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## SCIENTIFIC ARTICLE

# Trends in hospital consumption of analgesics after the implementation of a pain performance improvement plan



Beatriz Monje <sup>a,b,\*</sup>, Álvaro Giménez-Manzorro<sup>a,b</sup>, Cristina Ortega-Navarro<sup>a,b</sup>, Ana Herranz-Alonso<sup>a,b</sup>, María Sanjurjo-Sáez<sup>a,b</sup>

<sup>a</sup> Hospital General Universitario Gregorio Marañón, Pharmacy Department, Madrid, Spain

<sup>b</sup> Instituto de Investigación Sanitaria Gregorio Marañón (IISGM), Madrid, Spain

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### KEYWORDS

Analgesic;  
Consumption;  
Pain;  
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### Abstract

**Background:** Pain management committee established a pain performance improvement plan in 2012.

**Objectives:** The aim of the study was to assess the trends in analgesic consumption in a tertiary teaching hospital and the associated economic impact.

**Methods:** A descriptive, retrospective study was conducted between 2011 and 2015. The analysis included: anti-inflammatory and antirheumatic products non-steroids, opioid analgesics and other analgesics and antipyretics. Data are converted into DDD/100 bed-days to analyze consumption trends. Main outcome measure: assessment of the analgesic consumption after the implementation of a pain performance improvement plan.

**Results:** Overall, non-steroidal anti-inflammatory and antirheumatic products consumption decreased in 24.8 DDD/100 bed-days (−28.3%), accounting for most of the total analgesic consumption decrease (−13%) and total cost (−44.3%). Opioid consumption increased markedly from 22.3 DDD/100 bed-days in 2011 to 26.5 DDD/100 bed-days in 2015 (+18.9%). In 2011, the most consumed opioid was morphine (8.6 DDD/100 bed-days). However, there was an increasing trend in fentanyl consumption (from 8.1 to 12.1 DDD/100 bed-days in 2015), which resulted in fentanyl replacing morphine from the most consumed opioid in 2015 (12.1 DDD/100 bed-days). In 2015, the group of other analgesics and antipyretics represented 46.2% of the total analgesic consumption. Acetaminophen was the most commonly consumed analgesic drug (53.2 DDD/100 bed-days in 2015) and had the highest total cost, it represented 55.4% of the overall cost in 2015.

\* Corresponding author.

E-mail: [beatriz.monje@salud.madrid.org](mailto:beatriz.monje@salud.madrid.org) (B. Monje).

**PALAVRAS-CHAVE**

Analgésico;  
Consumo;  
Dor;  
Opioide

**Conclusion:** Opioid consumption showed an increasing trend during the 5 year period, with fentanyl replacing morphine as the most used opioid. In general, analgesics diminished use was due to the decreasing trend of consumption of non-steroidal anti-inflammatory and antirheumatic products.

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## Tendências no consumo hospitalar de analgésicos após a implantação de plano de melhoria do controle da dor

**Resumo**

**Justificativa:** A Comissão para o Manejo da Dor estabeleceu um plano de melhoria no controle da dor em 2012.

**Objetivos:** Avaliar as tendências do consumo de analgésicos em um hospital de ensino terciário e o impacto econômico associado.

**Métodos:** Estudo descritivo, retrospectivo, realizado entre 2011 e 2015. A análise incluiu: produtos anti-inflamatórios e antirreumáticos não esteroides, analgésicos opioides e outros analgésicos e antipiréticos. Os dados foram convertidos em DDD/100 leitos-dia para analisar as tendências de consumo. Principal medida do desfecho: Avaliação do consumo de analgésicos após o estabelecimento de um plano de melhoria no controle da dor.

**Resultados:** O consumo total de produtos anti-inflamatórios e antirreumáticos não esteroides diminuiu em 24,8 DDD/100 leitos-dia (-28,3%), representando a maior parte da redução total do consumo de analgésicos (-13%) e o custo total (-44,3%). O consumo global de opioides aumentou acentuadamente de 22,3 DDD/100 leitos-dia em 2011 para 26,5 DDD/100 leitos-dia em 2015 (+18,9%). Em 2011, o opioide mais consumido foi a morfina (8,6 DDD/100 leitos-dia). No entanto, houve uma tendência crescente no consumo de fentanil (de 8,1 para 12,1 DDD/100 leitos-dia em 2015), o que resultou na substituição de morfina por fentanil como o opioide mais consumido em 2015 (12,1 DDD/100 leitos-dia). Em 2015, o grupo dos outros analgésicos e antipiréticos representou 46,2% do consumo total de analgésicos. Acetaminofeno foi o analgésico mais consumido (53,2 DDD/100 leitos-dia em 2015) e teve o maior custo total, representou 55,4% do custo total em 2015.

