Internal Medicine Residency Training and Outcomes

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OBJECTIVE: **To review the impact of the clinical education of internal medicine residents on patients' outcomes.**

DATA SOURCES AND STUDY SELECTION: **English-language studies of the relation between internal medicine housestaff training and patients' outcomes were systematically identified by a MEDLINE search and from bibliographies and reference lists of recently published articles.**

MAIN RESULTS: **We hypothesized that the primary impact of internal medicine residency training on patients' outcomes would be the result of: (1) the inexperience of the residents; (2) the heavy workload these inexperienced residents are expected to manage; or (3) some structural feature of the internal medicine teaching services, such as the discontinuity of patient care inherent in night float systems and the fact that residents rotate to different services each month. We also hypothesized that residents may in many ways provide superior care, and may actually improve certain patient outcomes. Housestaff inexperience, workload, and structural features that promote discontinuity have been shown to affect especially outcomes of resource utilization, length of stay, and patient satisfaction. No study has demonstrated that internal medicine residents contribute to excess patient morbidity or mortality. However, the published studies in this area are for the most part retrospective and were conducted 10 to 15 years ago. The full extent of the untoward (or the beneficial) effects of internal medicine residency training on patients' outcomes is unknown.**

CONCLUSIONS: **Multisite, prospective studies would remedy the deficiencies in the published research in this area and would yield the most valid insight into the range and extent of the effects of housestaff training on patients' outcomes. In the absence of such studies and in a rapidly changing managed care environment, academic medical centers and departments of medicine need to be aware of those aspects of the clinical education of residents that are most likely to affect patients' outcomes.**

KEY WORDS: **internship; residency; teaching hospitals; costs; outcomes.**
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Over the past decade, profound changes have occurred in the health care delivery system of the United States. With the advent of managed care, greater attention is being placed on the quality of medical care, patients' outcomes, and cost. To remain viable and competitive, academic medical centers will have to streamline the delivery of patient care despite the lack of support for subsidizing the costs of medical education.[1–4] However, little is known about the effects of clinical education on medical outcomes. In addition, internal medicine residency training is undergoing substantial reform, with an emphasis on education rather than on service, and with a move toward increased training in the ambulatory setting,[5,6] However, little is known about how these modifications in internal medicine residency training will affect not only the clinical education of residents but also the process and outcome of patient care.[7]

We hypothesized that if the training of internal medicine residents were to have adverse effects on patient care, these effects would be the result of: (1) the inexperience of the residents; (2) the heavy workload and long hours these inexperienced physicians are expected to manage; or (3) some structural feature of the teaching services, especially structural features that promote discontinuity of patient care. In addition, we hypothesized that residents may in many ways provide superior patient care, and may actually improve certain patient outcomes. Issues covered in this review are outlined in Table 1.

METHODS

English-language studies published from 1980 through 1996 that involved housestaff and patient outcomes were systematically identified by a MEDLINE–Grateful Med search. Key words used in the search included "internship" and "residency," "teaching hospitals," "costs," and "outcomes." One hundred sixty-one articles were identified. Of these, 39 were reports of the effects of housestaff on patient outcomes, and 10 of these 39 concerned internal medicine housestaff. The reference lists of these 39 articles were reviewed, resulting in the identification of 18 additional studies, some dating back to 1973. Finally, because the journals *Academic Medicine* and *Journal of General Internal Medicine* frequently publish studies concerning the education of housestaff, the tables of contents of these journals from 1986 through 1996 were reviewed, resulting in the identification of another 11 studies. All of the identified articles are included in the present comprehensive review.

