

THE SOUNDS OF THE HOSPITAL

Paging Patterns in Three Teaching Hospitals

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Abstract To examine the influence of hospital paging systems on residency training, nursing services, and patient care, we asked medical interns (first-year residents) in three teaching hospitals to keep logs of pages they received during a three-day period.

Thirty-one logs from 26 interns were completed; a total of 1206 pages were recorded on 91 days (1095 hours). Interns were paged an average of once an hour; on 24 occasions, interns were paged five or more times an hour.

The majority of pages (65 percent) occurred when interns were engaged in patient care. Only 34 percent of the pages were judged both to require a response within one

hour and to result in a change in patient care. Twenty-four percent were clinically indicated and required a response within one hour but did not result in a change in patient care. Sixteen percent of pages resulted in a change in patient care or were clinically indicated but could have been postponed for more than an hour. An additional 26 percent of pages neither resulted in a change in clinical management nor were clinically indicated.

Reducing the number of unnecessary pages and postponing nonurgent ones could result in as much as a 42 percent decrease in disruptions of patient care and more rest for interns. (*N Engl J Med* 1988; 319:1585-9.)

It is hard to imagine a busy urban hospital without its chorus of “beepers,” or radiofrequency paging systems. Yet beepers are a relatively new addition to the hospital ward. As recently as 10 years ago, many hospitals relied for quick communication on “overhead” paging systems that were often difficult to understand and did not reach all parts of the hospital; other hospitals relied on the physical presence of their house staff on the wards where they worked.

Beepers have added enormous convenience to the lives of hospital staff members and house officers. Hospital staff members can reliably contact house officers, who, in turn, have more freedom to move about within the hospital. Patient care also benefits when house officers can be contacted rapidly to evaluate patients. These benefits are not without their costs, however. Easy access often means frequent calls that disrupt patient care. House officers on busy hospital wards may be paged several times an hour, requiring them to leave the bedside many times during the course of patient-care activities. Frequent interruptions hinder patient evaluation and treatment and may affect the physician-patient relationship adversely. Moreover, the additional time required to resume activities increases the total time of evaluation.

Several recent articles have examined the stresses of house-staff training.¹⁻⁸ Pages have been cited as contributing to the stress in the life of an intern (first-year resident).⁶ In addition to interrupting work, pages contribute to the sense that many house officers have of being burdened with their clinical responsibilities all the time — that no time, including that spent sleeping, eating, or attending to personal hygiene, is invulnerable. Investigators have demonstrated the deleterious effects of hectic, demanding jobs, especially when workers have little control over the conditions of their work.⁹⁻¹¹ As interns respond to their beepers, it is the

order of the pages that frequently determines the order in which they perform their work. This loss of control over their work schedule, coupled with frequent interruptions and no rest breaks, leads to stressful work conditions for interns and, in turn, to poor patient care.

We studied the use of beepers in three teaching hospitals associated with a large academic medical center. Our goals were to document the frequency of pages, the activities that are interrupted by pages, the common reasons for pages, and the urgency of the information transmitted.

METHODS

The Settings

The study was conducted between February and June 1987 at the three major teaching hospitals of the integrated internal medicine residency program of the University of California at San Francisco: Moffitt-Long Hospital, San Francisco General Hospital, and the Veterans Administration Medical Center.

Moffitt-Long is a 550-bed university hospital, with 100 beds for internal medicine, and is a major referral center for northern California. The medical wards are spread among three floors in two connected hospitals. Intern call is every third night, and there is no additional night coverage. The hospital beepers are voice activated.

The Veterans Administration Medical Center is a 330-bed hospital, with 100 beds for internal medicine, serving all veterans in the San Francisco Bay area, and is a cardiology referral center within the Veterans Administration system. The medical wards are on two floors, and the emergency room is in a neighboring building. Intern call is every fourth night, and there is no additional night coverage. The hospital beepers are voice activated.

The San Francisco General Hospital is a 450-bed municipal hospital for the city and county of San Francisco, with 100 beds for internal medicine, and is the only hospital explicitly designated for the care of medically indigent patients. The main wards for medical patients are all on one floor. Intern call is every third night, with no additional night coverage. The hospital beepers are digital.

