

# Consumption of Opioids in a Hospital Setting – What Can We Learn from a 10 Year Follow-Up?

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## Abstract

**Background:** The World Health Organization considers a country's morphine consumption to be an important indicator of progress in pain relief. Despite the strong consensus favoring the use of opioids in many types of pain, limited data are available for gauging the trends in opioid usage in specific medical institutions, such as hospitals

**Objectives:** To assess the possibility that monitoring opioid consumption can shed light on directions and trends in the treatment of pain in a hospital setting.

**Methods:** Data on opioid consumption, number of inpatient days and number of operations performed each year during the period 1990–1999 were obtained from records kept in the hospital's pharmacy and archives.

**Results:** During that decade the overall opioid consumption in the hospital increased from the equivalent of 3.7 mg of oral morphine per inpatient day to 7.3 mg, and from 56 mg per surgical procedure to 100 mg. In 1990, injected opioids accounted for 93% of the overall consumption, whereas in 1999 they accounted for only 44%. Yet, the proportion of injected meperidine to injected morphine increased only from 43% to 51%.

**Conclusions:** These results suggest that the ongoing monitoring of opioid consumption can highlight trends and directions and possibly emphasize strengths and weaknesses in the treatment of pain in hospitals.

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The under-use of opioids has been identified as one of the major causes of inadequate treatment of acute and cancer pain [1–3]. Therefore, increased opioid consumption can be expected to reflect improved, quality of pain control. Data on opioid consumption for medical use are now available in many countries, providing an indication of the quality of pain control in each [4]. Medical use of opioids is expected to increase as part of the continued effort by governments and health organizations to improve pain relief. In the United States, for example, during the years 1991–1996 the medical use of fentanyl increased by 1,168%, morphine by 59%, oxycodone by 23%, and hydromorphone by 19% [5]. The medical use of morphine in Israel also increased dramatically (by 700%) between 1984 and 1990 [6].

Despite the strong consensus favoring the use of opioids for many types of pain, limited data are available for gauging the trends in opioid usage in specific medical institutions, such as hospitals [7]. Assessing pain control quality in a hospital setting is not a simple task. The obvious basic component is measuring either pain intensity or patient satisfaction in all hospitalized

patients over a period and documenting any improvement in these parameters. However, this is time-consuming and difficult to conduct in a consistent manner. Having the medical and nursing staff complete questionnaires is likely to provide information on their attitudes and knowledge on pain control [8,9]. Yet, data from such questionnaires are likely to provide only indirect information on how pain treatment is actually being conducted in these institutions. Our working hypothesis in the present study was that based on the monitoring of opioid consumption within the hospital, we could obtain reliable data on trends and directions in the treatment of pain in the hospital and identify weaknesses and strengths in this area. It is likely that such information can be utilized to improve pain relief in the hospital. Accordingly, we conducted a structured survey in which we quantified the consumption of opioids in a referral university hospital setting during one decade.

## Materials and Methods

This study was conducted at Rambam Medical Center in Haifa, Israel. All data for the years 1990–1999 were obtained from records kept in the hospital's pharmacy. The monthly supply of all opioids allocated to each department is recorded regularly in these files. The pharmacy supplies the opioids on a monthly basis only after comparing the department's requirements with the amounts actually prescribed during the previous month. Every mismatch is carefully checked. The pharmacy records can therefore be regarded as a reliable source of information on the hospital's opioid consumption.

For the purpose of simplicity, all opioids used in the hospital are converted to their equianalgesic dosages of oral morphine according to previously published tables [1]: morphine solution for injection was multiplied by 3; meperidine solution for injection was multiplied by 0.3; oral oxycodone (Percocet, Percodan, Oxycontin) remained unchanged; buprenorphine was multiplied by 60; and pentazocine was divided by 5. Fentanyl patches were calculated according to the manufacturer's conversion tool [10]. A fentanyl patch of 25 µg/hour, for example, is the equivalent of ~90 mg of oral morphine daily. Since the fentanyl patch is typically applied for 3 days, it is equivalent to (90x3) 270 mg of morphine. Therefore, each µg/hr of fentanyl was converted to a total of 10.8 of oral morphine. All data are presented in the equivalent of grams or milligrams of oral morphine.

Additionally, data on annual inpatient days and inpatient surgical procedures were retrieved from the hospital's archives,

and the equivalent of oral morphine consumption per inpatient day and per surgical procedure were calculated where appropriate.

