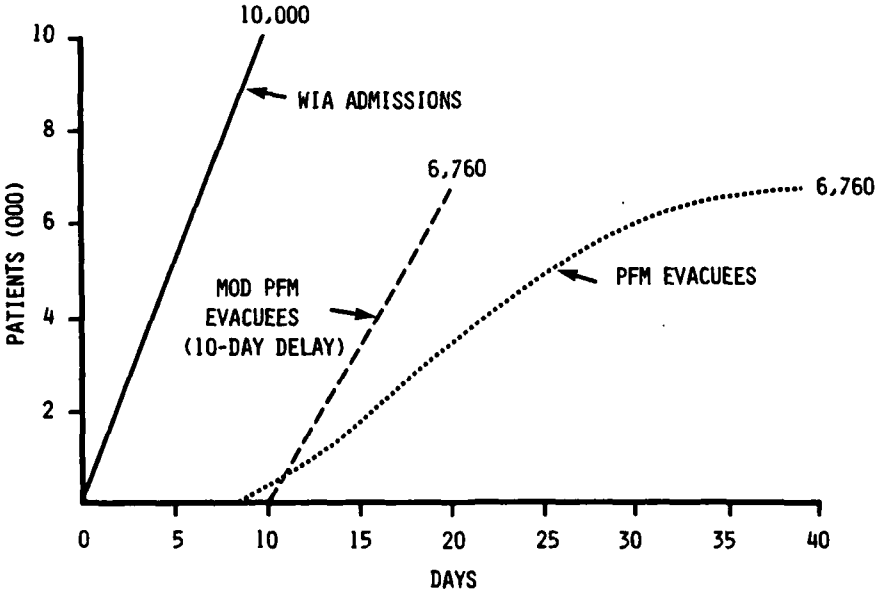

Figure 2. Verification of Evacuation Distribution (30-day evac policy)

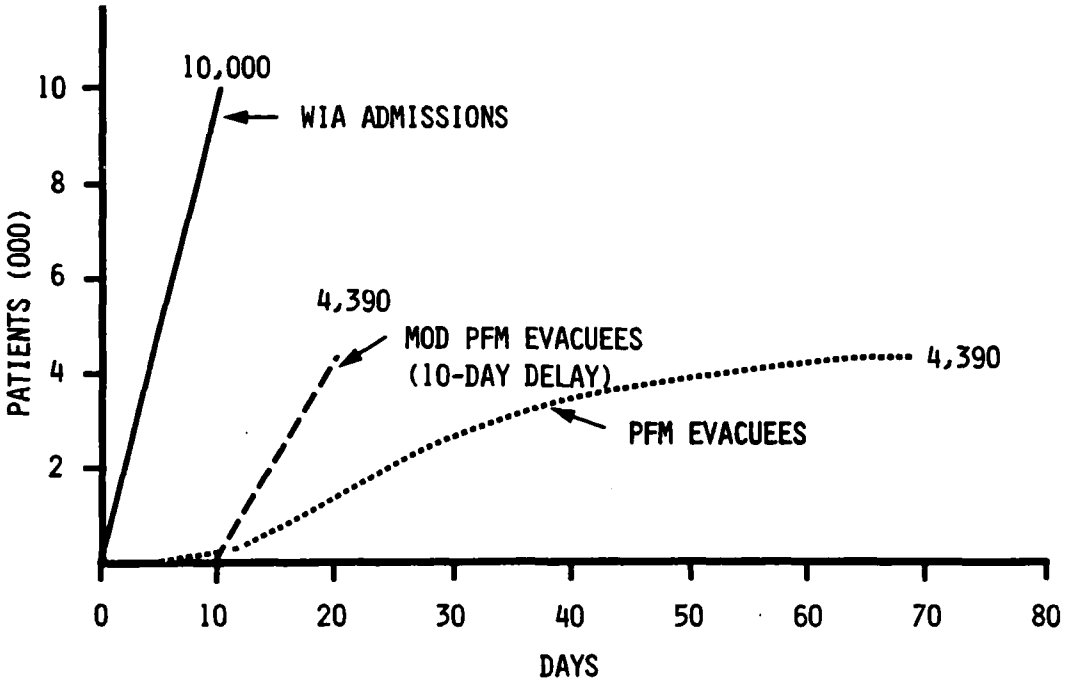

Figure 3. Verification of Evacuation Distribution (60-day evac policy)

7. **TEST RESULTS.** As described in paragraph 4 and Table 1, three tests were made of the modified PFM using three different fixed delay factors. These tests are described below.

a. Test 1. A 10-day evacuation delay factor, suggested by OTSG, was input to the modified PFM. This 10-day delay is composed of 3 days in combat zone hospitals (corps) and 7 days in communication zone (COMMZ) hospitals. These numbers are additive so patients entering combat zone hospitals will stay in the theater a total of 10 days prior to evacuation.

(1) Combat Zone. Figure 4 shows soldiers evacuated from corps hospitals. Time periods 91-100 through 161-170 are not shown because variations after D+90 are relatively constant (this is also true for the remaining similar figures in this report). There is essentially no difference in the number of evacuees from the corps to the COMMZ because the average evacuation delay in the combat zone for both models is the same--3 days. At D+180, there is only a .2 percent decrease in the total number of evacuees (509k to 508k). Figure 5 shows combat zone bed requirements. As expected, since there are minimal changes in evacuees, there are minimal differences in combat zone bed requirements. The average difference over the 180-day conflict was only 680 beds.