Data Collection

Interns working on the medical service of the three hospitals were asked to complete beeper logs for a three-day period: an admitting day, a postadmitting day, and a swing day. The admitting day was defined as the 24-hour period from 8 a.m. to 8 a.m. of the next day, during which the intern remained in the hospital, admitting new patients and providing care at night for the patients of other teams whose interns were off for the night. The postadmitting day was defined as beginning at 8 a.m. on the morning after the admitting

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Supported in part by a residency training grant (5 D28 PE19179-03) from the Bureau of Health Professions, U.S. Department of Health and Human Services.

night. The swing day was defined as the only day in the sequence when the interns woke up and went to sleep in their own homes, and it followed the postadmitting day (at the Veterans Administration Medical Center, where teams admitted every fourth night, there were two swing days in every sequence; interns were asked to record only one of these days in their logs).

Data collection was limited to interns on medical wards and excluded interns working on specialized services, such as the coronary care or the cancer-research ward, because on these wards interns tend to be in closer proximity to nurses and other hospital personnel.

Interns recorded in their beeper logs the activity they were performing when they were paged (e.g., patient care or sleeping); who paged them (e.g., a nurse or attending physician); the reason they were paged (e.g., for evaluation of a patient with abdominal pain); and their judgment of the immediacy of the page (whether it had to occur at that moment or whether it could have waited for a specified number of hours). Interns were also asked to classify the importance of each page in one of three groups: pages that led to a change in patient care (e.g., a new order written or patient care delivered); pages that did not lead to a change in patient care, but were clinically indicated (e.g., because of legitimate concern on the part of a nurse) or helpful in carrying out the duties of an intern (e.g., supplying information about a patient's condition); and pages that were unimportant because they neither led to a change in patient care nor were clinically indicated. Pages that were inaudible, that no one answered when the intern returned the call, and that were made in error were classified as unimportant.

The two questions concerning the immediacy and the importance of each page, although related, were designed to be answered independently. For example, in one instance an intern was called by a nurse to explain a patient's medication schedule after discharge because the patient's family had arrived (i.e., a page was required at that moment), but the intern had already responded to a previous reminder and was with the patient (i.e., the page had no clinical importance). Since these two questions assessed different aspects of each page, in the final analysis they were combined to form a measure of the urgency of each page. Pages were grouped from the least to the most urgent, as follows: pages that were unimportant (that resulted in no changes in management and were not clinically indicated); pages that caused a change in patient care or were clinically indicated but could have been postponed for more than one hour; pages that were clinically indicated and required a response within one hour but caused no change in management; and pages that caused a change in patient care and required a response within one hour. One hour was chosen as the limit of urgent pages because it was thought that alternative strategies for reaching interns (e.g., through a message board or by notes in the patient's chart) could not reliably reach interns within one hour.

Residents were encouraged to note that they had been paged, even if they did not have time to complete the data entry for a page, so that the overall count of the frequency of pages would be accurate.

Data Analysis

Data analysis was performed with use of BMDP software for frequencies and cross-tabulations. Chi-square analysis was used to compute significance levels of cross-tabulations.

RESULTS

Thirty-nine interns were asked to complete 45 logs (some interns were asked to complete logs in more than one hospital) (Table 1). Of the 45 logs, 31 were completed (response rate, 69 percent) by 26 interns. The most common reason given for not participating was being too overwhelmed by the frequency of pages to be able to stop and record them. Some interns succeeded in completing their logs only on a second attempt, because the first time they tried there were too many pages to record. Of the 31 logs, 1 included only

Table 1. Characteristics of the Study.

CHARACTERISTIC	
No. of interns	26
No. of logs	31
Response rate* (%)	69
No. of days	91
No. of hours	1095
No. of pages	1206
Pages per day (%)	
Admitting day	67
Postadmitting day	18
Swing day	15

*Thirty-nine interns were asked to complete 45 logs.

the admitting day and 1 included only the admitting and postadmitting days. Ten (32 percent) were completed at Moffitt-Long Hospital, 8 (26 percent) at the Veterans Administration Medical Center and 13 (42 percent) at the San Francisco General Hospital.