In an attempt to define trends in the use of opioids in different sections of the hospital, four divisions were compared: surgery, medicine, oncology, and pediatrics, each with several departments. The consumption of different opioids in each division was quantified separately as well.

Lastly, we also compared the amounts of injected versus non-injected opioids. By injected opioids, we refer to what used to be called parenteral opioids, meaning subcutaneous, intramuscular and epidural routes of administration, with the exception of transdermal fentanyl (which is also given parenterally). Non-injected opioids include the sublingual, oral, rectal and transdermal routes of administration.

## Results

### The hospital setting

Rambam Medical Center, a 900-bed facility, is the main teaching hospital affiliated with the Technion Faculty of Medicine and the major trauma center and only tertiary care facility in northern Israel. The hospital consists of four major divisions plus outpatient services. There was no significant change in the number of beds and the type of services provided by the hospital during the study period.

### Opioid preparations

In 1990, the only six opioid preparations available included morphine and meperidine for injection; morphine suppositories; sustained-release oral morphine; combinations of oxycodone plus acetaminophen, and oxycodone plus acetylsalicylic acid; and pentazocine. The number increased to 10 in 1999, and in addition to the above included sustained-release oxycodone, transdermal fentanyl patches, buprenorphine tablets, and immediate-release morphine tablets. Fentanyl injections are also available but are used primarily before and during surgery and were therefore not included in this study.

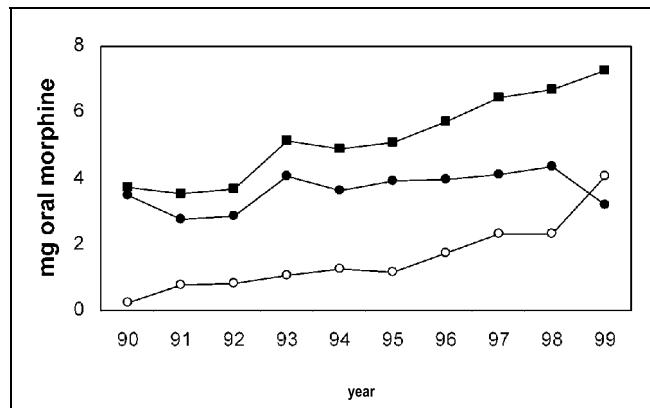
### Opioid consumption

The overall opioid consumption in the hospital, as measured by the equivalent of oral morphine, increased from 876 g in 1990 to 2,270 g in 1999 (a 2.59-fold increase). Similarly, the number of inpatient days also increased, from 234,037 to 312,482 (a 1.33-fold increase). Therefore, the opioid consumption per inpatient day increased from 3.7 mg in 1990 to 7.3 mg in 1999 (a 1.9-fold increase) [Figure 1].

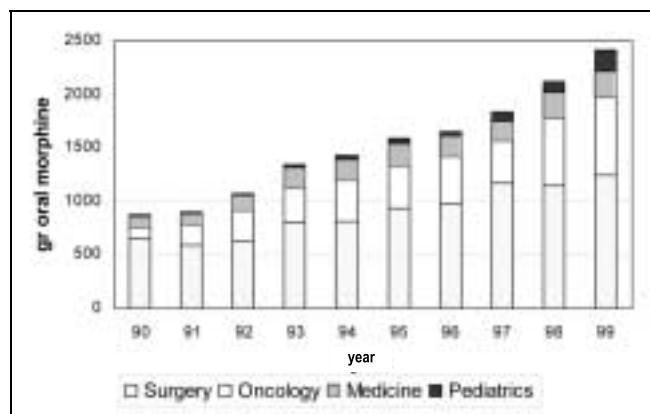
The change in the consumption of each opioid individually was calculated in a similar way. The use of morphine increased during the study period by 100%, meperidine by 27% and oxycodone by 275%. Fentanyl patches first appeared in 1997 and until 1999 increased by 1,208% (with a correcting factor of 1.07). Buprenorphine decreased from 1996 to 1999 by 3%. Pentazocine increased by 110% between 1991 and 1993, but has not been in use since 1998.

### Injected versus non-injected opioids

Another notable change was in the route of opioid administration. In 1990, 93% of all hospital opioids were given by injection (815 g of



**Figure 1.** Opioid consumption in the hospital during the years 1990–1999, presented as mg of oral morphine per inpatient day (injected opioids -o-; non-injected opioids -●-; total consumption -—).