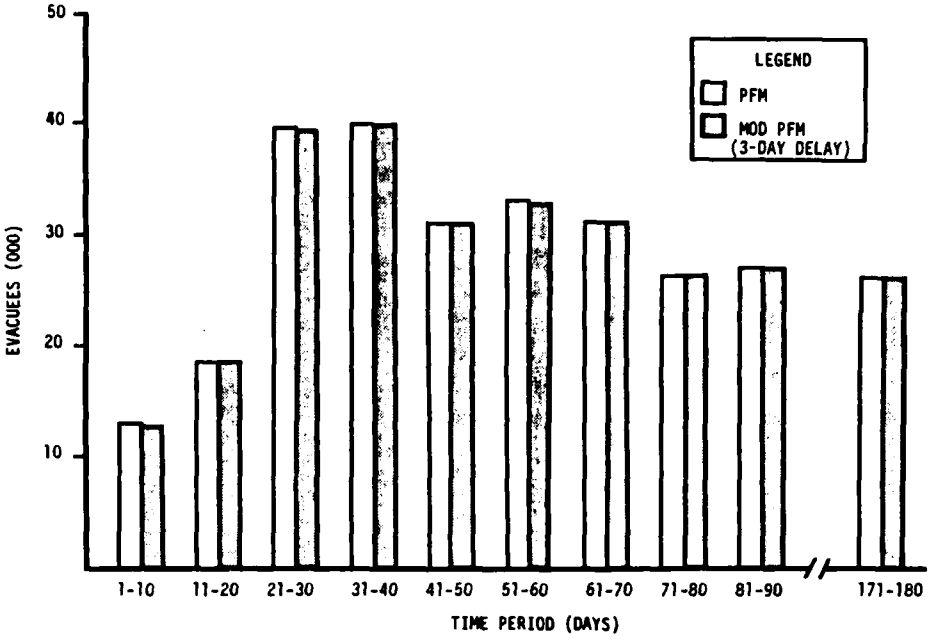

Figure 4. Soldiers Evacuated From Corps - Test 1

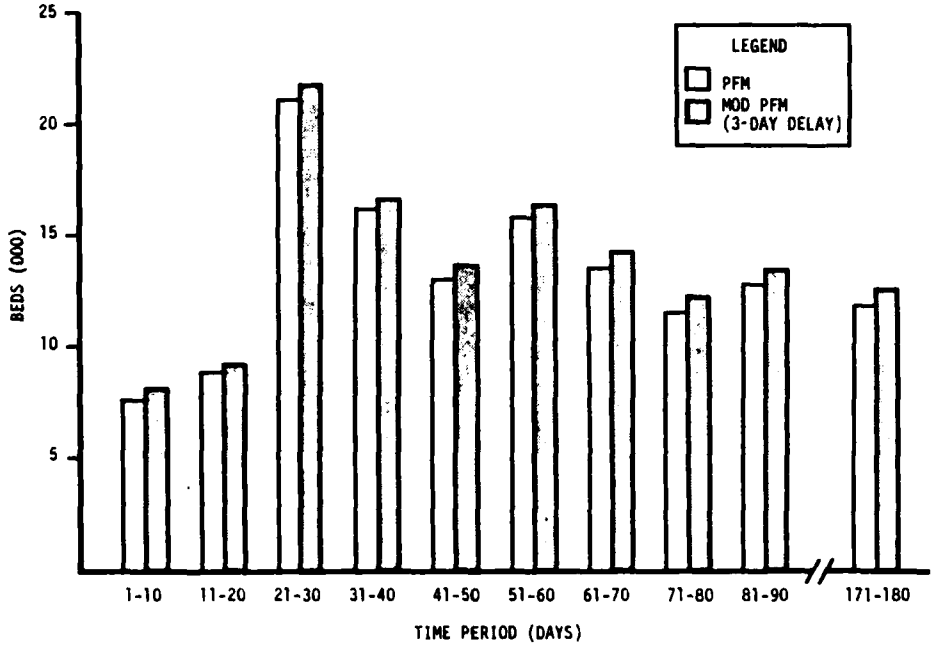

Figure 5. Combat Zone Bed Requirements - Test 1

(2) **COMMZ.** Figure 6 shows soldiers evacuated from the COMMZ for Test 1. Note that there is a large variation in the number of evacuees between the two models at time period 31-40. The 17,000 difference is caused by a medical evacuation policy change from 15 days to 30 days at D+31. Under a 30-day evacuation policy the PFM holds patients an average of 16 days; hence, the modified PFM with a 10-day delay evacuates patients more promptly out of theater. A similar change occurs at time period 61-70 when the evacuation policy changed from 30 days to 60 days. There are minimal differences between the two models at other time periods. Cumulative total evacuations out of theater at D+180 increased by 17,000 evacuees (from 223K to 240K). Figure 7 shows COMMZ bed requirements for Test 1. As expected, there are large reductions in bed requirements due to more prompt evacuations out of theater. At time period 31-40, the reduction is 17,000 beds, which corresponds to the increase in evacuees. The average difference between the two models over the 180-day conflict is 15,000 beds (22 percent reduction).