Paging Frequency

In all, 1206 pages were recorded on 91 days (1095 hours). The pages were weighted toward the admitting day (reflecting the greater time spent in the hospital on that day), with 67 percent of the pages recorded on this day, 18 percent on the postadmitting days and 15 percent on the swing day (Table 1). Of the 1206 pages, 32 percent were at Moffitt-Long Hospital, 24 percent at the Veterans Administration Medical Center, and 44 percent at San Francisco General Hospital. Since no significant differences were found among the paging patterns at the three hospitals, the results for the three hospitals will be presented together.

Interns were paged an average of 26 times on the admitting day, 7 times on the postadmitting day, and 6 times on the swing day (Table 2). When the values were adjusted for the number of hours worked, interns were paged once an hour on each day. The mean number of pages per hour per patient ranged from 0.3 on the admitting day to 0.2 on the postadmitting and the swing days. The distribution of paging was uneven and skewed to the right; on 24 separate occasions, interns were paged five or more times in a single hour.

Activity Interrupted

At the time of the majority of pages, interns were engaged in patient care (65 percent). Seventeen percent of the time interns were engaged in basic human functions (sleeping, eating, or personal hygiene), whereas 14 percent of the time they were on work rounds or teaching rounds. Interns were reading about medicine less than 3 percent of the time, and they were not working (e.g., reading the newspaper) less than 2 percent of the time.

Reasons for Pages

As expected, nurses made the most pages (50 percent) followed by team members (the interns' students or residents) and other house officers, including pages

Table 2. Frequency of Pages per Intern at Three Teaching Hospitals.

DAY RECORDED	ALL HOSPITALS	NO. OF LOGS*
	<i>mean ±SD</i>	
Pages per day		
Admitting day	26±10	31
Postadmitting day	7±6	30
Swing day	6±5	29
Pages per hour		
Admitting day	1±0.4	31
Postadmitting day	1±0.6	29
Swing day	1±0.5	24
Pages per hour per patient		
Admitting day	0.3±0.1	31
Postadmitting day	0.2±0.1	26
Swing day	0.2±0.1	23

*The numbers of logs in each group differ because of missing data.

to sign out at the end of the day (20 percent); hospital support personnel (social workers, laboratory personnel, pharmacists, and ward secretaries) (15 percent), attending physicians and fellows (6 percent), and others (8 percent). The most common reasons for paging an intern were the exchange of information between hospital staff members (23 percent), clarification of orders (22 percent), and the need for patient evaluation (19 percent). Less common reasons included new laboratory results (12 percent); a need for patient procedures, such as the insertion of an intravenous catheter (5 percent); admissions (4 percent); and other reasons (16 percent).

Urgency of Page

When assessed according to immediacy, close to a third of pages (32 percent) were judged to be needed when they occurred, and another 39 percent were judged to be timely and needed within an hour. Fourteen percent could have been deferred for three hours, 6 percent could have been deferred for six hours, and 9 percent could have been held for a day or more.

When assessed according to the importance of the pages, 39 percent led to a change in patient care. Thirty-four percent of pages were thought to be clinically indicated, and 26 percent neither led to a change in patient care nor were clinically indicated.

A total of 1005 pages were classified according to urgency (the combined measure of immediacy and importance); only 337 pages (34 percent) resulted in a change in patient care and required a response within one hour. An additional 238 pages (24 percent) were clinically indicated and required a response within one hour, but caused no change in care. However, 165 pages (16 percent) resulted in a change in patient care but could have been postponed for more than an hour, and 265 pages (26 percent) resulted in no changes in patient care and were not clinically indicated.

Figure 1 shows the urgency of the page according to the three groups of personnel that most commonly paged interns. Nurses were significantly more likely to page interns for matters that resulted in changes in management and required a response within one hour

(twice as likely as other hospital support personnel). Conversely, nurses were also the most likely to page interns for matters that were unimportant (twice as likely as physicians).