**Figure 2.** The relative annual consumption of opioids in the different divisions of the hospital, presented as the equivalent of oral morphine.

injected morphine versus 61 g of non-injected morphine). During the survey period the consumption of injected opioids increased by 22% and of non-injected opioids by 1,990%. Consequently, in 1999 only 44% of the overall opioid consumption comprised injected opioids; in other words, the ratio of injected to non-injected opioids changed from 13.5:1 in 1990 to 1:1.3 in 1999 [Figure 1]. A further analysis of injected opioids shows that meperidine constituted 43% of the total injected opioid consumption in the hospital in 1990 as compared to 51% in 1999.

With regard to non-injected opioids, oxycodone was the only one used in the hospital in 1990. By 1999, the percentage of oxycodone use had dropped to 21% and was overshadowed by morphine (45%) and transdermal fentanyl patches (34%). To summarize, the main routes of opioid administration in the hospital in 1999 were injection (44%), enteral (36%) and transdermal (20%).

### Divisions

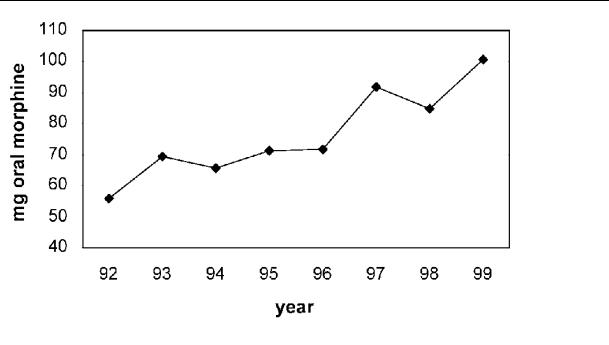
The proportional consumption of opioids in the different divisions is summarized in Figure 2. In 1990, the division of

surgery accounted for 74% of the entire hospital's opioid consumption, as compared to 12% in the division of medicine, 12% in oncology, and only 2% in pediatrics. In 1999, the respective percentages of opioid use changed to 52%, 10%, 30% and 8% respectively. As data on the number of inpatient days in each division were not available for analysis, adjustments according to the number of inpatient days in each division could not be made.

### Surgery

The surgical division is the largest opioid consumer in the hospital [Figure 2]. The overall morphine consumed in this division nearly doubled between 1992 and 1999 (from 650 to 1,244 g), while the number of surgeries increased only slightly during this same period (from 11,350 to 12,270). The calculated average dose of morphine administered per surgical procedure increased from the equivalent of 56 mg of oral morphine in 1992 (data on the number of surgeries in the years 1990–1991 were not available) to 100 mg in 1999 [Figure 3]. This refers only to operations performed on hospitalized patients.

