

Research Article

Patient Use of Tablet Computers to Facilitate Emergency Department Pain Assessment and Documentation

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Introduction. The goal of this project is to pilot automated pain tracker (APT) hardware/software system allowing patients to indicate their pain levels and whether they want analgesia, using tablet computers. **Methods.** Patients in an academic emergency department (ED) used a tablet computer (iPad, Apple Computer Company, Cupertino, CA, USA), programmed to allow them to indicate their pain level, whether pain medication was desired, and prompted the subject at regular intervals to indicate their pain level. The iPad was linked to a monitor in the ED's nursing/physician station. The pain assessment information was printed for scanning and inclusion in the ED's electronic medical records (EMR) system. A 5-point Likert scale questionnaire was used to assess the perceptions of patients and nurses about the utility of the APT. **Results.** The majority of 30 subjects (28 of 30; 93%) agreed or strongly agreed that the number of pain assessments was adequate. All of the subjects indicated the APT was easy to use, and 28 of 30 subjects (93%) thought the APT should be used more in the ED. **Conclusions.** The benefits of the iPad pain-tracking and reporting-system include patient satisfaction, improved pain care, operational efficiency, and improved pain assessment documentation.

1. Introduction

Pain is encountered with high frequency in the emergency department (ED). In addition to the clinical imperative to determine pain causation, the healthcare team must also aim to relieve the pain. One important step in relieving pain is to assess its presence and degree.

There are at least 3 major foundations for prioritizing pain assessment: (1) medical care quality, (2) patient satisfaction, and (3) compliance with regulatory requirements for assessing and documenting pain levels [1]. Thus, pain assessment should be considered a part of the “standard of care” for EDs everywhere.

The consistent message from existing studies is that ED pain assessment tends to be sporadic, unreliable, and a source of frustration for suffering patients and overtaxed providers. For decades, the medical literature has discussed

the problem of inadequate pain care (“oligoanalgesia”) in the overall ED population and in various subpopulations [2–6]. Experts writing as recently as mid-2012 note that the problem continues largely unabated [7].

In adults, the hallmark of pain assessment is the 0-to-10 numeric rating scale (NRS). The NRS is broadly validated, throughout the USA and across myriad patient types. NRS data are easily documented, intuitively interpretable, and (last but not least) meet regulatory requirements (i.e., Joint commission) for pain assessment and documentation [8].

At most EDs, nurses have the primary responsibility for initial and ongoing documentation of pain. Unfortunately, it is clear that the current system results in irregular pain assessment and insufficient documentation; nursing resources tend to be stretched too thin. Since pain is the “5th vital sign,” its regular assessment, display, and documentation should be facilitated. The reason that other vital signs are reliably

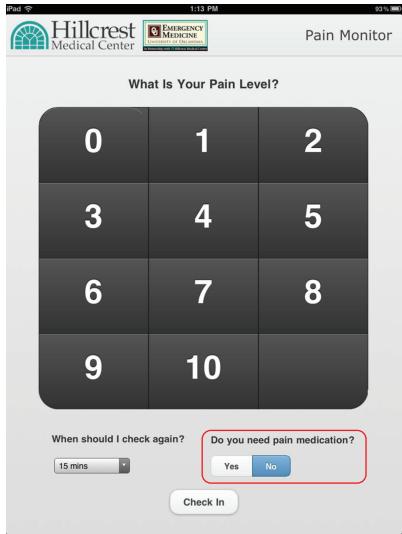


FIGURE 1: A screen shot of the tablet computer showing where patients indicate whether they desire pain medication.

