Prescription opioid abuse is not homogeneous due to varying patterns of use and different geographic preferences. Because doctor shopping is one of the main sources of diversion, it has previously been used to estimate drug abuse.

Objectives: The aim of this study was to describe and compare opioid abuse in 2008 using doctor shopping to estimate abuse in 3 French regions.

Setting: Data for this study came from the General Health Insurance (GHI) reimbursement database, which covers 77% of the French population. All individuals living in Provence-Alpes-Côte d’Azur-Corse (PACA), Rhône-Alpes (RA), or Midi-Pyrénées (MP) that received at least one reimbursement for oral opioids from the GHI in 2008 were included.

Methods: Oral opioids under study were opioids for mild to moderate pain (dextropropoxyphene, codeine, tramadol, dihydrocodeine), opioids for moderately severe to severe pain (oral morphine, oxycodone, buprenorphine painkiller, hydromorphone), and opioid maintenance treatments (buprenorphine maintenance, methadone). For a given opioid, the Doctor Shopping Quantity (DSQ) is the quantity obtained by overlapping prescriptions from several prescribers. It is used to estimate the magnitude of abuse. The Doctor Shopping Indicator (DSI) is the DSQ divided by the total dispensed quantity. It is used to estimate the abuse corrected for use.

Results: The total DSQ for opioids in PACA (213.3 DDD/1,000 inhabitants) was twofold superior to that in RA (115.1 DDD/1,000) and in MP (106.2 DDD/1,000). The DSQ of opioids for mild to moderate pain was 75.5DDD/1000 (DSI=1.1%), 19.7DDD/1,000 (DSI=5.0%) for opioids for moderately severe to severe pain, and 55.3DDD/1,000 (DSI=6.2%) for opioid maintenance treatments. Emergent signals of abuse have been observed at a regional level for oxycodone in MP and dihydrocodeine in RA and MP.

Limitations: The main limitation of this study is that the GHI reimbursement database provides information about dispensed and reimbursed prescription drugs, and not necessarily the actual quantity used.

Conclusion: These results confirm important variations in the 3 French regions despite them being geographically close. Besides, they highlight different rates of opioid abuse between opioids for mild to moderate pain, opioids for moderately severe to severe pain, and opioid maintenance treatments, as well as differences within these groups.

Key words: Prescription drug abuse, Opioid abuse, Prescription opioid analgesics, opioids for mild to moderate pain, Opioids for moderately severe to severe pain, Opioid maintenance treatments, Prescription drug database, Doctor shopping
Over the past 10 years the therapeutic use of opioids has escalated as has their abuse and non-medical use (1). However the public health impact of non-medical use and abuse of prescription opioids is not homogeneous due to varying patterns of use and different geographic preferences (2-8). Evaluating opioid abuse at a regional level may facilitate the detection of an emergent medication abuse problem that is restricted to one area before it spreads to other areas. Such an approach may optimize the local intervention strategies due to a better knowledge of determinants involved in abuse and non-medical use such as population characteristics or product availability (3,9).

In order to identify product availability, some studies have focused on the key diversion routes of prescription opioids and shown that the 2 main sources were friends or family and prescription or doctor shopping (10-13). Doctor shopping is when a patient consults several prescribers over the same period of time and thus obtains overlapping prescriptions (14-16). This behavior has been linked to substance abuse-related deaths in Australia (17) and in Ontario (18). Since the establishment of prescription drug monitoring programs in the US, this behavior can be identified (19-22). It has thus become a focus for clinical practice and authorities (23,24). Some years ago, a method that quantifies doctor shopping using the General Health Insurance (GHI) reimbursement database was developed to give the doctor shopping indicator (14,25,26). This quantitative assessment was used to estimate the magnitude of buprenorphine diversion (25) and to assess the impact of a national prescription drug monitoring program for buprenorphine (14). Recently, 2 other studies assessed the relative abuse potential of benzodiazepines in real-life settings using the doctor shopping indicator (26,27).

Even if some studies concerning doctor shopping have been published (15,16,27,28), few involved geographic information which may give a better comprehension of doctor shopping behavior (15).

Product availability is an important determinant of opioid misuse (4,9). The consumption of opioids has increased in France (29) as in other European countries (30,31) raising concerns about their misuse. Therefore this work focused on opioids including opioid analgesics and opiate maintenance treatments.

In this context, we performed a study based on 3 regions in the south of France: Provence-Alpes-Côte d’Azur-Corse (PACA), Rhône-Alpes (RA), and Midi-Pyrénées (MP) which represented a total of 14 million people in 2008.