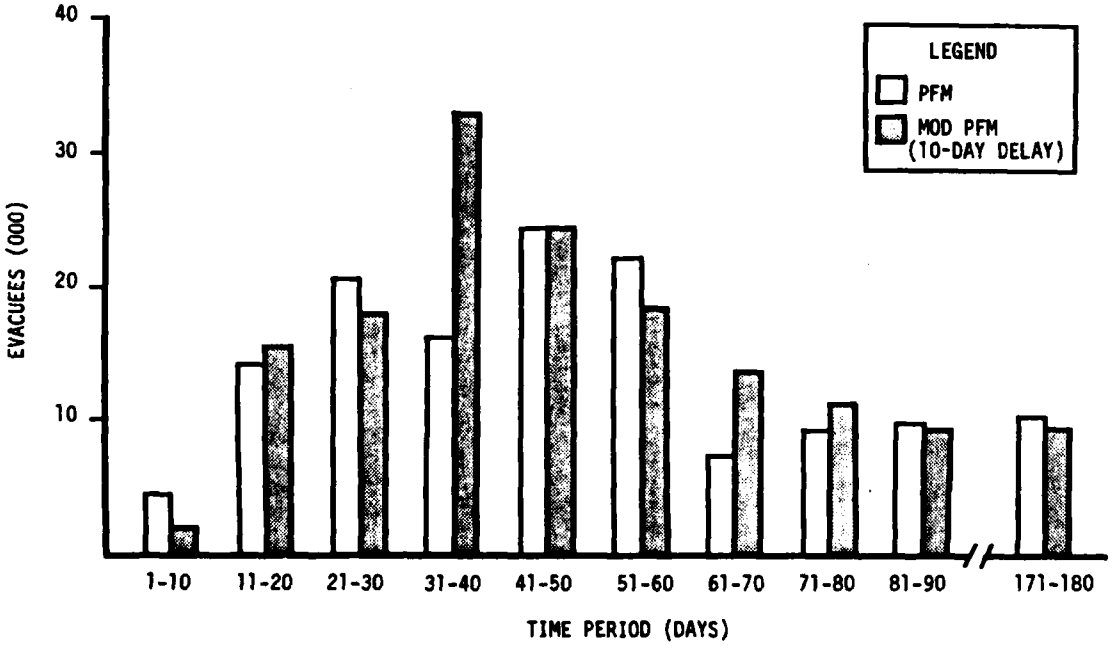

Figure 6. Soldiers Evacuated from the COMMZ - Test 1

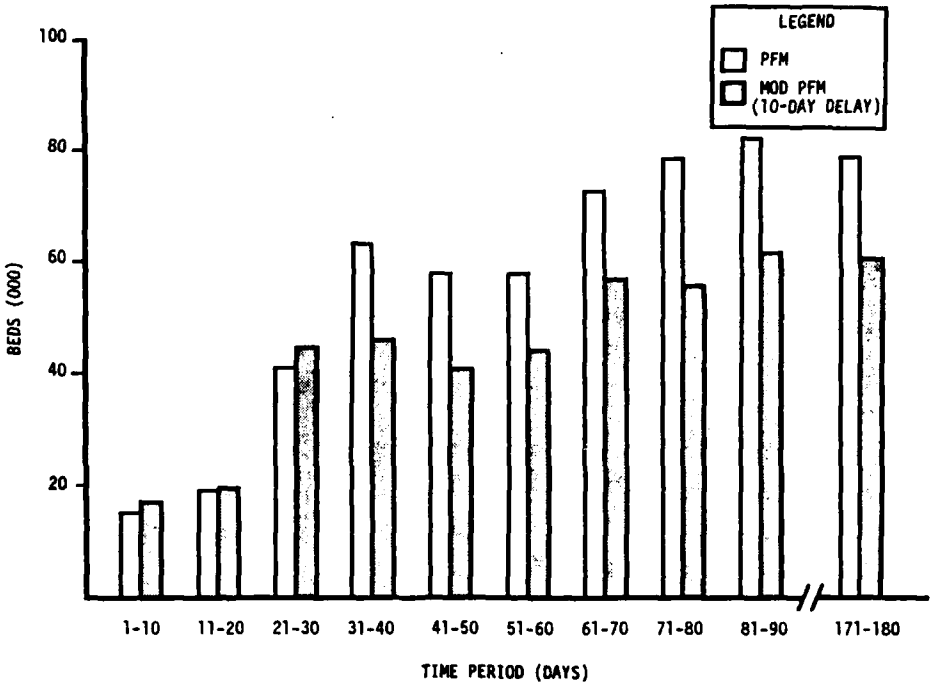

Figure 7. **COMMZ Bed Requirements - Test 1**

b. Test 2. An evacuation delay factor of 6 days was input to the modified PFM. The 6-day delay is composed of 3 days in combat zone hospitals and 3 days in COMMZ hospitals.

(1) Combat Zone. Since the 3-day evacuation delay in the combat zone is the same as Test 1, results in the combat zone are not discussed.

(2) COMMZ. Figure 8 shows soldiers evacuated from the COMMZ for Test 2. As in Test 1, there are minimal differences in evacuation requirements except at time periods 21-30, 31-40, and 61-70. The 14,000 variation at time period 31-40 and the 5,500 variation at time period 61-70 occur at evacuation policy changes as discussed in Test 1. However, the 8,000 increase at time period 21-30 is caused by the evacuation delay factor of 6 days being less than the average 9.5 days in the PFM for a 15-day evacuation factor (see Table 1). Cumulative total evacuations out of theater at D+180 increase by 20,000 evacuees over the PFM. Figure 9 shows COMMZ bed requirements for Test 2. Again, there are large reductions in bed requirements due to more prompt evacuations out of theater. The reductions at time periods 31-40 and 61-70 are approximately 32,000 beds. The average difference between the two models over the 180-day conflict is 23,000 beds (35 percent reduction).

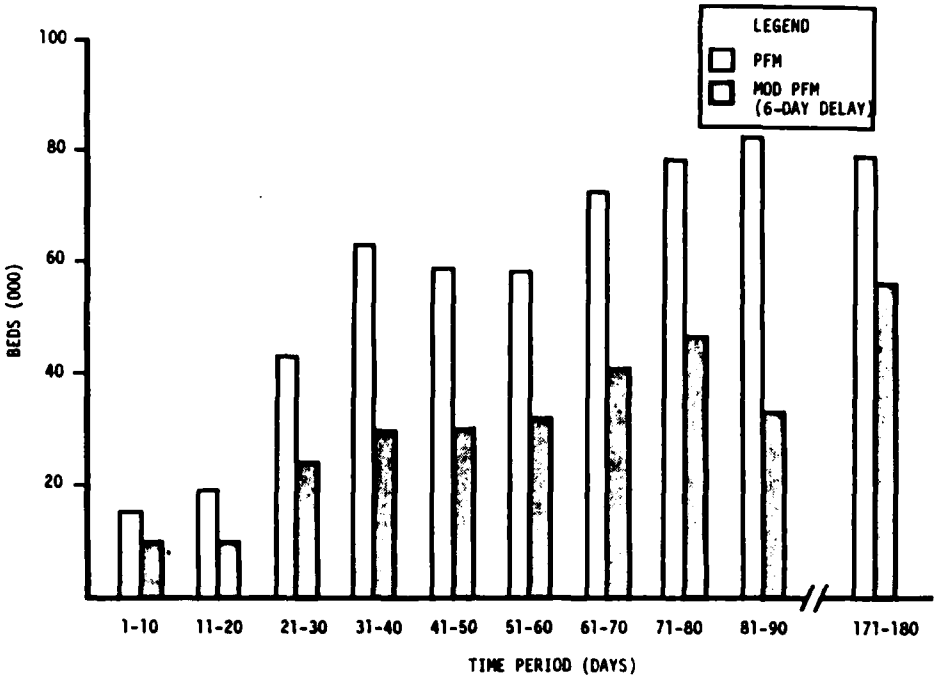

Figure 8. Soldiers Evacuated From COMMZ - Test 2

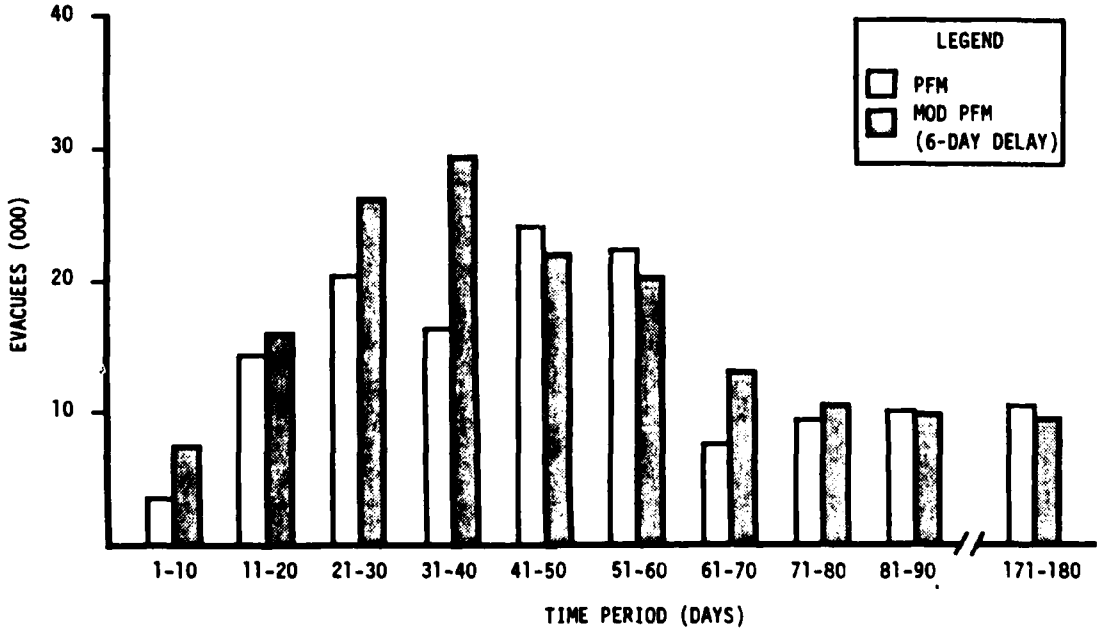

Figure 9. COMMZ Bed Requirements - Test 2

c. Test 3. An evacuation delay factor of 14 days was input to the modified PFM. The 14-day delay is composed of 3 days in combat zone hospitals and 11 days in COMMZ hospitals.