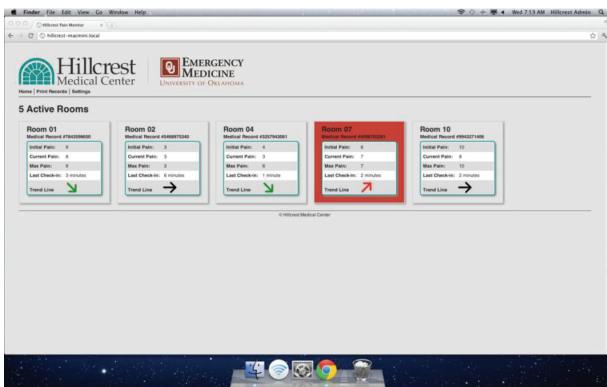


FIGURE 2: A screen shot of the monitor in the RN/MD work station.

and regularly obtained is that technology enables automated assessment of data (e.g., heart rate). Technology can do the same for NRS assessment.

Building upon previous studies of ED pain assessment and documentation, the current study aimed to provide patients the means to indicate their pain levels using a hand-held computer. A peer-to-peer network was utilized in order to facilitate communication of patient-indicated pain levels and analgesia desires, to the central nurses/physicians (RN/MD) station in the ED. The goal of this pilot project was to determine the feasibility of the tablet computer-based automated pain tracker (APT) and to assess patient and nurse satisfaction with the device.

2. Methods

2.1. Design. This was a prospective, nonrandomized trial of a novel pain-tracking device in a single cohort of 30 adult ED patients.

2.2. Setting. The study was conducted in an urban academic ED setting in the US southwest. The study ED, at Hillcrest Medical Center (HMC), sees roughly 50,000 patients annually and has an admission rate of about 22%. Physicians providing care are emergency medicine (EM) boarded attendings and EM residents. The study was approved by the IRBs at both HMC and the University of Oklahoma.

2.3. Subjects. Study subjects were a nonconsecutively enrolled convenience sample of all-diagnosis adults (>18) presenting to the HMC ED with any mention of pain in their chief complaint. Patients did not have to currently have pain to be eligible for the study. Ineligible patients were those who were deemed by treating physicians to have patient care needs (e.g., requirement for acute intervention) that prevented study personnel from approaching patients about participation.

Study subjects had to be fluent in either English or Spanish. Subjects who were eligible were approached by the study staff and had the study explained to them; if they were interested in participation they were entered as study subjects, and the consenting process took place.

2.4. Interventions. A tablet computer (iPad, Apple Computer, Cupertino, CA, USA) was given to study subjects. This hand-held personal computer (HHPC) had been pre-programmed with the APT software. APT software provided an introduction to the pain-tracking system (in English or Spanish); an interval between assessments was selected (15 minutes; 10, 15, 20, and 25 minutes are the available options), and an initial pain NRS was elicited from subjects. After the 15 minute interval elapsed, subjects were again assayed as to their pain level. At all NRS query times, subjects were asked to indicate on the HHPC, whether they desired analgesia (see Figure 1). Either subjects or their family members (or others accompanying the subjects in the ED) were allowed to use the HHPC and provide responses. Study subjects used the APT for at least 1 hour, and then were off-study after completing the study's verbal survey (see below).

The HHPC-indicates NRS levels, and desires for analgesia were communicated via a peer-to-peer network to a computer at the central RN/MD station in the ED (see Figure 2). This computer was connected to a monitor, which displayed each individual HHPC in use, as a separate icon. Each HHPC icon displayed the patient's NRS and analgesia indications and thus, provided this information at the central RN/MD station. The display on the central monitor allowed for both viewing of multiple patients and for focusing in on an individual patient's pain levels (and analgesia requests) over time. This was set up to be analogous to the patient pushing the "call-button" and requesting analgesia. The APT central computer was also connected to a printer, which printed results for each subject in a format suitable for inclusion in the electronic medical record (EMR) (see Figure 3).