**Conclusão:** O consumo de opioides mostrou uma tendência crescente durante o período de cinco anos, fentanil substituiu morfina como o opioide mais usado. Em geral, o uso diminuído de analgésicos foi devido à tendência decrescente do consumo de produtos anti-inflamatórios e antirreumáticos não esteroides.

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**Introduction**

The International Association for the Study of Pain (IASP) defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage".<sup>1</sup> Pain management is one of the most important issues in general health care.<sup>2</sup> Despite the availability of opioid and non-opioid analgesics and guidelines to manage pain, it often remains inadequately treated in clinical practice.<sup>3,4</sup> Undertreatment of pain is associated with increased disability and suffering and with personal and financial costs.<sup>5</sup> Furthermore, patient satisfaction with care is strongly related to their experiences with pain during hospitalization.<sup>6</sup>

The World Health Organization (WHO) considers an increase in opioid consumption a healthcare quality

indicator of progress in pain relief, especially for cancer pain.<sup>7</sup> Oral opioids are key medications for the treatment of moderate to severe pain and some of them are regarded as essential medicines by the WHO.<sup>8</sup>

Assessment of pain is one of the most important steps to providing good pain management. Several tools provide a rating of pain intensity, e.g., Visual Analogue Scale (VAS), Numeric Rating Scale (NRS). Assessment and management of pain are complex and require a series of procedures and protocols to support them.<sup>2</sup> In addition, adequate pain management requires an interdisciplinary approach, including physicians, nurses, social workers, and pharmacists.<sup>9,10</sup>

In 2012, a Pain Management Committee was created in our hospital. During the last 5 years, this committee has worked on the development of standard analgesic protocols, pain educational sessions and audits to monitor the

quality of pain management within the institution. In order to establish and maintain a pain performance improvement plan, it became necessary to analyze analgesic use in clinical practice.

### Aim of the study

The aim of this study was to assess the trends in opioid and non-opioid analgesic consumption in a tertiary teaching hospital and the associated economic impact.

### Ethics approval

The study was approved by Ethics Committee of Clinical Research of Hospital General Universitario Gregorio Marañón and Pain Management committee.

### Methods

The study design was retrospective observational. Analgesic consumption was analyzed between 2011 and 2015, pre and post implementation of a pain performance improvement plan in Hospital General Universitario Gregorio Marañón.

Drug consumption data were obtained retrospectively from the pharmacy information system, FarhosGestión® annually. Dispensed units of each drug presentation were converted into Defined Daily Doses (DDD) of active ingredient. The DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults (WHO Collaborating Centre for Drug Statistics Methodology)<sup>11</sup> and is expressed as the amount of active ingredient in milligrams, on the basic principle of only one DDD per route of administration within an Anatomical Therapeutic Chemical (ATC) code. DDDs of each specific drug were obtained from the WHO website.<sup>11</sup>

It calculated DDD/100 bed-days yearly from the dispensed units using the following formula:

DDD/100 bed-days

$$= \frac{\text{number of units dispensed} \times \text{amount of mg per unit} \times 100}{\text{DDD} \times \text{number of bed-days}}$$

The number of stays per day corresponding to every year of the study were obtained from the Hospital Information System. Paediatrics inpatients were excluded from the study.

The analysis included the following group of drugs according to the ATC/DDD classification system:<sup>11</sup>

1. Anti-inflammatory and antirheumatic products, non-steroids (NSAIDs) (M01A): aceclofenac, celecoxib, dexibuprofen, dexketoprofen, diclofenac, etoricoxib, ibuprofen, indometacin, ketoprofen, ketorolac, meloxicam, nabumetone, naproxen and piroxicam.
2. Opioid analgesics (N02A): buprenorphine, fentanyl, morphine, oxycodone, pethidine, tramadol and tapentadol.
3. Other analgesics and antipyretics (N02B): acetylsalicylic acid, metamizole, acetaminophen and lysine clonixinate.

Data are presented in DDD/100 bed-days for ATC group and for each active ingredient included.

Drug costs were calculated on an annual basis using official prices applying the discounts according to the Spanish Sustainability Decree<sup>12</sup> and other discounts negotiated with suppliers, and adding 4% Value Added Tax (VAT). Drug costs are presented in euros and percentage of the total cost for each ATC group.