(1) Combat Zone. As in Test 2, results in the combat zone will not be discussed since the same 3-day evacuation delay is used.

(2) COMMZ. Figure 10 shows soldiers evacuated from the COMMZ for Test 3. As in the other tests, there are minimal evacuation requirement changes for most periods. However, it is interesting to note, for the first time, evacuations for the first 30 days of combat for the modified PFM are less than in the PFM. This is because the 14-day delay of the modified PFM is greater than the 9.5-day average of the PFM for a 15-day policy (see Table 1). Also the variations for the time periods 31-40 through 51-60 are not as great because the 14-day delay in the modified PFM is approaching the 16-day average delay for the PFM for a 30-day policy (see Table 1). The variations at time periods 31-40 and 61-70 are 9,000 and 6,000 evacuees, respectively. Cumulative total evacuations out of theater at D+180 increase by 9,000 evacuees over the PFM. Figure 11 shows COMMZ bed requirements for Test 3. Again as expected, there are reductions in COMMZ bed requirements. However, a large reduction (11,000 beds) does not occur until time period 61-70, when the evacuation policy changes to 60 days. The slight increase in bed requirements for the first 30 days occurs because patients are held longer in the modified PFM as mentioned above. The average reduction over the 180-day conflict is 9,000 beds (12 percent reduction).