At the conclusion of the one-hour minimum study period, patients were asked to indicate using a 5-point Likert

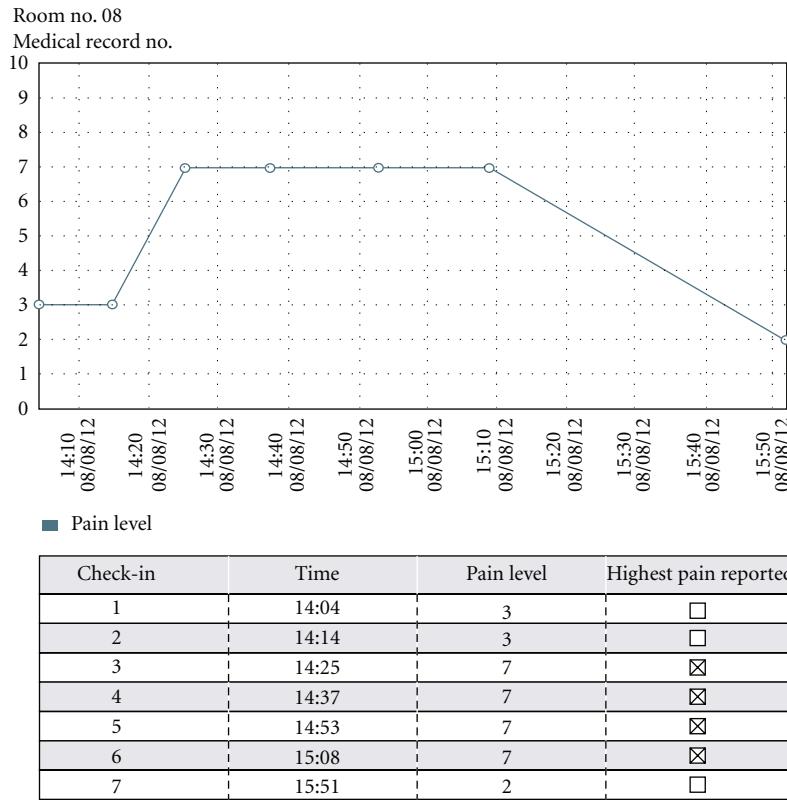


FIGURE 3: Printed documentation of pain assessments.

scale (1 = strong disagreement to 5 = strong agreement), their levels of agreement with the following queries.

- (i) The number of times I was asked to indicate my pain level was adequate.
- (ii) The APT was easy to use.
- (iii) The APT should be used with more patients in the emergency department.

Also at the conclusion of the study period, the RNs providing care for study subjects were asked to indicate using a 5-point Likert scale, their levels of agreement with the following queries.

- (i) I was satisfied with my level of awareness of the patient's pain level.
- (ii) The APT should be used with more patients in the emergency department.

2.5. Analysis. Nonparametric continuous or ordinal data results were reported as medians with interquartile range (IQR), and analysis was conducted with Kruskal-Wallis testing. Categorical data were reported as proportions with exact 95% confidence interval (CI) based upon the binomial distribution; analysis of categorical data was performed with Fisher's exact testing. For all statistical testing, a P value of <0.05 was set as being significant; calculations were performed with STATA 12MP (StataCorp, College Station, TX, USA).

3. Results

The study patients were middle-aged adults who were mostly white and who had relatively severe pain. General characteristics of the 30 study subjects are shown in Table 1.

The results with respect to APT functionality were positive. The system had one failure during the study, in that the wireless peer-to-peer network signal was only intermittently available for some ED patient rooms; this problem was addressed by the information technology group and did not recur. In every case in which APT was deployed, the monitor for display of pain scores and analgesia requests functioned, and in every case the APT produced an exportable (to EMR) documentation of ongoing pain assessment and intervention. No HHPCs were lost, broken, or otherwise rendered unusable.

With respect to the questionnaires administered to patients and RNs, the responses were very positive. The responses on the 5-point Likert scale, in which 1 corresponds to "strongly disagree" and 5 corresponds to "strongly agree"—with 3 being neutral—indicated consistent opinion in favor of the APT. Only 2 patients (7%) indicated as low as "3" (neutral) on the query with regard to adequacy of number of pain assessments; these 2 patients both indicated APT was easy to use and should be used more in the ED. All patients agreed with the statement that APT was easy to use, and 28 of 30 patients (93%, 95% CI 78–99%) thought APT should be used on more ED patients.