Figure 2 indicates that health care workers are somewhat discriminating in their paging of interns. A significantly higher percentage of pages that woke interns or took them from other basic life functions resulted in a change in management and required a response within one hour than did pages that interrupted other activities.

DISCUSSION

The frequency with which interns were paged was not as high as might have been expected, for two major reasons. First, several interns were not able to complete protocols at busy times; thus, the data probably represent an underestimate of the actual frequency of paging. Second, the mean frequency of pages obscures the extreme occasions when interns were paged many times an hour. We documented 24 occasions when interns were paged five or more times in one hour, with a maximum of eight pages in an hour for one unfortunate intern. Frequent pages occur as a result of a large service of very sick patients, but the pages often make it difficult for an intern to concentrate on the many necessary tasks. Each delay caused by answering a page increases the likelihood that the in-

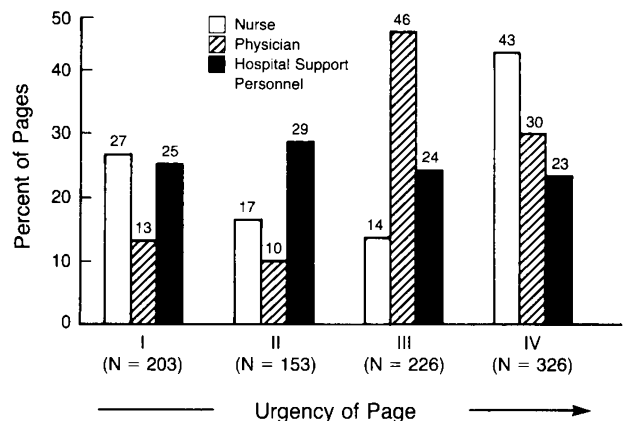


Figure 1. Numbers of Pages, According to the Pager and the Urgency of the Page.

Pages were grouped from the least to the most urgent: I denotes pages that resulted in no changes in patient care and were not clinically indicated; II, pages that resulted in a change in patient care or were clinically indicated but could have been postponed for more than one hour; III, pages that were clinically indicated and required a response within one hour; and IV, pages that resulted in a change in patient care and required a response within one hour.

Significant differences were found between pagers (χ^2 , 123.4; $P < 0.001$) and for coupled comparisons of nurses versus physicians and hospital support personnel combined (χ^2 , 77.1), nurses versus physicians (χ^2 , 99.4), nurses versus hospital support personnel (χ^2 , 41.8), and physicians versus hospital support personnel (χ^2 , 41.8) ($P < 0.001$ for all comparisons). Hospital support personnel include laboratory technicians, pharmacists, social workers, physical therapists, and unit coordinators.

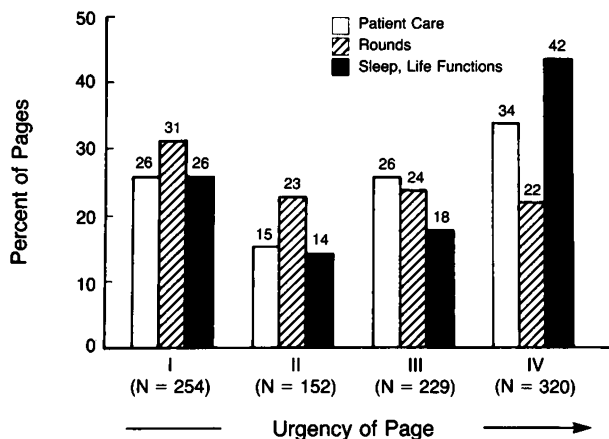


Figure 2. Activity Interrupted, According to the Urgency of the Page.

Pages were grouped from the least to the most urgent: I denotes pages that resulted in no changes in patient care and were not clinically indicated; II, pages that resulted in a change in patient care or were clinically indicated but could have been postponed for more than one hour; III, pages that were clinically indicated and required a response within one hour; and IV, pages that resulted in a change in patient care and required a response within one hour.