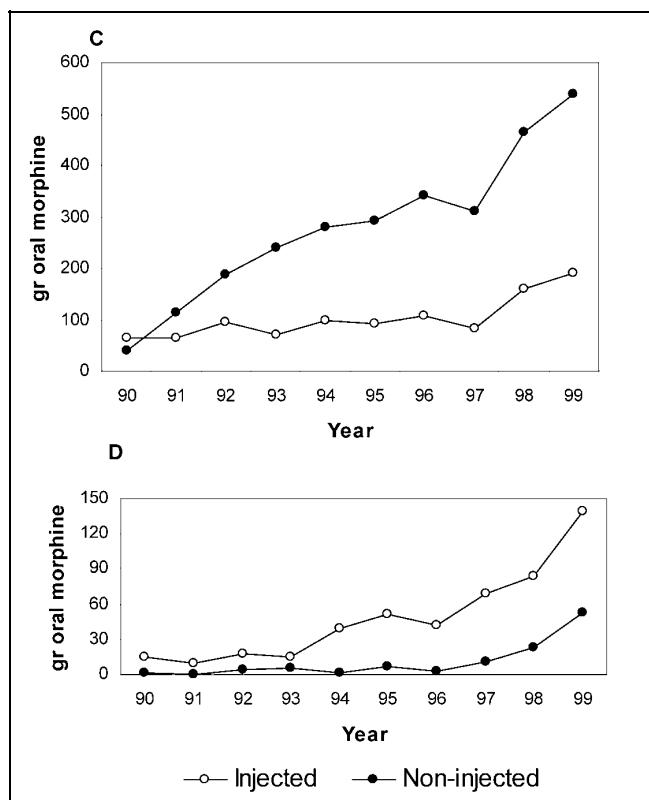
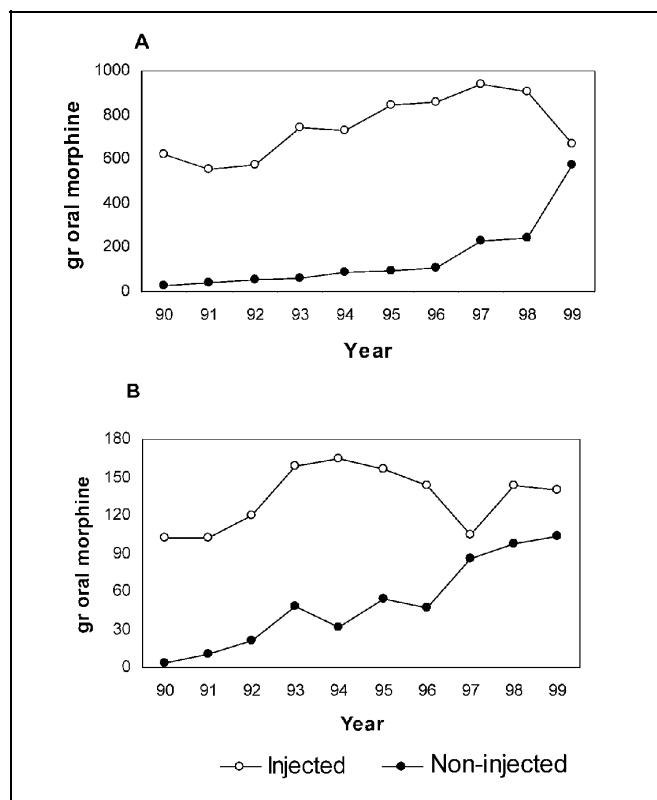
Interestingly, the proportion of injected to non-injected opioids also changed. In 1990, injected opioids comprised 96% of the annual surgical consumption, whereas in 1999 they constituted only 54% of the consumption [Figure 4A]. Regardless of these changes, the percentage of injected meperidine increased from 41% of the injected opioids in 1990 to 54% in 1999.



**Figure 3.** The average quantity of opioids administered per inpatient surgical procedure during the years 1992–1999, presented as the equivalent of oral morphine.

### Medicine

Despite a recorded increase in the use of opioids from 105 to 243 g in the medical departments, the significance of this rise is unclear in the absence of available data on the number of inpatient days in the division. However, two important observations are worth noting. First, the use of non-injected preparations increased consistently, while use of injected opioids remained relatively steady [Figure 4B]. Second, a comparison between the two injected opioids, meperidine and morphine, shows that the use of injected meperidine decreased steadily, dropping from 55% of the injected opioids in 1990 to 38% in 1999.



**Figure 4.** Injected (-o-) versus non-injected (-●-) opioids during the years 1990–1999 in the divisions of: [A] surgery, [B] medicine, [C] oncology, and [D] pediatrics, presented as the equivalent of oral morphine.

### Oncology

Between the years 1990 and 1999, the oncology division consisted of two departments (radiotherapy and chemotherapy), which constantly operate at full capacity. Given that the number of beds remained unchanged during this time period, it is reasonable to assume that the number of inpatient days did not change either. Yet, a nearly sevenfold increase in the use of opioids was recorded in this division between the years 1990 and 1999. This marked change was mainly due to an ongoing increase in the use of non-injected opioids [Figure 4C]. Moreover, a threefold increase in the use of injected morphine was recorded during the years 1997–1999. In contrast, the administration of meperidine in this division declined to the point where it is barely in use.

### Pediatrics

A tenfold increase in the use of opioids was recorded in the pediatrics division during the last decade, particularly for the years 1996–1999. This increase can almost certainly be attributed to the pediatric cancer pain unit that was opened in 1995. Unlike the other divisions, this rise in opioid administration is mainly the function of an increase in the use of injected opioids, primarily morphine [Figure 4D]. In contrast, the use of meperidine declined steadily.

### Discussion

United States Drug Enforcement Administration data indicate that the amounts of distributed opioids, such as morphine, oxycodone, hydromorphone and fentanyl, have substantially increased in recent years [11]. According to the World Health Organization, increasing medical use of opioids is one indication that progress is being made to improve pain management [12,13]. The present study shows a continuous increase in the use of opioids in the hospital setting as a whole, and more specifically per inpatient day. To our understanding, this indicates a higher degree of awareness about the need to treat pain and an enhanced readiness among the hospital's physicians to actually prescribe opioids. Judging by the WHO statement, it may also indicate that progress has been made toward improving pain management in the hospital.