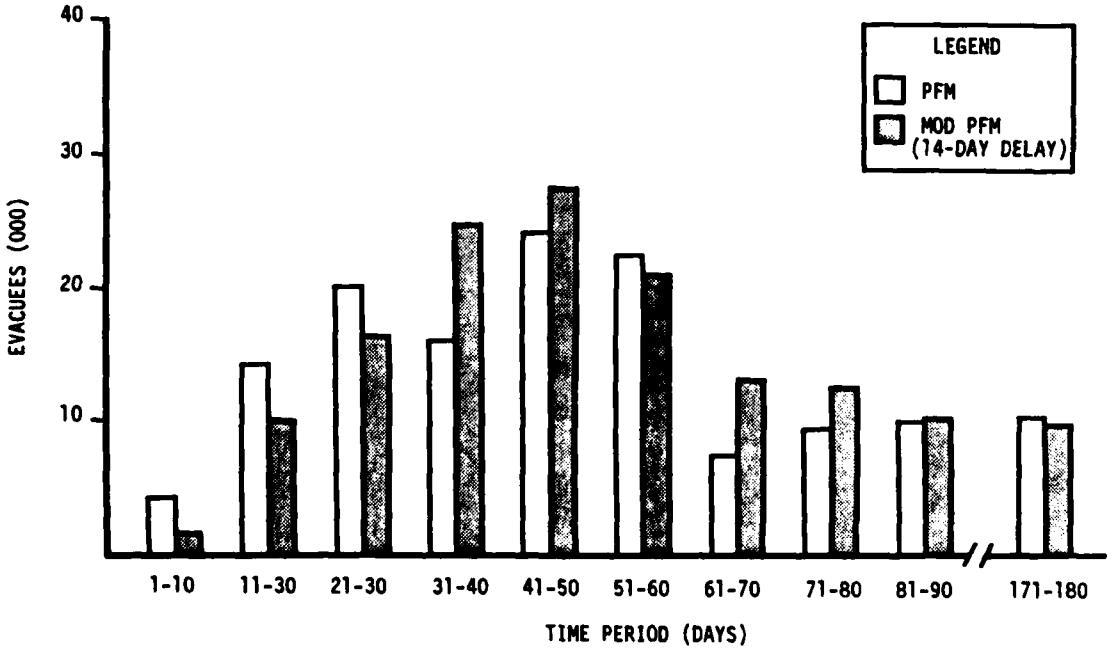

Figure 10. Soldiers Evacuated From the COMMZ - Test 3

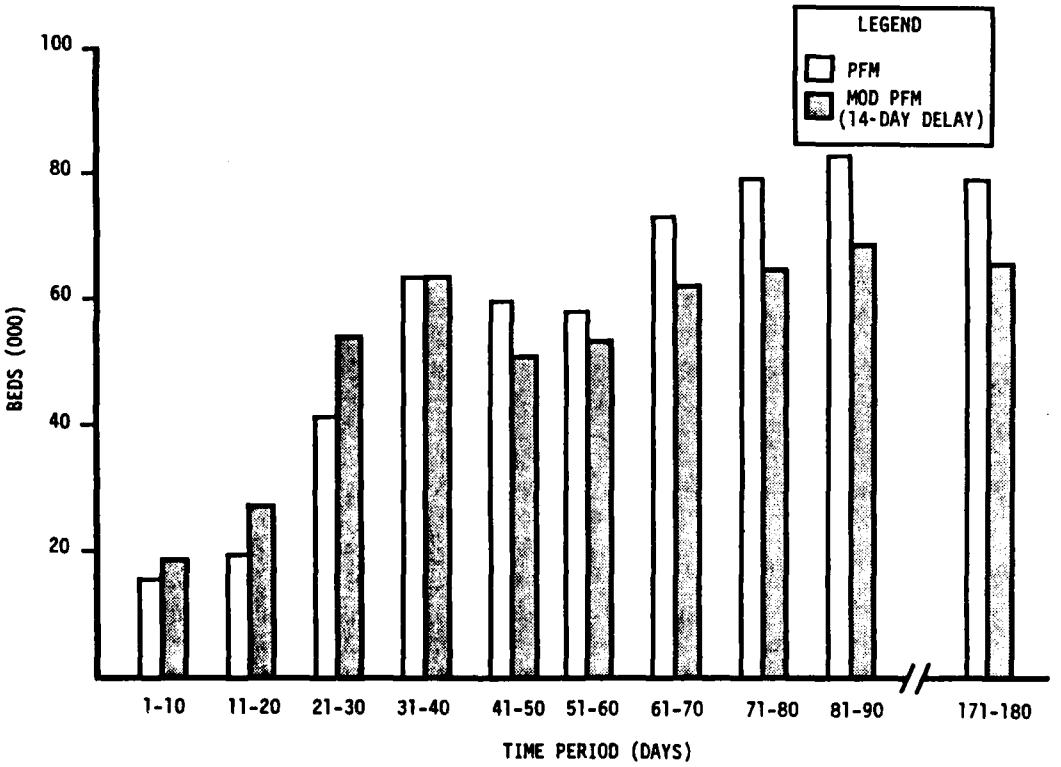

Figure 11. COMMZ Bed Requirements - Test 3

d. Comparison of Tests. Figure 12 shows a comparison of soldiers evacuated from the COMMZ among the three tests and the PFM. There are minimal differences among the three tests, except for the first 50 days, and these differences are mainly timing changes which affects when soldiers are evacuated. The lower the evacuation delay factor, the quicker the maximum is reached. Figure 13 shows a comparison of COMMZ bed requirements among the three tests and the PFM. The fluctuations in bed requirements during the first 60 days are caused by the timing of when evacuees leave the COMMZ, as mentioned above. After time period 61-70, the difference in bed requirements among the three tests are fairly consistent.

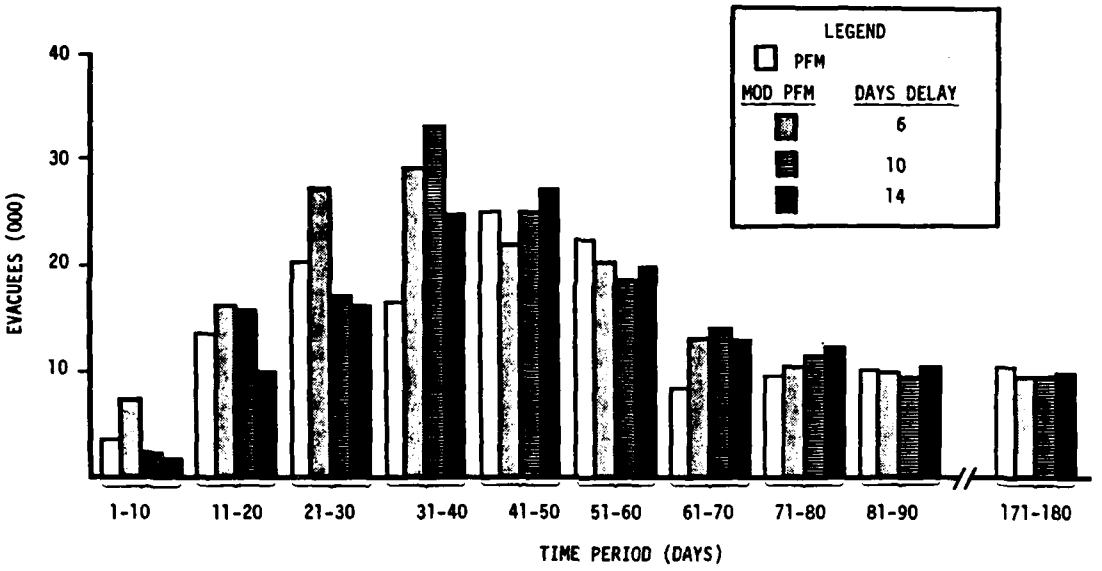

Figure 12. Comparison: Soldiers Evacuated From COMMZ

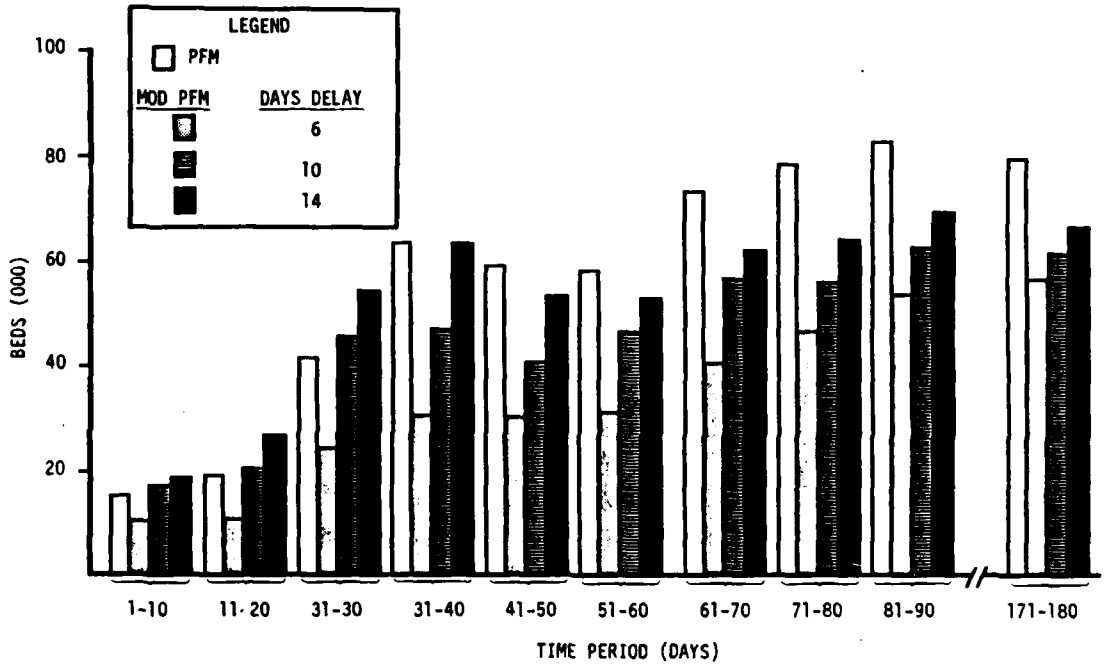

Figure 13. Comparison: COMMZ Bed Requirements

e. The changes in COMMZ bed requirements were as expected. As the evacuation delay factor was increased, the COMMZ bed requirements increased as shown in Figure 13. Table 2 shows a summary of changes in bed requirements as compared to the PFM. As mentioned earlier in the report, the 5 percent change in combat zone beds is only 680 beds. A further examination of results found in Table 2 shows that the modified PFM tends to converge to PFM results as the evacuation delay factor increases.

Table 2. Summary of Changes In Bed Requirements (D+180)

Delay factor (days)	Change[a]	
	Cbt zone[b]	COMMZ
6	+5%	-35%
10	+5%	-22%
14	+5%	-12%

[a]Change in PFM results: (MOD-OLD)/OLD x 100.

[b]Evacuation delay factor remains 3 days in combat zone.

8. OBSERVATIONS

a. The modified PFM was verified.

b. The modified PFM produced significant reductions in COMMZ bed requirements for all three tests.

c. The modified PFM produced minimal changes in combat zone bed requirements.

d. Using the modified PFM for force structuring will result in fewer COMMZ hospitals due to fewer COMMZ bed requirements.

e. The modified PFM results are consistent with changes in the evacuation delay factor.

f. The modified PFM results in significant increases in patient evacuations during time periods where the evacuation policy changes. However, overall changes are minimal.

g. The modified PFM evacuates patients out of theater more promptly than the PFM.