Significant differences were found between activities interrupted (χ^2 , 19.4; $P < 0.005$) and for coupled comparisons of sleep versus patient care and rounds combined (χ^2 , 8.6; $P < 0.05$), patient care versus rounds (χ^2 , 11.0; $P < 0.01$), and rounds versus sleep (χ^2 , 15.2; $P < 0.002$). The comparison of patient care versus sleep approached significance ($P < 0.10$). Life functions denotes eating and personal hygiene.

tern will be paged to do a task that might already have been accomplished had there been fewer interruptions.

Our findings may not be characteristic of other teaching hospitals. However, the fact that the paging patterns in our study were similar in three very different hospitals suggests that our results may have broader applicability. Another limitation of our study is that the classification of pages according to urgency was based entirely on the judgment of the interns. There are no hard-and-fast rules about what constitutes a legitimate concern on the part of nurses and other hospital personnel. Mild complaints from a patient may signal serious problems that require the notification of a physician (e.g., constipation in a patient at risk for bowel perforation). In contrast, some serious-sounding pages may not be clinically indicated, because the concern is not based on a thorough evaluation. For example, an intern was paged from sleep to evaluate a patient's change in mental status. On arrival, the intern learned that the patient appeared drowsy because he had been asleep, like the intern, when the nurse evaluated him. It is likely that if nurses, for example, were asked to classify the urgency of their pages, they would judge them differently than did the interns.

Nurses cannot be expected to page interns with perfect accuracy (i.e., only for urgent matters). If the paging threshold is too high, then interns may not be

called to evaluate patients who need medical attention. The situation is somewhat analogous to the reciprocal relation between the sensitivity and specificity of laboratory tests. In the case of paging, it is more important to aim for maximal sensitivity (not missing a potentially serious incident) than for specificity (avoiding unnecessary pages). However, there is obviously a need for some discrimination to maintain the value of the pages. How to achieve the proper balance should be a topic of communication between house officers and the nursing staff. One possible solution is joint, case-oriented conferences to address appropriate indications for paging. The goal of such sessions should not be to reduce the frequency of pages but to improve communication about decisions on patient care.

Much has been written about the stress of internship. In its report on the Libby Zion case, the New York State Health Commission focused on the supervision of house staff and work schedules.^{5,7,8} Several state legislatures are addressing plans that would limit the number of hours that house officers could work. Another approach to reduce stress for interns is to look for ways to limit the demands placed on interns, especially strategies that would allow them to sleep for a few hours at night so that they could function better the next day.

Our data indicate that only 34 percent of pages both resulted in changes in management and required a response within one hour. Problems that can wait for more than one hour could be written on message boards and "scut" sheets (duty rosters) on hospital wards. Interns could initial posted items when they were on the wards. When interns are called during the night about urgent matters, they could also be read the list of less urgent matters. Grouping nonurgent pages and calling interns only once with several concerns could reduce the number of times that interns are called. Hospital personnel may already be attempting to be discriminating in their paging of interns at night. A higher proportion of pages that woke interns from sleep or took them from similar activities were urgent pages. Further efforts to reduce the number of unnecessary pages at night, such as having nursing supervisors review questions before interns are awakened, need to be given greater consideration. These efforts could, according to our data, reduce the number of paging interruptions up to 42 percent. Reducing the frequency of interruptions could lead to better patient care and more contented interns.

We are indebted to the interns who filled out the questionnaires; to Richard K. Root, M.D., Merle A. Sande, M.D., Lawrence M. Tierney, M.D., and Walter R. Mebane, Ph.D.; and to Genevieve Buehler, for assistance in the preparation of the manuscript.