The main objective of this study was to describe and compare opioid use and abuse using doctor shopping to estimate the abuse over a one year period (2008) in 3 French regions.

**Methods**

**Settings**

Data for this study came from the GHI reimbursement database. The GHI is a public insurance system, which covers 77% of the French population. The remaining part of the French population is insured by other public insurance systems (32). It should be noted that in France, medication is dispensed in a pharmacy and then reimbursed by the GHI, either to the patient or directly to the pharmacist.

Everyone covered by the GHI in 2008 in the PACA (4,054,669), RA (4,732,936), and MP (1,980,913) regions was included. In PACA, RA, and MP, there were respectively 47, 36, and 27 care centers dedicated to drug users. This study analyzed, for every insured inhabitant of these regions, all oral and sublingual forms of prescription opioids dispensed and sent for reimbursement between January 1, 2008 and December 31, 2008. Medications dispensed in hospitals were not included in the GHI reimbursement database. Included medications were oral opioids for mild to moderate pain (codeine combinations [N02AA59], dextropropxphene combinations [N02AC54], dihydrocodeine [N02AA08], tramadol as a single-ingredient drug [N02AX02] or combination [N02AX52]), oral opioids for moderately severe to severe pain (buprenorphine painkiller [N02AE01], hydromorphone [N02AA03], immediate and sustained release oral morphine and morphine syrup [N02AA01], immediate and sustained release oxycodone [N02AA05]), and oral opioid maintenance treatments (methadone syrup, methadone tablets [N07BC02] and buprenorphine used as maintenance treatment [N07BC01]). Fen tanyl was not included because no oral form was available in 2008 in France. Five variables were extracted: the date of dispensing, the CIP code (drug box identification code, which is a French equivalent to the national drug code in the USA), the patient’s anonymous number, the prescriber’s anonymous number, and the quantity of reimbursed medication given as defined daily doses (DDD).

The DDD is the assumed average maintenance dose per day for a drug used according to its main indication in adults; DDD are defined by the World Health Organization (WHO) Collaborating Centre for Drug Statistics...
Methodology, according to the ATC (Anatomical Therapeutic Chemical-code) classification index. One purpose of the ATC/DDD system is to allow comparison of drug consumption statistics at an international level. We used the 2010 version of this index (WHO, 2010) (33).

**Calculation of Doctor Shopping Quantity (DSQ)**

The principle of DSQ calculation is based on the number of overlaps of different prescribers’ prescriptions for a given patient. This is illustrated in the appendix with an example of a fictitious patient with 2 prescribers.

A prescription period is defined for each prescriber/patient couple as the period between the first and the last observed dispensing. This prescription period is not necessarily continuous and may be interrupted. For instance the patient may consult another prescriber if the regular prescriber is on holiday. So when the interval between 2 consecutive dispensings is superior to a threshold, the prescription period is declared interrupted. This threshold is defined as the eightieth percentile of the observed intervals between 2 consecutive dispensings for all prescriber/patient couples. The threshold is calculated separately for each region and for each medication.

In the doctor shopping method, it is assumed that within the quantity obtained by multiple prescribers during overlapping prescription periods, a certain proportion is medically legitimate. For instance, in the case of overlapping prescription periods from 3 different prescribers, it is assumed that one-third of the total quantity is medically legitimate and the remaining two-thirds are obtained using doctor shopping.

Therefore, the DSQ is computed for each patient using the formula:

$$DSQ = \sum \frac{n_i - 1}{n_i} Q_i$$

where $n_i$ is the number of simultaneous prescription periods at the date of dispensing $i$ and $Q_i$ the quantity dispensed.

When there is no overlap between prescription periods of several prescribers for a patient (one or several prescribers with non overlapping prescriptions), $n_i=1$ for all dispensings and therefore DSQ is null.

For a population, the total DSQ is the sum of doctor shopping quantities of all patients. It reflects the magnitude of abuse. It is given in DDD/1,000 inhabitants covered by the GHI per year (DDD/1000) to allow geographical comparison.

The Doctor Shopping Indicator (DSI) is the DSQ divided by total dispensed quantity and reflects the abuse corrected for use. The DSI is considered clinically significant over 1% (27,34). Below this value, we consider that there is no signal of abuse.

Separate analyses were conducted on each medication and each region. Results were computed using SPSS V13.0®.