APPENDIX A

CONTRIBUTORS

1. AUTHOR

MAJ R. M. Anthony, Forces Directorate

2. CONTRIBUTORS

Ms Laurie Sutkowski

APPENDIX B

STUDY DIRECTIVE

DEPARTMENT OF THE ARMY
OFFICE OF THE SURGEON GENERAL
WASHINGTON, DC 20310

REPLY TO
ATTENTION OF

DASG-HCO-F

6 February 1984

MEMORANDUM FOR DIRECTOR, US ARMY CONCEPTS ANALYSIS AGENCY

SUBJECT: Improved Casualty Estimation and Evacuation System (ICEES)

1. Purpose of Study Directive: This directive provides tasking which is intended to improve the methodology used in support of the Army's casualty estimation process by more realistically portraying the patient evacuation system.

2. Study Title: Improved Casualty Estimation and Evacuation System (ICEES).

3. Background:

a. A memorandum, dated 26 July 1982, from the Assistant Secretary of Defense for Health Affairs to all Services, challenged all Services to develop and implement a common methodology to determine wartime medical requirements. Each of the Services was requested to determine wartime health resource requirements based on the following criteria:

(1) Specific diagnosis clinical data base.

(2) Facilities Model, developed by the Army's Academy of Health Sciences, for determining staffing requirements.

(3) JOPS III Medical Planning Module (MPM) for determining aggregate workload-based requirements for medical personnel and beds.

b. In response to ASD-HA's request, the Office of The Surgeon General requested that a TAA-90 excursion be completed to assess the impacts on the Army's support force structure of using JOPS III MPM accumulation and disposition factors as inputs to the FASTALS Model instead of the Patient Flow Model (PFM) input factors. Although there are model differences, the only change was the evacuation delay factor (patient stabilization time, plus evacuation time) used for computing patient accumulation and disposition factors. The results of the excursion, using a different (shorter) evacuation delay factor, showed a six percent reduction in medical support force requirements.

c. A detailed assessment of the MPM and PFM methodologies revealed that the PFM is a better analytical tool for use by the Army in support of force structuring because it produces a more dynamic portrayal of the total patient

DASG-HCO-F
SUBJECT: Improved Casualty Estimation and Evacuation System (ICEES)

flow process. However, the assessment revealed a potential weakness of the PFM methodology, in that the PFM data base may overstate theater bed requirements for certain evacuation policies because it holds patients longer than the minimum time prior to evacuation.

4. Study Proponent: Department of the Army Surgeon General.

5. Study Agency: Forces Directorate, CAA.

6. Terms of Reference:

a. Purpose: The purpose of this study is to incorporate the evacuation delay factor methodology of the MPM into the Patient Flow Model program.

b. Tasks: The study tasks are as follows:

(1) Modify the PFM program logic and data base to allow for the patient's time in hospital prior to evacuation (evacuation delay factor) to be user input.

(2) Test the output of the modified PFM, using the TAA-90 Design Case as the Base Case and vary the evacuation delay factors and the theater evacuation policies.

(3) Document the results by providing an updated PFM User's Manual and a scripted report describing the test results.

c. Limitations: None.

d. Constraints: None.

e. Assumptions: None.

7. Responsibilities:

a. OTSG:

(1) Provide the medical data necessary to conduct the study.

(2) Prepare an evaluation of study IAW AR 5-5.

b. USACAA: Complete all analytical work on ICEES and provide documentation to Study Sponsor.

DASG-HCO-F
SUBJECT: Improved Casualty Estimation and Evacuation System (ICEES)

8. Administration:

a. Milestone Schedule:

(1)	Study Team formed.	9 Nov 83
(2)	Tasker approved.	10 Dec 83
(3)	Methodology developed.	20 Dec 83
(4)	PFM logic changes completed.	20 Jan 84
(5)	Verify modified PFM.	10 Feb 84
(6)	Test application of model, using TAA-90 data.	17 Feb 84
(7)	Finalize documentation for model.	10 Mar 84

b. Products:

(1) Modified PFM program.

(2) Updated PFM documentation.

(3) A scripted report will be prepared describing the test application of the modified model to the TAA-90 Design Case.

FOR THE SURGEON GENERAL:

Girard Seitter III

GIRARD SEITTER, III
Brigadier General, MC
Director, Health Care Operations

LTC Ethington/71895
Typed by Miss Joan Feggins

APPENDIX C

BIBLIOGRAPHY

Patient Flow Model Reference Manual, US Army Concepts Analysis Agency for Department of the Army Surgeon General, CAA-D-82-1, July 1982

Joint Operation Planning System (JOPS) III Medical Planning Module Users Manual (draft), Worldwide Military Command and Control System, Washington, DC, December 1982

Total Army Analysis, FY 1986-1990 (TAA-90), Volume II, Appendix E: Analysis of Medical Planning Module Methodology Versus Patient Flow Model (U), US Army Concepts Analysis Agency, CAA-SR-83-15, October 1983

APPENDIX D

SPONSOR'S COMMENTS

DASG-HCO-F (30 Mar 84) 1st Ind
SUBJECT: Improved Casualty Estimation and Evacuation System (ICEES) Study

HQDA(DASG-HCZ), WASH DC 20310 30 MAY 1984

TO: Cdr, US Army Concepts Analysis Agency, ATTN: CSCA-FOS, 8120 Woodmont Ave, Bethesda, MD 20814

1. The Improved Casualty Estimation and Evacuation System (ICEES) Study (Draft) has been examined by members of the DASG-HCO-F staff. The study has been determined to satisfy the requirements set forth in reference a. Attached as an inclosure are comments primarily of an editorial nature.

2. The draft report is well documented and will greatly assist in the execution of medical planning. The study author, Major Robert M. Anthony and the contributor, Ms Laurie Sutkowski, are to be commended for their efforts.

FOR THE SURGEON GENERAL:

1 Incl
wd all incl
Added 1 incl
as

for: GIRARD SEITTER, III
Brigadier General, MC
Director, Health Care Operations

CHARLES C. OTTERSTEDT
Colonel, MSC
Deputy Director, Health
Care Operations

DEPARTMENT OF THE ARMY
US ARMY CONCEPTS ANALYSIS AGENCY
8120 WOODMONT AVENUE
BETHESDA, MARYLAND 20814

REPLY TO
ATTENTION OF

CSCA-FOS

30 MAR 1984

SUBJECT: Improved Casualty Estimation and Evacuation System (ICEES) Study

Department of the Army
The Surgeon General
ATTN: DASG-HCO-F
Washington, DC 20310

1. Reference:

a. Memorandum, HQDA, DASG-HCO-F, 6 February 1984, subject as above.

b. Letter, HQDA, DACS-DMO, 19 October 1983, subject: Responsibility of Study Performing and Study Sponsoring Organizations.