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MEDICAL INTELLIGENCE



UNMASKING OF HYPOPARATHYROIDISM IN FAMILIAL PARTIAL DiGEORGE SYNDROME BY CHALLENGE WITH DISODIUM EDETATE

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NEURAL-CREST cells participate in the embryonic development of the aortopulmonary and conotruncal septa and the thymus and parathyroid glands.¹ The recognition of a clinical syndrome with developmental anomalies of these tissues — the DiGeorge, or “third and fourth nasopharyngeal pouch,” syndrome — has suggested a causal relation for an abnormality of neural-crest development.² The clinical and pathologic manifestations of this syndrome are variable, ranging from the complete form, with absence of the affected glands and complex cardiac malformations (truncus arteriosus and interrupted aortic arch Type B), to less severe forms, with hypoplasia of the parathyroid glands and thymus, with or without an associated cardiac defect.^{2,3} The pattern of inheritance of the DiGeorge syndrome has not been clearly established, probably because of the lethality of the complete form and the absence of overt clinical symptoms associated with mild hypoplasia of the affected glands. Siblings have been reported to have the syndrome,^{4,5} and in two studies the fathers of affected infants were noted to have a history of hypocalcemia and the characteristic facies of the syndrome.^{6,7}

This report describes the unmasking of latent hypo-

parathyroidism by disodium edetate (EDTA) infusion in a woman with heart disease who had no symptoms of hypoparathyroidism and who had many relatives with cardiac lesions commonly associated with the DiGeorge syndrome. The data suggest that valuable clinical information about the inheritance of this syndrome, similar congenital cardiac defects, and associated disturbances of mineral metabolism may be obtained through careful study of controlled perturbations of calcium homeostasis. We suggest that latent hypoparathyroidism be included in the clinical spectrum of the DiGeorge syndrome.

SUBJECTS AND METHODS

The index patient was a 26-year-old woman (gravid 5 para 4) in whom a tetralogy of Fallot had been repaired. She was selected for study because one of her four children was identified as having the DiGeorge syndrome and another was identified as having congenital cardiac defects known to be associated with the syndrome (see below). One of the patient's three siblings had tetralogy of Fallot. The patient had no history of frequent or recurrent infections, and no signs or symptoms associated with chronic or acute hypocalcemia were observed during surgical procedures or during her four pregnancies. There were no physical signs of hypoparathyroidism, even on detailed ophthalmologic examination. The patient had no bony abnormalities commonly associated with hypoparathyroidism, and her stature was normal. Her peripheral white-cell count was 5.5×10^9 per liter, with 42 percent polymorphonuclear leukocytes and 47 percent lymphocytes. Further analysis of the lymphocytes demonstrated a normal percentage of B cells (B_1 cells, 6 percent; normal, 5 to 20 percent) and a normal percentage of T cells (T-cell E-rosette receptor antigen [T_{ER}], 79 percent; normal, 55 to 80 percent). The T-cell population was further characterized by counting T helper and T suppressor cells; the T-cell helper/suppressor ratio (0.6) was below the normal range (1.2 to 2.6). To evaluate this reduced ratio further, T-cell function was studied; testing with antigens (phytohemagglutinin, pokeweed mitogen, and concanavalin A) gave normal results. Immunoglobulin levels were normal: IgG, 13 arbitrary units (1300 mg per deciliter); IgM, 1.51 arbitrary units (151 mg per deciliter); and IgA, 2.32 arbitrary units (232 mg per deciliter).

The first affected child was diagnosed at birth as having interrupted aortic arch type B, by cardiac catheterization. The diagnosis of the DiGeorge syndrome was made on the basis of the heart defects, hypoparathyroidism (blood ionized calcium, 1.07 mM [normal, 1.21 ± 0.13 ; mean ± 2 SD]) and an undetectable level of mid-molecule parathyroid hormone), an elevation of the percentage of B cells (B_1 cells, 35 percent), and a decrease in the percentage of T cells (T_{ER} , 46 percent). The T-cell population was further characterized by measurement of T helper and suppressor cells; the helper/suppressor ratio (1.1) was below normal (1.2 to 2.6). T-cell function as evaluated by antigen testing (phytohemagglutinin, pokeweed mitogen, and concanavalin A) was normal at both 11 days and 11 months of age. Cardiac surgery was successfully performed during the first month of life. At 17 months of age, the patient died suddenly at home. An autopsy revealed an absence of thymus and parathyroid tissue, surgical repair of an interrupted aortic arch, multiple thromboemboli in pulmonary

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Supported in part by grants (DK-33949 and AR-30692) from the National Institutes of Health and by the Children's Memorial Institute for Education and Research.