### Results

From 2011 to 2015, total analgesic consumption decreased in our hospital from 188.1 DDD/100 bed-days to 166.2 DDD/100 bed-days (−13%). Overall opioid (N02A) consumption increased from 22.3 DDD/100 bed-days in 2011 to 26.5 DDD/100 bed-days in 2015 (+18.9%). In 2015, opioid consumption represented 16.0% of the total analgesic consumption. During the study period, overall NSAIDs (M01A) consumption decreased by 24.8 DDD/100 bed-days (from 87.7 DDD/100 bed-days to 62.9 DDD/100 bed-days in 2015). Analgesic consumption information and trend of consumption during years 2011–2015 are shown in Table 1 and Fig. 1.

In 2011, the most consumed opioid was morphine (8.6 DDD/100 bed-days). During the study period, morphine consumption showed some fluctuations with an overall decrease (−3.5%). However, there was an increasing trend in fentanyl consumption (from 8.1 to 12.1 DDD/100 bed-days in 2015), which resulted in fentanyl replacing morphine from the most consumed opioid in 2015. Tramadol (3.0 DDD/100 bed-days) was the third most consumed opioids in 2015. Fentanyl, morphine and tramadol accounted for 88.3% of the overall opioid consumption in 2015. It is important to note that the use of tapentadol started in 2013 and its consumption showed a high increase in 3 years (0.1 DDD/100 bed-days in 2015). Oxycodone, pethidine and buprenorphine consumption remained both stable during the study period. Consumption trend of each opioid analgesic from 2011 to 2015 is shown in Fig. 2.

With regard to NSAIDs, a decreasing trend in dexketoprofen (−16.8%), ibuprofen (−34.9%), naproxen (−34.4%) and diclofenac consumption (−46.1%) was observed. In 2015, these four drugs accounted for 99.1% of the total NSAIDs consumption in our hospital. Consumption of the others (ketorolac, aceclofenac, indometacin, nabumetone, meloxicam, etoricoxib and celecoxib) was 0.4 DDD/100 bed-days (0.8%). Note dexibuprofen and piroxicam were not used after 2012 and ketoprofen not since 2014. At the end of the study period, NSAIDs represented up to 37.8% of the total analgesic consumption.

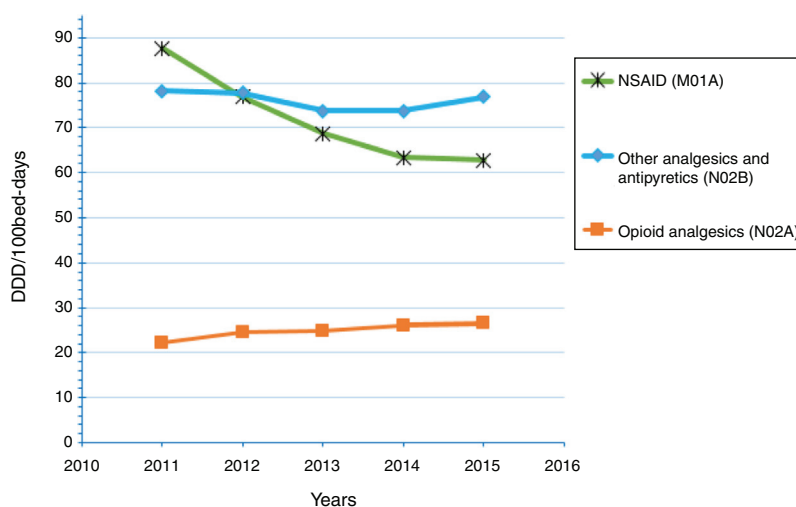
From 2011 to 2015, the group of other analgesics and antipyretics (N02B) showed an overall consumption decrease of 0.8% (from 78.1 to 76.8 DDD/100 bed-days in 2015), representing 46.2% of the total analgesic consumption in 2015. Although acetaminophen consumption decreased from 2011 to 2015, it accounted for the most consumed drug of this ATC Group (69.3%) and it represented up to 32.0% of the overall analgesic consumption in 2015 (53.2 DDD/100 bed-days). On the contrary, metamizole, the second most commonly consumed drug of this group, exhibited a continuous increased consumption (+31.1%).