EFFECTS OF INEXPERIENCE ON PATIENT CARE

Less-experienced resident physicians are not expected to be as adept at patient care as more-experienced

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Table 1. Impact of Internal Medicine Residency Training on Patient Care

I. What are the effects of the inexperience of internal medicine housestaff on patient care?
  A. Residents vs attending physicians
    1. Test ordering
    2. Length of stay
    3. Resource use
    4. Medication selection
  B. The "July" phenomenon
    1. Resource use and charges
    2. Length of stay
    3. Morbidity and mortality

II. What are the effects of the workload of internal medicine housestaff on patient care?
  A. Patient load and number of admissions
    1. Length of stay
    2. Patient satisfaction
    3. Knowledge of social history
  B. Impact of long work hours and sleep deprivation on
    1. Housestaff functioning
    2. Patient outcomes

III. What are the effects of the structure of the teaching service on patient care?
  A. Impact of night float
    1. Length of stay
    2. Test ordering
    3. Medication errors
    4. Patient satisfaction
  B. Impact of cross-coverage
    1. Diagnostic test ordering
    2. Complications
    3. Mortality
  C. Impact of changing service
    1. Length of stay
    2. Hospital cost
  D. Discontinuity in ambulatory setting
    1. Patient appointment keeping
    2. Patient satisfaction

IV. What are the beneficial effects of internal medicine residency training on patient care?
  A. Anecdotal evidence
  B. Decision making
  C. Patient outcomes
    1. Morbidity and morality
    2. Hospital costs
  D. Hospital workforce and finances

physicians; this is the rationale for residency training after medical school. Nevertheless, not all of the evidence supports the common perception that the inexperience of housestaff can have adverse effects on patient care.

Early studies related to housestaff inexperience focused on costs, especially the use of diagnostic tests. A 1973 study by Schroeder and O'Leary noted that the patients of 13 practicing community internists underwent significantly more diagnostic tests if they were admitted to the university hospital (where housestaff wrote all orders) than if they were admitted to a nearby community hospital (where housestaff needed faculty approval before ordering tests).[8] The 180 patients admitted to the teaching hospital underwent a mean of 26 laboratory tests and 2.9 radiographs and scans, whereas the 267 patients admitted to the community hospital underwent 18 laboratory tests and 2.3 radiographs and scans (p of both $<.001$). In a study published in 1978, Martz and Ptakowski reported that the service charges for patients admitted to the teaching wards of one hospital were 60% higher than those for patients admitted to the nonteaching wards.[9] A 1978 study by Garg et al. reported that charges for 40 patients with congestive heart failure treated on the teaching service were 52% higher than those for 65 similar patients treated on the nonteaching service.[10] These three studies found no significant differences in length of stay, morbidity rates, or mortality rates between the two groups of patients.[8–10] In a study published in 1983, Boice and McGregor found that ordering of diagnostic tests decreased by 20% when attending physicians rather than residents were asked to order all laboratory tests.[11] However, a 1980 study by Detsky et al. found no difference in the number of diagnostic tests ordered per patient during 1 week when residents were on strike and faculty members were writing orders.[12]

These studies of diagnostic test ordering were conducted in the 1970s and early 1980s,[8–12] a time that was perhaps less cost conscious. Whether current housestaff order excessive diagnostic tests is unknown. Regarding other sources of increased cost, Udvarhelyi and colleagues reported in 1990 that the mean length of stay for patients with acute myocardial infarction was shorter (by 0.6 days; $p = .04$) when they were admitted to the teaching service than when they were admitted to the nonteaching services of one hospital, even though the attending physicians, nurses, and ancillary services were the same on both services.[13] The most recent study we identified regarding housestaff effects on patient costs was published in 1994 by Hayward and colleagues; these authors examined whether the practice styles of attending physicians and residents (including test ordering) account for variations in the use of hospital resources.[14] This study of 7,667 general medicine patients and 7,546 subspecialty medicine patients hospitalized between 1986 and 1991 found that variations in the practice styles of individual resident physicians may account for 2% of total resource use; practice styles explained the same percentage of resource use by individual attending physicians. These findings suggest that residents contribute no more to the variation in resource use than do their supervising attending physicians.