TABLE 1: Study subject baseline characteristics.

Age (median, interquartile range/IQR)	48.5 (32–56)
Male sex	13 (43%)
Race (self-described)	
White	19 (63%)
Black	10 (33%)
Hispanic	1 (3%)
Pain location	
Abdominal/flank	11 (37%)
Chest	13 (43%)
Extremity injury	4 (13%)
Headache	1 (3%)
General	1 (3%)
Initial pain score (median, IQR)	7 (4–9)
Triage-to-bed time in minutes (median, IQR)	7 (1–13)

RNs were near unanimous in their agreement with the statement that APT allowed them to have adequate awareness of their patients' pain levels; 29 of 30 (97%, 95% CI 83–100%) agreed with the statement. Two RNs (7%, 95% CI 1–22%) disagreed (indicated Likert "2") with the statement that APT should be used in more ED patients; 23 (77%, 95% 58–90%) agreed with the statement; 5 were neutral.

Median and IQR for RN and subject responses to the Likert questionnaires are shown in Table 2.

The fact that the preponderance of responses to APT queries were "strongly agree" responses (5 on the Likert scale) limited the capability of the study's analytics with regard to subgroup comparisons. With this limitation in mind, there was no difference in the likelihood of a "5" response to any of the three patient queries between males and females ($P = .36$ for query no. 1, $P = 1.0$ for query no. 2, and $P = .14$ for query no. 3) or between whites and Nonwhites ($P = .36$ for query no. 1, $P = .52$ for query no. 2, and $P = .63$ for query no. 3). Similarly, the nonparametric (Kruskal-Wallis) comparison of ordinal scale responses (1 to 5) on the three patient queries indicated no differences associated with sex ($P = .40$ for query no. 1, $P = .93$ for query no. 2, and $P = .23$ for query no. 3) or white/non-white status ($P = .70$ for query no. 1, $P = .64$ for query no. 2, and $P = .64$ for query no. 3).

With respect to nonanalytical results, pertinent outcomes included costs and functionality. The overall cost of the project, including programming time and hardware, software, and networking costs, was roughly \$25,000. This figure included the central computer and monitor, printer, and five programmed HHPCs. The functionality results were strongly positive; other than expected startup issues with programming and related software/hardware implementation, the APT software and hardware functioned smoothly during the 3-month pilot period. Notably, the output of the APT regarding pain assessment and documentation is currently included in the EMR as a scanned (image) file (see Figure 3); the raw data on pain scores and times are not imported into the EMR in the current iteration of APT.

4. Discussion

Pain is the primary complaint of patients presenting to the ED, and pain relief is therefore one of the most important duties for the ED provider [9]. This priority is reflected in the frequent description of pain assessment as "the 5th vital sign" [10–13]. Existing data on pain assessment make a clear case for its importance, but questions remain about the optimal methods for assuring this critical parameter is appropriately assessed and documented.

Despite the fact that pain is well known to be an important impetus for ED presentation, pain care represents an area of potential improvement for many acute care settings [2–6]. For example, even in cases such as extremity fractures, in which the need for analgesia is usually obvious, patients often go for extended periods of time without adequate pain assessment (or relief) [14–16]. Pain management is also a key component of the US healthcare regulatory sector (e.g., Joint Commission and Hospital Consumer Assessment of Healthcare Providers and Systems, HCAHPS) [1].

While there are myriad reasons for suboptimal pain relief in acute care, one important contributor appears to be caregiver workload [17, 18]. One thing that is known, is that more attention to pain assessment tends to translate into better pain care and patient satisfaction [19, 20].