**Results**

**Opioid User Population**

The number of individuals that received at least one dispensing of oral opioids reimbursed by the GHI in 2008 was 885,941 in PACA (21.8% of the insured population), 945,102 in RA (20.0% of the insured population), and 386,834 in MP (19.5% of the insured population). The male/female ratio was 0.43 in PACA, 0.45 in RA, and 0.44 in MP. The proportion of individuals under 30 years old was 19% in PACA, 18% in RA, and 19% in MP. The proportion of individuals over 60 years old was 30% in PACA, 31% in RA, and 29% in MP. Thus, in the 3 regions studied, there was very little difference observed in the general profile of opioid users.

**Product-Specific Analysis**

**Dispensed Quantity**

For the 3 regions taken together, opioids for mild to moderate pain represented 83.8% (n = 70, 388, 614 DDD) of the total dispensed quantity of opioids, opioids for moderately severe to severe pain represented 5.0% (n = 4, 120, 808 DDD) and opioid maintenance treatments represented 11.2% (n = 9, 536, 221 DDD). The total dispensed quantities in 2008 in PACA, RA, and MP are presented in Table 1.

2.2. Doctor Shopping Quantity

The total DSQ for all oral opioids represented 150.5 DDD/1,000. Opioids for mild to moderate pain represented 50.2% (75.5 DDD/1,000) of the total DSQ for oral opioids, opioids for moderately severe to severe pain represented 13.1% (19.7 DDD/1,000) and opioid maintenance treatments represented 36.7% (55.3 DDD/1,000) (Table 2).
Doctor Shopping Indicator

Opioids with the highest DSI were buprenorphine maintenance (8.0%), oral morphine (5.5%), dihydrocodeine (3.7%), buprenorphine painkiller (2.9%), and oxycodone (2.7%) (Table 2).

Region Specific Analysis

Dispensed Quantity

PACA was the region with the highest total dispensed quantity of opioids per 1,000 insured inhabitants (8331 DDD/1,000), followed by RA (8030 DDD/1,000) and MP (6853 DDD/1,000). As shown in Fig. 1, PACA was the region with the highest dispensed quantity for each medication except for codeine (for which RA had the highest dispensed quantity), methadone, dihydrocodeine, and hydromorphone (for which MP had the highest quantities).

Doctor Shopping Quantity

The total DSQ for opioids was 213.3 DDD/1,000 in PACA, 115.1 DDD/1,000 in RA, and 106.2 DDD/1,000 in MP. According to Fig. 2, the 5 medications with the highest DSQ were buprenorphine maintenance (first in all regions), dextropropoxyphene (second in PACA and RA, and fourth in MP), codeine (second in MP, third in RA, and fifth in PACA), tramadol (third in PACA and MP, and fourth in RA) and oral morphine (fourth in PACA and fifth in RA and MP). PACA was the region with the highest DSQ for all medications except for oxycodone and dihydrocodeine, for which MP had the highest DSQ.

Doctor Shopping Indicator

As shown in Fig. 3, PACA had the highest DSI for all opioids except oxycodone (for which MP had the high-
### Table 2. Dispensed quantity, doctor shopping quantity and doctor shopping Indicator of oral opioids in Provence-Alpes Côte-d'Azur Corsica, Rhône-Alpes and Midi-Pyrénées in 2008.

<table>
<thead>
<tr>
<th></th>
<th>Dispensed quantity (DDD/1000)</th>
<th>Doctor Shopping Quantity (DDD/1000)</th>
<th>Doctor Shopping Indicator (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weak opioid analgesics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dextropropoxyphene</td>
<td>1199</td>
<td>27.6</td>
<td>0.8%</td>
</tr>
<tr>
<td>Codeine</td>
<td>3296</td>
<td>24.1</td>
<td>2.0%</td>
</tr>
<tr>
<td>Tramadol</td>
<td>2131</td>
<td>23.3</td>
<td>1.1%</td>
</tr>
<tr>
<td>Dihydrocodeine</td>
<td>14</td>
<td>0.5</td>
<td>3.7%</td>
</tr>
<tr>
<td><strong>Strong opioid analgesics</strong></td>
<td>395</td>
<td>19.7</td>
<td>5.0%</td>
</tr>
<tr>
<td>Oral morphine</td>
<td>324</td>
<td>17.8</td>
<td>5.5%</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>56</td>
<td>1.5</td>
<td>2.7%</td>
</tr>
<tr>
<td>Buprenorphine painkiller</td>
<td>7</td>
<td>0.2</td>
<td>2.9%</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>9</td>
<td>0.2</td>
<td>1.8%</td>
</tr>
<tr>
<td><strong>Opioid maintenance treatments</strong></td>
<td>891</td>
<td>55.3</td>
<td>6.2%</td>
</tr>
<tr>
<td>Buprenorphine maintenance</td>
<td>626</td>
<td>50.3</td>
<td>8.0%</td>
</tr>
<tr>
<td>Methadone</td>
<td>265</td>
<td>4.9</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