2. The Director of Health Care Operations of TSGO (see reference 1a, above) requested that CAA conduct the Improved Casualty Estimation and Evacuation System (ICEES) Study to incorporate the evacuation delay factor methodology of the Joint Operations Planning System (JOPS) Medical Planning Module (MPM) into the Patient Flow Model. Attached at Inclosure 1 are two copies of the draft final report of the ICEES Study which documents the results.

3. This draft report is being provided in accordance with reference 1b in order to obtain your comments prior to publication of the final report. For this purpose, a study critique sheet (Inclosure 2) is provided for your use. Also attached at Inclosure 3, for your comment, is the distribution list that we plan to use. Request that your comments on the report and the distribution list be provided to CAA within 30 days after receipt of the final report. Your comments, if any, will be included in the final report if they are provided to CAA prior to the planned publication date.

David C. Hardison

3 Incl
as

DAVID C. HARDISON
Director

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS

For use of this form, see AR 310-1; the proponent agency is the US Army Adjutant General Center.

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WASH, DC 20310

PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC SM) AND BLANK FORMS

PUBLICATION FORM NUMBER	DATE	TITLE
		Improve Casualty Estimation and Evacuation System (ICEES)

ITEM NO.	PAGE NO.	PARAGRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
1	NA	(1)	1			(Second Bullet) "significant reductions in..." change to "reductions in calculated requirements for communications zone (COMMZ) hospital beds given a JCS 15-30-60 day evac policy and a fixed evacuation delay user input factor."
2	NA	(1)	1			(Fourth Bullet) delete "significant" add at end... from the COMMZ to CONUS given a JCS 15-30-60 day evacuation policy and a fixed evacuation delay user input factor.
3	NA	(3)	1			delete, replace with "The modified PFM operates with the redesigned user input evacuation delay factors."
4	2-3	4&6				Combine para 4 and 6. Para 4 and 6 need to be further clarified. As presently written, it is difficult for the reader to fully understand the remainder of the study, specifically the methodology differences between the Verification (para 7) and Test Results (para 8) processes. As a suggestion, allowing for the author's editoral license, a statement similar to the following should be made: "In the Verification process notional input data, provided by the author, was used to verify the viability of the model. These inputs were limited to eight time periods." "Following the Verification process actual TAA 1986-1990 data was utilized in the test of the model. During this test the model was executed in its entirety."

*Reference to line numbers within the paragraph or subparagraph.

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PART I - ALL PUBLICATIONS (EXCEPT RPSTL AND SC SM) AND BLANK FORMS

PUBLICATION FORM NUMBER	DATE	TITLE
		Improved Casualty Estimation and Evacuation System (ICEES)

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO.*	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Exact wording of recommended change must be given)
5	4	7a	3			Second sentence cumbersome, should be restructured to say "Conceptually, the disposition of these 10,000 patients should be the same for both models.
6	4	7a	4			Third sentence should be restructured for clarity, example: "In comparing the two models, the modified PFM should reflect a more prompt evacuation of casualties out-of-theater with parallel effects on bed requirements.
7	4	7a				A comment needs to be made in this paragraph addressing the parallel effects on return-to-duty, died in hospital and other dispositions in regards to this 10,000 population. If there are no changes in other dispositions between the two models, then this should be stated.
8	4	7b	2			Substitute the word "fixed" or "constant" for "straight" in this paragraph.
9	4	7b	4			Insert "verification"before the word process.
10	4	7d				Add a comment as to whether these evacuees would be evacuated regardless of length of stay in theater.

*Reference to line numbers within the paragraph or subparagraph.

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GLOSSARY

1. ABBREVIATIONS, ACRONYMS, AND SHORT TERMS

ASD-HA	Assistant Secretary of Defense for Health Affairs
CAA	US Army Concepts Analysis Agency
cbt	combat
COMMZ	communication zone
FASTALS	Force Analysis Simulation of Theater Administrative and Logistics Support (model)
ICEES	Improved Casualty Estimation and Evacuation System (study)
JOPS	Joint Operations Planning System
K	thousand(s)
MOD PFM	modified Patient Flow Model
MPM	Medical Planning Module
NATO	North Atlantic Treaty Organization
OTSG	Office of The Surgeon General
PFM	Patient Flow Model
TAA	Total Army Analysis (study)
WIA	wounded in action

2. TERMS UNIQUE TO THIS STUDY

Accumulation Factors. Assuming one admission per day during a time period and none thereafter, the expected number of patients occupying beds in the echelon specified at the end of successive periods. Equivalently, for patients admitted on the first day of a period, the average number of hospital days spent at the echelon specified during successive periods. Accumulation factors are computed for each patient type and for the applicable time sequence of evacuation policies.

Combat Zone. The mobile-bed echelon of hospitalization. Normally, taken as the first (forwardmost) echelon.

Communications Zone (COMMZ). The fixed-bed echelon of hospitalization within a theater of operations. Normally taken as the second echelon.

Continental United States (CONUS). Normally taken as the last (rearmost) echelon of hospitalization.

Disease and Nonbattle Injury (DNBI). Sickness/disease and nonbattle accident/injury. The classification of all patients other than those wounded-in-action.

Disposition. Either final or intermediate. Final dispositions are return to duty (RTD), death in hospital (DIH), and disability separation (DS) which occurs only in CONUS. The intermediate disposition is evacuation (EVAC) which can occur only from echelons forward of the rearmost.

Disposition Factors. Assuming one admission per day during a time period and none thereafter, the expected number of patients receiving a particular disposition from the echelon specified during successive periods. Disposition factors are computed for each patient type, for each disposition type, and for the applicable time sequence of evacuation policies.

Echelon. Level of hospitalization. A level of medical treatment and evacuation composed of all hospitals operating under the same evacuation policy. The first or lowest echelon named is always the forwardmost level of hospitalization beginning at the forward edge of the battle area (FEBA), and the last or highest echelon named always includes CONUS. Since there is never evacuation from the last (rearmost) echelon, it may be viewed as having an infinitely long evacuation policy.

Evacuation Delay Factor. The amount of time it takes to resuscitate and stabilize patients prior to evacuation to more definitive care.

Evacuation Policy. The evacuation policy is a command decision indicating the length in days that patients may be held within the comand for treatment. Patients who, in the opinion of responsible medical officers, cannot be returned to duty within the prescribed period are evacuated to the next level of care immediately following surgery and stabilization.

Time Periods. Periods of estimate. Consecutive intervals of time, all of equal length in days.