The first question to be addressed in efforts to optimize pain assessment is that of what tools should be used for measuring pain. Pain scales such as the 0–10 NRS are commonly used, and their documentation is required by many hospitals and accrediting authorities [21]. The NRS has been suggested to be useful for pain assessment in a broad range of ages, cultures, painful conditions, co-existing diagnoses (including mild dementia), and care settings [22–28]. As compared to more complicated pain assessment systems, the NRS may be particularly helpful in the acute care setting [26]. These pain scales are proven useful for both clinical and research purposes. However, longitudinal pain scale documentation can tax time resources in a busy ED [21].

Given the fact that pain scale documentation is time-consuming, and with the understanding that pain scores represent the "objectification of subjective data," some have posited that perhaps it would be better to simply ask patients if they want analgesia [29]. This approach, for all its common-sense appeal, is demonstrated to be insufficient in the ED population. Previous work has clearly demonstrated that patients want the ability to report *both* a pain score and a desire for analgesia [30]. It is well demonstrated that physicians cannot reliably predict patients' pain levels—thus the critical need for patient self-report of pain [31]. One logical extension of this point is that, even if they know patients pain score numbers, physicians may not be able to reliably know whether patients want analgesia.

Providers also do not know how frequently patients want their pain assessed. A frequent assessment of pain that represents appropriate attention to detail for one patient may be seen as unnecessarily bothersome and intrusive to another. Research shows that ED patients want the ability to change the frequency with which their pain is assessed; those

TABLE 2: Patient and nurse responses to Likert-scale queries regarding pain assessment.

Queries to patients	Response median (IQR)
(1) The number of times I was asked to indicate my pain level was adequate.	5 (5-5)
(2) The APT was easy to use.	5 (5-5)
(3) The APT should be used with more patients in the Emergency department.	5 (5-5)
Queries to nurses	
(1) The APT should be used with more patients in the Emergency department.	5 (5-5)
(2) I was satisfied with my level of awareness of my patient's pain level.	5 (4-5)

with more severe pain, want pain assessed more frequently [32].

For reasons of improving medical care, maximizing patient satisfaction, and even meeting regulatory standards for pain documentation, ED practitioners are well advised to focus attention on pain assessment. Studies in the ED setting, using pain-tracking and display methods that are “run-ups” to the current proposed method, have shown that increased attention to pain assessment translates into better pain care and improved patient satisfaction [20, 33].

When increased attention to pain assessment is complemented by technological assistance in recording pain levels, healthcare providers benefit from medical records that appropriately reflect the attention they give to the vital parameter of pain level; data show that, otherwise, the ED record fails to reflect the pain assessment that is in fact performed but “underdocumented” [21].

Previous work by our group has demonstrated the feasibility and desirability—from both patient and provider viewpoints—of bedside pain-tracking and central information display [20, 30, 32, 33]. These previous studies, conducted in the ED at Harvard’s Massachusetts General Hospital, started with undergraduates’ querying patients on pain levels and writing the numbers on bedside easels. Followup data proved the viability of using a portable computer (running in either English or Spanish) to assess and display pain scores. The current study represents use of HHPCs as a simple, relatively inexpensive extension of the earlier work on pain assessment and tracking.

As a pilot study, this project was characterized by many limitations preventing definitive conclusions. Perhaps most important were the relative small numbers of subjects, the lack of a control group, and the convenience sample nature of subject accrual. These limitations and others must be considered before drawing conclusions from the data.

Small subject numbers were planned *a priori*, to allow for a reasonably quick decision regarding justification (or nonjustification) of the APT-associated expenses (e.g., tablet HHPCs, central monitoring equipment). The study numbers were in the judgment of the investigators and the funding source (the hospital) sufficient for determination that the pilot was “successful” but the numbers were insufficient to allow for rigorous exploration of associations between degrees of APT success and independent variables such as diagnostic group or initial pain level.