**Table 1** Consumption of analgesic drugs during 2011–2015.

Analgesic group	2011	2012	2013	2014	2015
NSAIDs (M01A) total (DDD/100 bed-days)	87.7 (46.6%)	76.8 (42.9%)	68.7 (41.1%)	63.4 (38.8%)	62.9 (37.8%)
Dexketoprofen	38.2	35.9	33.6	31.5	31.7
Ibuprofen	36.8	32.1	27.3	24.4	23.9
Naproxen	5.2	4.4	3.5	3.2	3.4
Diclofenac	6.2	3.9	3.6	3.6	3.3
Ketorolac	0.5	<0.1	0.2	0.2	0.2
Aceclofenac	0.3	0.1	0.2	0.1	0.1
Indometacin	0.1	<0.1	0.1	0.1	0.1
Nabumetone	0.1	0.1	<0.1	0.1	0.1
Meloxicam	0.2	0.1	0.1	0.1	<0.1
Etoricoxib	<0.1	<0.1	<0.1	<0.1	<0.1
Celecoxib	<0.1	0.1	<0.1	<0.1	<0.1
Ketoprofen	<0.1	<0.1	<0.1	–	–
Dexibuprofen	<0.1	–	<0.1	–	–
Piroxicam	<0.1	–	–	–	–
Opioids analgesics (N02A) total	22.3 (11.8%)	24.6 (13.7%)	24.8 (14.8%)	26.1 (16.0%)	26.5 (16.0%)
Fentanyl	8.1	9.0	10.7	11.7	12.1
Morphine	8.6	9.5	8.7	9.2	8.3
Tramadol	2.7	3.0	2.6	2.7	3.0
Oxycodone	1.7	1.8	1.6	1.2	1.8
Pethidine	0.9	0.9	0.8	0.8	0.8
Buprenorphine	0.3	0.4	0.4	0.4	0.4
Tapentadol	–	–	<0.1	<0.1	0.1
Other analgesics and antipyretics (N02B) total	78.1 (41.6%)	77.8 (43.4%)	73.8 (44.1%)	73.7 (45.2%)	76.8 (46.2%)
Acetaminophen	59.2	55.8	54.0	52.6	53.2
Metamizol	17.6	20.8	19.0	20.4	23.0
Acetylsalicylic acid	1.1	0.9	0.6	0.6	0.5
Clonixinate lysine	0.3	0.3	0.2	0.1	0.1
Total analgesic group	188.1	179.2	167.3	163.2	166.2

Note: The values are shown as DDD/100 bed-days (%).

–, no consumption.

**Figure 1** Consumption of analgesic drugs during years 2011–2015.

These two drugs accounted for 99.3% of the total analgesic and antipyretic consumption in 2015. Acetylsalicylic acid and lysine clonixinate consumption showed a continuous decrease.

### Cost

The total cost of analgesics decreased from 585,960€ in 2011 to 326,517€ in 2015 (–44.3%). In 2015, analgesic cost

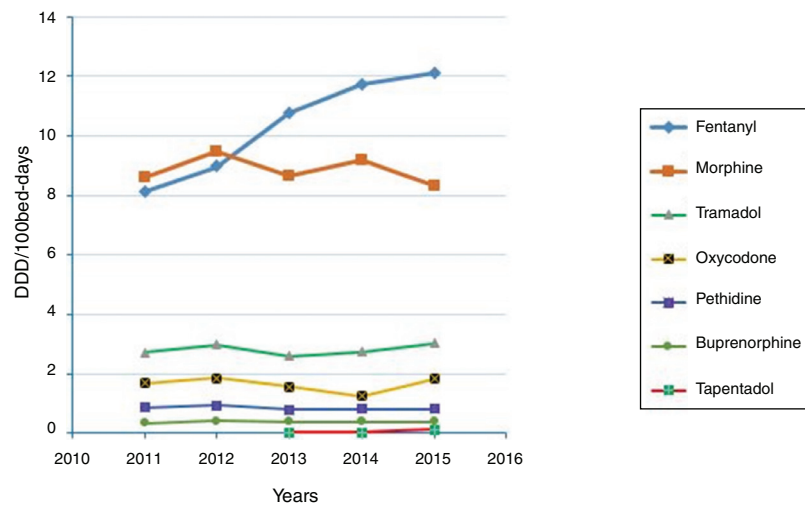


Figure 2 Consumption of opioid analgesics during years 2011–2015. Total consumption and cost of analyzed analgesics.

Table 2 Cost of analgesic drugs during 2011–2015 (€).