Wounded in Action (WIA). Wounded or injured in action. The classification of all patients other than those with the disease and nonbattle injury classification.

CAA	IMPROVED CASUALTY ESTIMATION AND EVACUATION SYSTEM (ICEES)	ONE SHEET STUDY GIST CAA-SR-84-16

THE PRINCIPAL FINDINGS of the work reported herein are as follows:

(1) Changing that portion of the Patient Flow Model (PFM) which treats evacuation dates of patients who must be returned to CONUS hospitals results in:

- more prompt evacuations out of theater,
- reductions in calculated requirements for communication zone (COMMZ) hospital beds given a JCS 15-30-60-day evacuation policy and a fixed evacuation delay user input factor,
- minimal changes in the calculated requirements for combat zone hospital beds,
- increases in evacuation requirements at specific time periods from the COMMZ to CONUS given a JCS 15-30-60-day evacuation policy and a fixed evacuation delay user input factor, and
- fewer COMMZ hospital requirements due to fewer COMMZ bed requirements.

(2) Varying the time patients are held prior to evacuation produces results consistent with intuition.

(3) The modified PFM operates with the redesigned user input evacuation delay factors.

THE PRINCIPAL LIMITATIONS of this work are:

(1) The model verification process involved only a check to ensure that patient dispositions are the same in the modified PFM as in the PFM.

(2) No attempt was made to test model validity. It was assumed that validity testing was done when the original model was developed.

(3) The impact of a more prompt patient evacuation policy on CONUS hospital workload or patient transportation requirements were not addressed in this study.

THE SCOPE OF THE STUDY was taken to include modification of the PFM to allow for the patient's time in hospital prior to evacuation (evacuation delay factor) to be a user input, and testing of the modified PFM using TAA-90 NATO Design Case data to determine impacts on theater bed and evacuation requirements.

THE STUDY PURPOSE was to incorporate the evacuation delay methodology of the Joint Operation Planning System (JOPS) Medical Planning Module (MPM) into the Patient Flow Model program.

THE BASIC APPROACH followed in doing this study can be described as: initially, a thorough examination of the PFM was made to determine the necessary coding changes. After the program was modified, the model was verified to ensure the program changes were correctly implemented. Next, sensitivity tests were run to see if the modified PFM would act in the way expected--not counter to intuition. The TAA-90 NATO Design Case was selected as the base. Three tests were run using evacuation delay factors of 6 days, 10 days, and 14 days as input to the modified PFM. In all three tests the modified PFM was executed and results were compared with the original PFM results and changes to evacuation and bed requirements documented.

THE REASON FOR PERFORMING THE STUDY was mainly as follows: an analysis of the PFM methodology revealed that the PFM data may overstate the time a patient stays in theater hospitals prior to evacuation. The Office of the Surgeon General requested that the model be modified to permit the time taken to resuscitate and stablize patients be input to the model as a specific input variable. This study was directed to address that issue.

THE STUDY SPONSOR was the Director, Health Care Operations, Office of The Surgeon General, who sponsored the work, established objectives, and monitored study activities.

THE STUDY EFFORT was directed by MAJ R. M. Anthony, Forces Directorate.

COMMENTS AND QUESTIONS may be directed to CAA, Assistant Director for Forces, ATTN: CSCA-FO, 8120 Woodmont Avenue, Bethesda, Maryland 20814.

CAA	IMPROVED CASUALTY ESTIMATION AND EVACUATION SYSTEM (ICEES)	ONE SHEET STUDY GIST CAA-SR-84-16

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CAA (CONCEPTS ANALYSIS AGENCY, UNITED STATES ARMY)	**IMPROVED CASUALTY ESTIMATION AND EVACUATION SYSTEM (ICEES)**	**ONE SHEET STUDY GIST CAA-SR-84-16**

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CAA — CONCEPTS ANALYSIS AGENCY — UNITED STATES ARMY	**IMPROVED CASUALTY ESTIMATION AND EVACUATION SYSTEM (ICEES)**	**ONE SHEET STUDY GIST CAA-SR-84-16**

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- fewer COMMZ hospital requirements due to fewer COMMZ bed requirements.

(2) Varying the time patients are held prior to evacuation produces results consistent with intuition.

(3) The modified PFM operates with the redesigned user input evacuation delay factors.

THE PRINCIPAL LIMITATIONS of this work are:

(1) The model verification process involved only a check to ensure that patient dispositions are the same in the modified PFM as in the PFM.

(2) No attempt was made to test model validity. It was assumed that validity testing was done when the original model was developed.

(3) The impact of a more prompt patient evacuation policy on CONUS hospital workload or patient transportation requirements were not addressed in this study.

THE SCOPE OF THE STUDY was taken to include modification of the PFM to allow for the patient's time in hospital prior to evacuation (evacuation delay factor) to be a user input, and testing of the modified PFM using TAA-90 NATO Design Case data to determine impacts on theater bed and evacuation requirements.

THE STUDY PURPOSE was to incorporate the evacuation delay methodology of the Joint Operation Planning System (JOPS) Medical Planning Module (MPM) into the Patient Flow Model program.

THE BASIC APPROACH followed in doing this study can be described as: initially, a thorough examination of the PFM was made to determine the necessary coding changes. After the program was modified, the model was verified to ensure the program changes were correctly implemented. Next, sensitivity tests were run to see if the modified PFM would act in the way expected--not counter to intuition. The TAA-90 NATO Design Case was selected as the base. Three tests were run using evacuation delay factors of 6 days, 10 days, and 14 days as input to the modified PFM. In all three tests the modified PFM was executed and results were compared with the original PFM results and changes to evacuation and bed requirements documented.

THE REASON FOR PERFORMING THE STUDY was mainly as follows: an analysis of the PFM methodology revealed that the PFM data may overstate the time a patient stays in theater hospitals prior to evacuation. The Office of the Surgeon General requested that the model be modified to permit the time taken to resuscitate and stablize patients be input to the model as a specific input variable. This study was directed to address that issue.

THE STUDY SPONSOR was the Director, Health Care Operations, Office of The Surgeon General, who sponsored the work, established objectives, and monitored study activities.

THE STUDY EFFORT was directed by MAJ R. M. Anthony, Forces Directorate.

COMMENTS AND QUESTIONS may be directed to CAA, Assistant Director for Forces, ATTN: CSCA-FO, 8120 Woodmont Avenue, Bethesda, Maryland 20814.

CAA	IMPROVED CASUALTY ESTIMATION AND EVACUATION SYSTEM (ICEES)	ONE SHEET STUDY GIST CAA-SR-84-16

THE PRINCIPAL FINDINGS of the work reported herein are as follows:

(1) Changing that portion of the Patient Flow Model (PFM) which treats evacuation dates of patients who must be returned to CONUS hospitals results in:

- more prompt evacuations out of theater,
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