The study’s original intent was to include a control group, but the Hawthorne effect associated with providing patients

a “sham” HHPC and “sham” pain assessment would be significant. Furthermore, given the pilot nature of this study, it was difficult to justify inclusion of a control group who had to undergo the consent and data tracking processes, but who did not accrue the potential benefits of APT monitoring. Some form of controlled study will likely be necessary if APT appears to warrant more widespread investigation and deployment.

The convenience sampling of the study leads to high potential for some degree of selection bias. Study personnel were only available to enroll patients between 0900 and 1700 weekdays, and the exclusion of any patients in whom “there was too much going on” (e.g., high acuity) limits the generalizability of results.

Nonwhites were grouped, due to the low numbers of minority patients in the study (there was only one Hispanic). No pediatric patients were studied, and the study included insufficient numbers of older patients (only 3 patients over 65 years) to allow for assessment of APT use in older adults. The study did not ascertain information regarding socioeconomic status (although the study ED tends toward caring for a large proportion of uninsured patients). Further studies can focus attention on possible differential APT performance and utility in differing age groups, diagnostic categories, and other patient categories.

Detailed subgroup analysis of the RN queries was not performed, because there were a number of cases in which RNs, who were using APT, had used the device earlier in the study. There were insufficient study numbers to perform meaningful analysis controlling for the fact that all 30 patient subjects were discrete (no repeats) but many of the 30 “RN subjects” were repeats. Further study should assess the impact of APT on RNs’ perceptions about, and actual provision of, pain care quality as well as documentation (and associated workflow advantages).

In conclusion, the APT pilot using HHPC was judged highly successful by the standards of a pilot project. The APT devices were nearly universally appreciated by patients, and an overwhelming preponderance of patients and RNs indicated strong agreement that the use of the device should be spread to more ED patients. The central monitoring station and printout of APT pain levels was successful in its technical implementation and ability to generate data for the EMR. Overall, the pilot data indicate a strong likelihood of some utility to having some ED patients use APT to monitor and record pain assessment. Further extension of APT in the study ED is ongoing, and more detailed analysis of APT’s use

in the ED and in other units will doubtless inform further decisions as to how to best track patient's pain levels.

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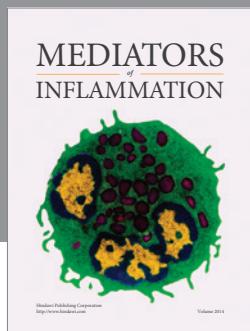
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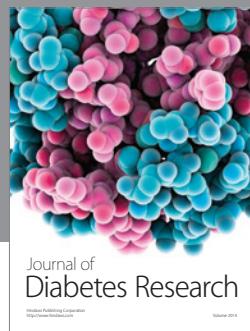
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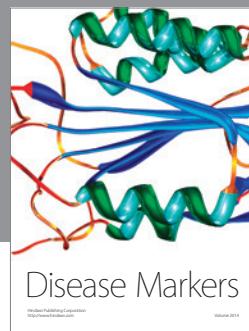
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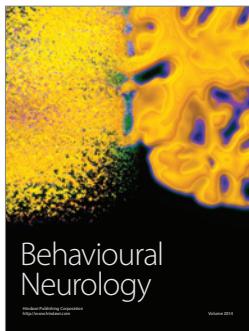
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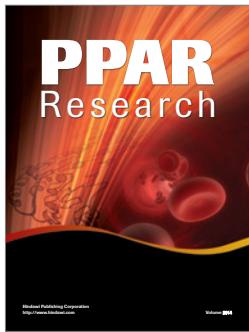
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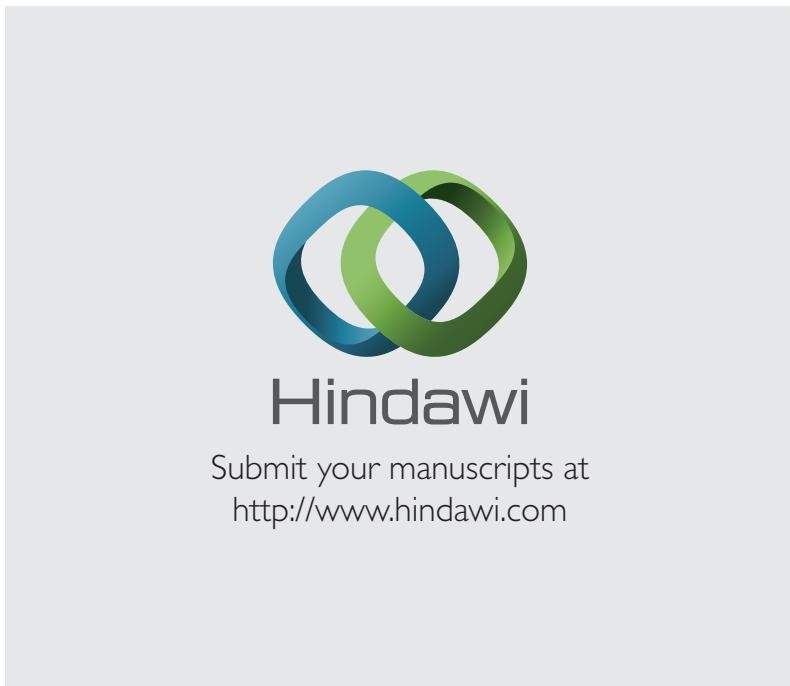
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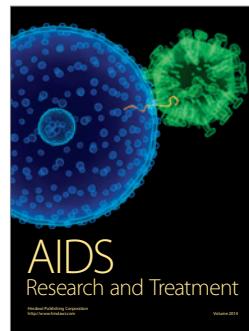