Another potential source of increased costs attributable to the inexperience of housestaff is the selection of medications. Residents may not be as adept at prescribing cost-effective medications, or they may be unaware of the costs of medications. One 1989 study of four faculty members and 10 internal medicine residents found that housestaff prescribed more expensive antihypertensive

medications than did their faculty preceptors, when differences in the compositions of practices were statistically controlled.[15] Most of the increased costs resulted from residents' tendency to prescribe calcium channel blockers (rather than less expensive thiazide diuretics). One 1987 study conducted in a tertiary care teaching hospital focused on errors in prescribing medications.[16] The authors reviewed 289,411 medication orders over a 1-year period and found that 904 errors occurred, 522 of which were judged to have potentially adverse consequences. The prescription error rate of less-experienced first-year residents was higher (4.25 per 1,000) than that of more senior residents (1.98 per 1,000 for third-year residents). However, the prescription error rate of attending physicians was higher than that of senior residents (3.30 per 1,000). This study included housestaff from all disciplines, and the error rate of residents on internal medicine services was lower than that of residents on the other specialty services. No within-service analyses were performed; thus, it is unclear whether the findings of the study apply to internal medicine residents.

A number of studies have examined the "July" phenomenon, the notion that poorer outcomes occur early in the academic year when housestaff are least experienced.[17–19] Buchwald and colleagues at Brigham Hospital studied 1,251 patients hospitalized in July and August of the years 1982 through 1984, comparing their outcomes with those of 1,338 patients hospitalized in April and May of the same years.[17] After correcting for age, gender, diagnosis-related group, urgency of admission, temporal change, and mortality, these authors found no difference in length of stay, total charges, or subcategories of ancillary charges, suggesting that in their study no July phenomenon existed for these categories. Rich and colleagues studied the outcomes of 21,679 internal medicine patients discharged from the St. Paul–Ramsey Medical Center in Minnesota between 1980 and 1986.[18] Length of hospital stay and total hospital charges declined significantly as the experience of internal medicine housestaff increased; over the academic year, these declines amounted to a decrease of 0.43 days and $370 per discharge. This study found no evidence of a July phenomenon related to hospital mortality, readmissions, or nursing home placement. Subsequently, the same group studied several hospitals in the Twin Cities area, reviewing the outcomes of patients with 25 preselected discharge diagnoses between 1983 and 1987 (the total number of outcomes analyzed was 240,467).[19] For internal medicine diagnoses, charges for diagnostic and pharmaceutical services declined throughout the academic year. Again, the level of experience of housestaff was not related to mortality.

In summary, published reports (from the 1970s and 1980s) suggest that the inexperience of internal medicine housestaff can result in greater use of resources, increased length of stay, and more errors in prescribing medications, but housestaff inexperience has no impact on morbidity and mortality.

EFFECTS OF WORKLOAD ON PATIENT CARE

We hypothesized that different aspects of the workload of internal medicine housestaff could influence patient care and patient outcomes. One aspect of workload is the "busyness" of the work environment. Housestaff caring for a large number of patients or those who are responsible for numerous admitted patients may not have the time to provide optimal care for each patient. Heavy workload may be a particular problem for inexperienced physicians, who may not be as adept as experienced physicians in time management and the ability to discriminate important tasks from less-important tasks.

Hillson and colleagues studied 19,025 patients admitted to St. Paul–Ramsey Medical Center between 1980 and 1987 by an on-call first-year resident and discharged from the internal medicine service.[20,21] The authors found that as the number of admissions by an intern increased, the length of hospital stay and the total charges for that intern's patients declined, suggesting that at high levels of workload, patients (especially elderly patients) were discharged more quickly. In addition, the hospital stays and total charges of patients admitted later in a sequence were increased by up to 15%, even after case mix and time of admission were statistically controlled.[20]

In a 1996 abstract, Meltzer et al. reported that the hospital stays of patients admitted to an internal medicine house officer who was responsible for 11 or more other patients were 0.7 days longer than those of patients admitted to a house officer responsible for fewer than 11 patients.[22] This increased length of stay was estimated to increase the annual costs of care on the medical service by 1 million dollars.[22] A recent study of 87 patients with chronic obstructive pulmonary disease found that they were less satisfied with the care provided by an intern who was already caring for a greater number of patients when these patients were admitted.[23] Another study found that residents' knowledge of their patients' social history significantly decreased with increasing patient census.[24] No study has demonstrated that increased patient census or a high number of admissions affects morbidity or mortality rates.