Recent data from the United States Drug Enforcement Administration show that meperidine was the only opioid that decreased in medical use during the years 1990–1996 [5]. Contrary to this trend, our data show that the total amount of meperidine used in the hospital increased during the study period by over one-third. Its relative share in comparison to the use of injected morphine also increased. This unexpected rise results from the increased use of meperidine in the division of surgery, which is the largest opioid consumer in the hospital. In contrast, the use of meperidine decreased in the three other divisions examined, by 17–51%. The conclusion from these findings is that there is insufficient awareness within the division of surgery about the shortcomings of the use of meperidine; namely, its short duration of action and the potential accumulation of its toxic metabolite normeperidine [1,14,15].

Nevertheless, the increase in the amount of opioids administered per inpatient surgical procedure suggests an improvement in postoperative pain treatment. It is true that the average dose of

opioids used in 1999, which is equivalent to 100 mg of oral morphine, might seem relatively low. However, several factors should be taken into account. First, this figure reflects all surgical procedures performed on inpatients and also includes small procedures, such as hernia repairs, for which a small dose of opioids is usually required. Second, there is a small but slowly growing use of postoperative epidural analgesia (estimated at 3–5% of all inpatient procedures in 1999), which is likely to reduce the overall opioid consumption. Third, since there are no data from other institutions with which to compare, it is difficult to estimate the significance of this absolute amount.

Another interesting finding is the huge difference in the increased use of non-injected opioids as compared to injected opioids, the former being nearly a hundred times larger than the latter. For a better understanding of this trend we need to look at the different divisions. In the division of oncology, for example, opioids were barely even used in 1990. A continuous growth in use can be seen over the years, but mainly of non-injected opioids in accordance with numerous cancer pain treatment guidelines – all of which recommend the use of oral opioids whenever possible. The largest increase in the use of opioids was noted during the last 3 years of the study period and can be attributed to the fact that a special emphasis was put on the treatment of cancer pain in this division. Similarly, the increase in administration of injected opioids during those years was the consequence of enhanced usage of intravenous or subcutaneous infusions of morphine, with or without patient-controlled analgesia, in patients with advanced cancer. Quite similar trends can be seen in the division of medicine as well. The division of surgery, however, was marked by a slow increase in the use of both injected and non-injected opioids during the years 1990–1997, as well as the absence of any significant change in the proportion between them. Such trends would seem to suggest an overall conservative approach to the management of post-operative pain. In contrast, there was a dramatic increase in the use of oral opioids during the years 1998 and 1999, accompanied by a decrease in the use of injected opioids. This change resulted from the introduction of an experimental program in which oral morphine, instead of injected morphine, was administered for the management of postoperative orthopedic pain. The details of this program were published recently [16]. Different trends were found in the division of pediatrics, where the increase in the use of injected opioids was much larger than that of non-injected opioids. Furthermore, morphine, rather than meperidine, was identified as the most commonly used injected opioid in this division. We believe that this reflects the utilization of an 'aggressive' approach to the treatment of cancer pain in children.

Although the results of this study indicate that the monitoring of opioid consumption may be helpful in the assessment of the quality of pain treatment in a hospital setting, several caveats should be taken into account. First, by no means is this monitoring meant to replace the ongoing assessment of pain in the individual patient by means of pain intensity, patient comfort or satisfaction. Second, data on opioid consumption should be accompanied by data on

other hospital factors, such as number of inpatient days, number of surgeries, and type of referrals to the institution (e.g., whether it is a tertiary care facility). In the absence of such data, it would be impossible to place the results in context. Third, due to lack of information about the route of administration, pharmacy data on injected opioids can be difficult to interpret, especially as the increased utilization of advanced techniques, such as epidural administration of opioids, will reduce opioid consumption. One way to overcome this difficulty is by monitoring specific agents that are not used epidurally, such as meperidine in our study, or, in contrast, by monitoring such agents as fentanyl, which in some institutions are used primarily in the epidural space. Another way is by keeping records of the percentage of patients who receive epidural analgesia and making adjustments according to equianalgesic dosages.

The findings of this study highlight the usefulness of ongoing monitoring of opioid consumption as a major source of information on the trends, directions and possibly weaknesses and strengths in the treatment of pain in a hospital setting. This is the case not only for the hospital as a whole but for its different divisions as well. As such, it provides a helpful tool for the construction of a proper educational program aimed at improving pain management in hospital settings. Further studies from additional hospitals are needed to confirm this suggestion.

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