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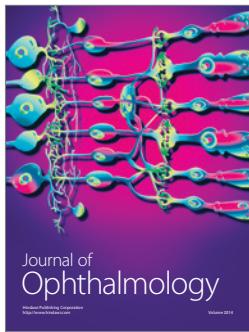
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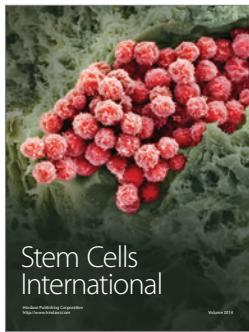
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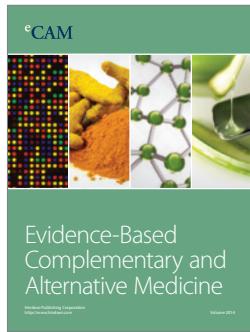
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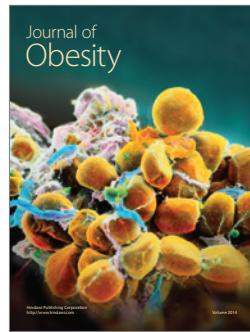
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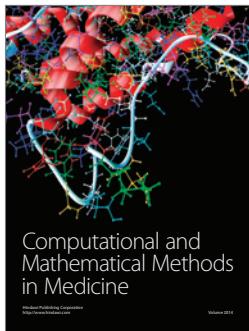
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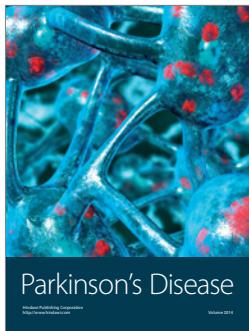
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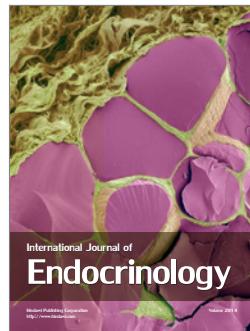
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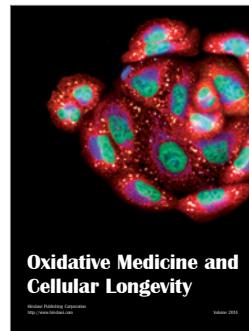
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