A more frequently publicized component of residents' workload is long hours and sleep deprivation. The effects of sleep deprivation on residents have been reviewed in detail elsewhere.[25] After a night on call, housestaff have been shown to perform less well on tests of simple reasoning and on scanning laboratory reports[26]; on speed of response, recall, and self-rated efficiency[27]; and on tests of concentration.[28] Although there has been much speculation and anecdotal suggestion that resident sleep deprivation adversely affects patients, no study has demonstrated that these deficits result in adverse patient outcomes.[25] Many authors worry that legislation limiting residents' work hours will result in a shift-work mentality, and that residents will not learn accountability and responsibility to patients.[29–33] Others, however, assert that sleep depri-

vation fosters cynicism and loss of the ability to "care" about patients.[25]

In summary, although a greater number of admissions to a first-year resident has been associated with a shorter length of stay for those patients, other studies have found that patients admitted to housestaff who are caring for a greater number of patients may have a longer length of stay and may be less satisfied with housestaff. Neither increased admissions nor increased patient census has been associated with increased morbidity or mortality rates. The long work hours of internal medicine housestaff have not been shown to adversely influence patient outcomes.

EFFECTS OF THE TEACHING SERVICE STRUCTURE ON PATIENT CARE

We hypothesized that certain features of the structure of the teaching service could affect patient outcomes. These structural features include night float systems, "cross-coverage," and rotation across services from month to month; each of these structural features introduces discontinuity into patient care, and this discontinuity could have adverse effects on patient outcomes.

Several studies have reported the impact on inpatient care caused by instituting a night float system; most of these reports used a pre-post study design. In general, a night float system requires certain residents to spend a rotation working strictly at night, either partially or completely relieving the daytime housestaff of night duty. The purpose of such a system is to reduce housestaff work hours and to decrease housestaff fatigue. A 1989 survey found that 30% of internal medicine residency programs had experience with a night float system.[34] Nevertheless, evidence about the effects of a night float system on improving patient care is sparse and mixed.

Gottlieb et al. studied a night float system introduced into a large Veterans Affairs medical center.[35] In this pre-post comparison study, the inpatient length of stay decreased from 10.9 to 9.3 days ($p < .01$) after the institution of the night float system, and the number of laboratory tests per patient also decreased (24 vs 19; $p < .01$), as did the number of medication errors (16.9 vs 12.0 per 100 patients discharged). Neuropsychological testing showed that the depression scores of night float residents were significantly lower than those of traditional call residents, although the scores of both groups were high for depression, hostility, and anxiety.[36] Conversely, Laine et al. studied the effect of reducing housestaff work hours (including institution of a night float system) on patients' outcomes,[37] and reported findings much different from those of Gottlieb. In this study, patients who were admitted in October 1989, after the restriction in work hours had gone into effect, were more likely to suffer a medical complication (35% vs 22%; $p = .002$) than were patients admitted in October 1988 (before the restrictions) and were also more likely to experience a delay in receiving diagnostic tests (17% vs 2%; $p < .001$). There was no difference in mortality rates, transfers to intensive care, length of stay, or discharge disposition. A recent study of 145 patients reported that patients admitted to "nightfloat" housestaff may be less satisfied with their house officer than patients admitted to a house officer who is on a more regular call schedule.[38]

Cross-coverage in general, including the use of night float systems, has been associated with adverse patient outcomes.[38,39] Cross-coverage occurs when a house officer other than the patient's primary house officer (or team) is responsible for the patient's care; such a situation typically occurs on nights or on weekends when the primary house officer or team is not on call. Restricting housestaff work hours necessarily increases cross-coverage time. Lofgren et al. reported that patients of cross-covering residents underwent more laboratory tests (44% vs 32%; $p = .01$) than those admitted to a service's primary resident; these findings suggest that discontinuity of care can result in adverse outcomes.[39] Petersen et al. reported that preventable adverse events were more likely for cross-covered patients (including those covered by night float residents) than for patients covered by their primary team (26% vs 12%; odds ratio 3.5; $p = .01$).[40] However, some evidence suggests that standardizing sign-out practices or instructing residents in improving their signouts to cross-covering residents may reduce the number of errors made during cross-coverage.[41,42]

