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## TRENDS IN BOARDING OF ADMITTED PATIENTS IN US EMERGENCY DEPARTMENTS 2003–2005

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□ **Abstract—Background: Boarding of admitted patients in the Emergency Department (ED) is common and is associated with poor patient outcomes. Objectives: We sought to estimate the magnitude of and trends for ED boarding in the US. Methods: We used the 2003–2005 National Hospital Ambulatory Medical Care Survey to estimate the time patients spent boarding in EDs in the US. We used fixed and imputed times required to evaluate, treat, and decide to admit each patient using the number of medications and diagnostic tests received. We calculated the absolute and relative patient-care hours spent boarding in US EDs over the 3-year period. Results: Total patient-hours spent in US EDs increased from 209 million to 217 million between 2003 and 2005. Overall admission rates decreased between 2003 and 2005 (13.9% in 2003, 12.3% in 2005), whereas intensive care unit admission rates increased (1.3% in 2003, 2.0% in 2005). Mean ED length of stay decreased (5.4 h in 2003, 4.6 h in 2005). The proportion of patient-hours accounted for by ED boarding decreased over the study period (11.3–17.1% in 2003, 5.9–15.3% in 2004, and 2.8–12.0% 2005). Conclusions: Boarding of admitted patients in the ED accounts for a substantial portion of ED patient-care hours. Overall boarding time decreased over the 3 years.** © 2010 Elsevier Inc.

□ **Keywords—emergency medicine; health policy; ED boarding**

### INTRODUCTION

Emergency department (ED) crowding has been recognized as a public health crisis in the United States (1–3). One of the principal causes for crowding is the use of EDs to care for admitted patients for extended periods of time (4). This practice has been termed ED boarding. Reasons for the practice of ED boarding are complex. Hospitals board admitted patients when hospitals are at full capacity or inpatient beds are reserved for other patients (transfers from other hospitals or elective admissions). In addition, financial considerations may influence a hospital's decision to use the ED to board admitted patients for long periods because it allows a higher proportion of overall hospital capacity to be used for elective high-margin admissions such as scheduled surgeries (5).

The boarding time has been defined as the time from inpatient bed request to physical departure from the ED (6). Although there is no widely accepted definition for when an ED patient moves from the status of active patient to ED boarder, a recent summit defined this as: "an admitted patient for whom the time interval between decision to admit and physical departure of the patient

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from the ED treatment area exceeds 120 minutes" (7). ED boarding is associated with poorer quality ED care and adverse outcomes (8–12). Despite widespread concern over the boarding of admitted patients in US EDs, the absolute and relative magnitude of and trends for ED boarding are currently unknown.

We sought to estimate US ED boarding times over 3 years by determining the total patient-care hours that admitted patients spend in the ED after the decision to admit using varying assumptions about the time required for ED care. We hypothesized that the overall boarding burden would have increased over the study period.

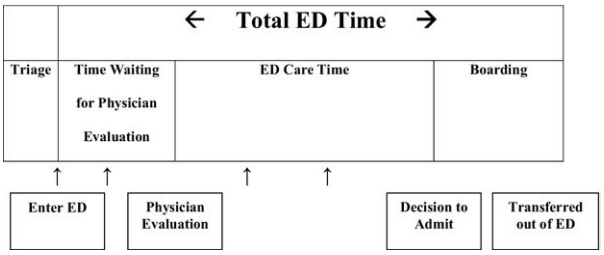


**Figure 1. Determination of ED boarding estimates.Boarding time = Total ED time − (Time Waiting for Physician Evaluation + ED Care Time). ED care time was estimated using fixed (2 h, 3 h, and 4 h) and imputed methods to generate boarding estimates.**

## MATERIALS AND METHODS

### *Study Design and Data Processing*

We performed an analysis of data from the 2003–2005 National Hospital Ambulatory Medical Care Survey (NHAMCS) to estimate the boarding burden. NHAMCS is a national probability sample survey of US ED visits that is collected and reported annually. In each year, ED visits are abstracted prospectively, de-identified, and patient-level data are reported, including demographics, patient characteristics, visit characteristics such as number of medications received and number of diagnostic tests ordered, waiting time to be evaluated by a physician, total ED length of stay, and disposition. For patients admitted to the hospital, there is information on admission to the intensive care unit or hospital floor beds. The probability sample design of the NHAMCS allows the data to be weighted to produce national estimates of care in the United States (13). The data are publicly available through the National Center for Health Statistics and were downloaded through the Centers for Disease Control website. The NHAMCS data from 2003 to 2005 were chosen for analysis because 2003 was the first year in which both waiting time to be evaluated by a physician and total time spent in the ED were reported. We excluded patients who left without being seen, left against medical advice, were transferred to another facility, expired in the ED, or were dead on arrival. To account for over-sampling in NHAMCS and to produce accurate point estimates and standard errors, we used weighted estimates as described by the National Center for Health Statistics. All data were analyzed using Stata 9.0 (StataCorp LP, College Station, TX). The study was determined to be exempt from review by the institutional review board of the University of Pennsylvania.

### *Data Analysis*

We tested whether any differences existed in the demographics (age, gender, and black race) of ED admissions through the 3-year period using *t*-tests and chi-squared tests. In NHAMCS, the time that an admitted ED patient becomes a boarder is not recorded because there is no reported time that the decision was made to admit the patient to the hospital. To generate an estimate of boarding time we subtracted ED care time and time waiting to see a physician from the total time spent in the ED (Figure 1). Time to see a physician is recorded in the data, but ED care time is not. We therefore used multiple estimates of when an admitted ED patient moved from the status of ED patient to ED boarder. Our underlying assumption was that all patients admitted to the hospital from the ED require some amount of time (ED care time) before a decision to admit can be made. ED care time is an estimate of the time that it may take for ED evaluation, stabilization, treatment, diagnostic testing, medical decision-making, and disposition. We generated four different estimates for ED care time.

First, to estimate an individualized time estimate for ED care time, we used linear regression to determine the incremental time required for each medication and diagnostic test. We used these incremental times to predict the total ED stay (not including waiting time) for patients who were treated and discharged using number of medications and number of diagnostic tests as continuous variables. For this calculation, we excluded admitted patients, patients who were dead on arrival, expired in the ED, were transferred to other hospitals, and those who left without being seen and against medical advice. After determination of an incremental time for each test and medication, we imputed an estimated time for each admitted patient using the regression coefficients from the model. In addition to the regression model, we generated three fixed time estimates for ED care and decision to admit. We assumed that ED care time would take 2 h, 3 h, or 4 h after being seen by a physician, and generated estimates for each time interval. By using multiple assumptions of the amount of time required for ED care, we were able to evaluate trends