Analgesic group	2011	2012	2013	2014	2015
Other analgesics and antipyretics (N02B) (%)	347,902€ (59.4%)	254,639€ (55.4%)	213,079€ (54.2%)	216,945€ (66.5%)	203,793€ (62.4%)
Opioids analgesics (N02A) (%)	78,695€ (13.4%)	74,566€ (16.2%)	65,425€ (16.7%)	68,502€ (21.0%)	84,545€ (25.9%)
NSAIDs (M01A) (%)	159,363€ (27.2%)	130,538€ (28.4%)	114,298€ (29.1%)	40,604€ (12.5%)	38,179€ (11.7%)
Total	585,960€	459,743€	392,802€	326,051€	326,517€

distribution was as follows: other analgesics and antipyretics group (62.4%), opioid analgesics (25.9%) and NSAIDs (11.7%). Cost data is outlined in Table 2. Regarding the cost of each group, acetaminophen represented 55.4% of the overall cost in 2015, accounting for 180.926€. The total cost of opioids increased from 78,695€ in 2011 to 84,545€ in 2015 (+25.9%). Fentanyl (10.3% of the total analgesic cost), morphine (6.7%) and oxycodone (5.1%) cost represented 85.3% of the overall cost of opioids in our hospital in 2015. Regarding NSAIDs, dextketoprofen (9.6% of the total analgesic cost) and ibuprofen (0.9%) cost accounted for 90.3% of the total cost of NSAIDs in our institution in 2015.

## Discussion

An increasing trend in the consumption of opioids was observed during the study period, whereas the consumption of NSAIDs decreased significantly.

This increasing trend of opioid consumption is in accordance with the pattern of opioid consumption in Spain,<sup>13,14</sup> and is considered a healthcare quality indicator of progress in pain relief by the WHO. All healthcare professionals should work together to assess and manage pain adequately and establish strategies to ensure patients are not undertreated

or on the contrary, overtreated. Since the Pain Management Committee was created in 2012, a multidisciplinary team has worked to improve analgesic treatment in our hospital. The increasing trend of opioid consumption could be the result of education activities, surveys and protocols performed at our hospital. These efforts have had a positive impact on our clinical practice.

The effectiveness of strong opioids for relief pain is recognized, but there are concerns about physical dependence, tolerance and addiction.<sup>15,16</sup> It would be interesting to know age and gender of patients to identify possible deviations related with opioid side effects, for example opioid prescription in young adults. In this kind of patients, opioid exposure is concerning given the effects associated with long-term consumption.

Fentanyl showed an increasing pattern of consumption and cost during the last 5 years. Since 2012, fentanyl has been the most prescribed opioid. This trend was similarly observed by Garcia del Pozo et al., who studied the consumption of opioid analgesics in Spain.<sup>13</sup> This increase could be influenced by the large number of new marketed presentations in Spain: sublingual tablets, buccal tablets and inhalers.<sup>14</sup>

The sharp decrease in NSAIDs consumption could be explained by restrictions on prescribing diclofenac and COX-2 selective drugs due to the increased risk of heart

attack and stroke.<sup>17-19</sup> In addition, further adverse events of NSAIDs, as acute renal failure associated with parenteral ketorolac, have been reported.<sup>17,20</sup> It may be plausible that opioid consumption has replaced NSAIDs consumption because of these safety concerns.

During the 5 year period, total analgesic consumption and consequently, overall cost decreased. Furthermore, discounts negotiated with suppliers have a significant economic impact, for example in the price decrease of acetaminophen. This drug has had the highest consumption and the highest total cost during the study period, with a slight decline in DDD consumption and a great decrease in cost. In our pain management protocols, acetaminophen represents the first-line treatment for mild to moderate acute pain, as it is generally well tolerated, has few interactions and a favourable safety profile.<sup>21,22</sup>

The analysis of analgesic consumption allows us to monitor the use of analgesics in clinical practice, and detect potential deviations. Hospital comparisons of current analgesic consumption would be advantageous but they are scarce and old,<sup>23,24</sup> not allowing us to draw strong conclusions. However, this articles show that opioid consumption is insufficient and an improvement in pain relief is required.

The method used to calculate drug consumption (DDD) is a limitation of the study as it is only an approach of real use (e.g. renal impairment). We assumed that the dispensed medication, accounted as DDD per 100 stays and day, was actually administered to the patient, which is not real in some cases. Besides, DDD is not applicable in paediatric inpatients, who had to be excluded from the study. Other limitation is that efficacy was not assessed in this study. Further studies are necessary to establish whether current analgesic consumption in Spanish hospitals corresponds to the real patient needs, also including paediatric patients.

## Conclusion

Opioid consumption showed an increasing trend in the tertiary teaching hospital during the 5 year period, with fentanyl replacing morphine as the most used opioid. In general, analgesics diminished use due to the decreasing trend of NSAIDs consumptions.

## Conflicts of interest

The authors declare no conflicts of interest.

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