Discontinuity of care is also introduced as housestaff rotate to different services each month. Rich et al. retrospectively analyzed 5,805 patients discharged from an internal medicine service between 1980 and 1986.[43] Patients who were in the hospital on the day that interns rotated ($n = 1,705$) experienced significantly longer lengths of stay ($\beta = .341$ days; $p = .001$) and higher hospital charges ($p = .01$) than did patients not in the hospital during rotation changes, when other patient characteristics were statistically controlled. This study found no differences in hospital deaths, nursing home placements, or 30-day readmission rates.

Internal medicine residency training is moving more and more into the ambulatory setting. Few studies have addressed the effects of the month-to-month and year-to-year discontinuity inherent in a residency program on patient outcomes in the ambulatory setting. Two studies have suggested that the patients of graduating senior residents do keep their subsequent appointments.[44,45] A 1991 study of 376 patients found that 18% were frankly dissatisfied with the transfer of their care from a departing resident to a new resident physician.[46] However, these patients were generally more satisfied if the resident had personally notified the patient of the transfer.[46]

In summary, structural features of internal medicine residency programs that introduce discontinuity into patient care appear to affect selected patient outcomes. Structural features such as night float, cross-coverage, and scheduled rotations may have a negative impact on

the risk of medical complications and rate of preventable complications, and adversely affect length of stay, patient satisfaction, and costs. These structural features do not affect morbidity or mortality rates.

BENEFICIAL EFFECTS OF RESIDENCY TRAINING ON PATIENT CARE

Most of the studies discussed in this review assumed that patients may have some increased risk of adverse outcomes when cared for by resident physicians, if only because patients are cared for by inexperienced physicians who are often expected to manage an extremely heavy workload and work long hours, and who are often working in systems that promote discontinuity of patient care. However, several authors have asserted anecdotally that patient care is better in teaching hospitals because of the involvement of residents.[32,47] Several factors could explain these anecdotal assertions.

The team format used in most teaching hospitals ensures multiple evaluations of each patient and multiple opinions about the best course of care for that patient, providing in essence a system of checks and balances. Indeed, Poses et al. reported that the combined judgment of two junior or senior house officers regarding the prognosis of intensive care patients may be as good as or better than the prognostic judgment of the attending physician.[48] Further, the presence of bright housestaff (and medical students) may challenge and stimulate attending physicians to be as up-to-date and as rational as possible in patient care.[47] Finally, housestaff provide continuous on-site patient care, which may be invaluable in emergency situations. Indeed, in the one study reporting that length of stay was shorter for patients on teaching services than for those on nonteaching services,[13] patients were assigned by the attending physicians either to their own private nonteaching service or to the teaching service they supervised. These attending physicians chose to assign the sicker patients to the teaching service, reflecting their trust in the care provided by the residents.

Aside from Udvarhelyi's study of patients with acute myocardial infarction,[13] we identified no study with the primary hypothesis that housestaff would provide better care or be more cost-efficient. Nevertheless, findings from the studies discussed in this review can be instructive. For example, teaching hospitals tend to care for sicker patients with more complex problems than do nonteaching hospitals, and for many more patients with rarer diagnoses.[49–51] Nevertheless, despite the fact that at these institutions housestaff participate in the care of extremely ill patients, no study has demonstrated that housestaff inexperience or workload adversely affects morbidity or mortality rates. Indeed, some studies comparing teaching hospitals with nonteaching hospitals suggest that even with sicker patients, patients in teaching hospitals may have better outcomes,[49,50] indicating that residents' involvement in care may be beneficial.

Another area in which residency training may be beneficial is in providing to hospitals a source of cheap labor that would be very costly to replace. While a review of graduate medical education finance is beyond the scope of this review, two issues are apparent. First, residents provide a source of funding well in excess of their own salaries,[47] and second, the cost of substitute providers to replace the work of resident physicians would be high, around $58,000 to $77,000 per resident per year (in 1993 dollars).[52] In 1990, Thorpe estimated that to comply with state laws restricting residents' work hours and duties. New York hospitals would have to hire an additional 5,358 full-time equivalent personnel to replace the work of housestaff, at a yearly cost of $358 million.[53]

Housestaff participation in patient care has not been shown to increase morbidity and mortality rates. In fact, the opposite may be true if, indeed, teaching hospitals are caring for sicker patients. Thus, residents' involvement may be beneficial as has been suggested in a study showing that the judgment of two junior housestaff may exceed that of an attending physician. Housestaff also provide a difficult-to-replace source of economical labor. Anecdotally, the presence of housestaff may also enhance patient care indirectly by contributing to the intellectual climate and stimulating attending physicians to be up-to-date and to provide the best care possible.

DISCUSSION

Relatively few studies have assessed the impact of resident involvement on patient care. Studies primarily from the 1970s and 1980s suggested that the inexperience and the clinical workload of housestaff may contribute to adverse patient outcomes, as may structural features of residency programs that introduce discontinuity into patient care. In these early studies, the outcomes affected included costs, resource use, medication errors, length of stay, and preventable adverse events; more recent studies have shown some effects on patient satisfaction. No study has demonstrated that housestaff contribute to excess morbidity and mortality rates. The published studies in this area are for the most part retrospective and were conducted at single sites. The effects of internal medicine training on patient outcomes in the 1990s are largely unknown.

Academic medical centers are being pressured to streamline and to increase the efficiency of patient care, placing particular emphasis on reducing costs in a capitated environment. If academic medical centers are viewed as more costly, they will be placed at a competitive disadvantage with nonteaching hospitals for managed care contracts. Whether housestaff contribute to excess costs in the 1990s is therefore an important question, but the answer is largely unknown because previous studies in this area were conducted in an era that placed less emphasis on cost containment. Further, designing studies to answer this question may be difficult, because residency

training in internal medicine is undergoing substantial reform, with a greater emphasis on ambulatory education and less subspecialty service time. Whether these changes in the clinical education of residents will benefit or adversely affect patient outcomes is largely unknown.[7] Ideally, future studies should be designed and implemented to assess features of internal medicine residency training, with careful attention to study design so as to account for housestaff characteristics (such as workload and experience), patient characteristics (such as severity of illness), and supervision of housestaff.

Unfortunately, pressures from managed care companies and changes in the financing of teaching hospitals may force teaching hospitals to change their residency programs without the luxury of empirical data. However, by recognizing potentially sensitive areas such as those identified in this review, program directors can make more rational changes in residency training programs. For example, published reports suggest that the adverse effects of discontinuity can be attenuated by better checkout practices.[41,42] Likewise, restricting residents' workloads to fewer than 11 patients may enhance the care they provide.[22] Studies suggest that when graduating residents inform their patients that their care will be transferred to another resident physician, the dissatisfaction patients feel with this process is reduced.[46] Attention to details such as these will help ensure that the clinical education of housestaff does not adversely affect patient care and, ultimately, will improve the care of patients at academic medical centers.

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REFLECTIONS

Seeds

I was only eighteen when my belly first bloomed.
Long before my breasts began to swell and ache
in anticipation of the constant cry
and the blind mouth's suck,
I became aware of the unsought growth within:
reminded each sunrise by nausea and fear
of the unknown,
aware only of a woman's sacrifice
for that which grows within.

At eighty-two I bloom again.
Beneath fresh bandages
a long pink scar stretches
from below my withered breasts
across my wrinkled womb
where yesterday surgeons peered within:
"Miliary metastases. Nothing more to do."

Now swaddled in sterile sheets
I am left alone
With the beautiful image
of a million malignant, glistening seeds,
waiting for them to bloom.

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