![Dispensed quantity in DDD/1000 of oral opioids Provence-Alpes Côte-d’Azur Corsica, Rhône-Alpes and Midi-Pyrénées in 2008.](image)

Fig. 1. Dispensed quantity in DDD/1000 of oral opioids Provence-Alpes Côte-d’Azur Corsica, Rhône-Alpes and Midi-Pyrénées in 2008.
Fig. 2. Doctor shopping quantity of oral opioids in DDD/1000 Provence-Alpes Côte-d’Azur Corsica, Rhône-Alpes and Midi-Pyrénées in 2008.

Fig. 3. Doctor shopping indicator of oral opioids Provence-Alpes Côte-d’Azur Corsica, Rhône-Alpes and Midi-Pyrénées in 2008.
est DSI) and dihydrocodeine (for which RA and MP had higher DSI).

In each region, the opioids with the highest DSI were buprenorphine maintenance in PACA (11.8%) and RA (5.6%) and oral morphine in MP (5.1%). Oral morphine had the second highest DSI in PACA (7.9%) and the third in RA (3.4%). Oxycodone was second in MP (4.8%), fourth in RA (2.0%) and sixth in PACA (2.5%). Dihydrocodeine was eighth in PACA (1.6%), second in RA (4.2%), and second in MP (4.8%).

**Discussion**

The purpose of this study was to assess the geographical variations of opioid use and abuse in 3 French regions using doctor shopping to estimate abuse. Opioid abuse is a major public health issue, as one fifth of the population received at least one opioid in our study. The key findings of this study were that the total opioid DSQ per inhabitant of PACA (213.3 DDD/1,000) was twofold superior to that in RA (115.1 DDD/1,000) and in MP (106.2 DDD/1,000). The DSQ of opioids for mild to moderate pain was 75.5 DDD/1000 (DSI = 1.1%), 19.7 DDD/1,000 (DSI = 5.0%) for opioids for moderately severe to severe pain, and 55.3 DDD/1000 (DSI = 6.2%) for opioid maintenance treatments. Regional specificities were observed, such as the emergence of oxycodone abuse in MP and dihydrocodeine abuse in RA and MP.

**Geographically-specific Analysis**

Despite a comparable global level of opioid use across the 3 regions (approximately 8000 DDD/1,000 in PACA and RA, 7,000 DDD/1,000 in MP), the total opioid DSQ per inhabitant of PACA (213.3 DDD/1,000) was twofold superior to that in RA (115.1 DDD/1,000) and in MP (106.2 DDD/1,000). Moreover, PACA was the region with the highest DSI for all opioids except oxycodone (higher in MP) and dihydrocodeine (higher in RA and MP). A parallel could be drawn with socio-demographic and economic data presented in Table 3 (35). Indeed, several indicators, such as the number of crimes and offences/1,000 inhabitants, the proportion of the population living in difficult urban areas, the poverty rate, the unemployment rate, and the proportion of individuals covered by the universal complementary health insur-

| Table 3. Socio-demographic and economic characteristics of the general population living in 2008 in Provence-Alpes Côte-d’Azur Corsica, Rhône-Alpes and Midi-Pyrénées |
|----------------------------------|--------|--------|--------|
| **Demographic characteristics**  | PACA   | RA     | MP     |
| Population                       | 5 185 879 | 6 117 200 | 2 838 228 |
| Gender (% of women)              | 52     | 51     | 51     |
| Age>20 (%)                       | 23     | 26     | 23     |
| Age<60 (%)                       | 25     | 21     | 25     |
| **Demographic and economical characteristics** |        |        |        |
| Density (inhabitants/km²)        | 157    | 141    | 63     |
| Urbanization indicator (%)*      | 59     | 35     | 36     |
| Proportion of the population living in difficult urban areas (%) | 8       | 6     | 2     |
| Poverty rate† (%)                | 16     | 12     | 14     |
| Median income per year (€)       | 17 147 | 18 143 | 17 157 |
| Unemployment rate (%)            | 11     | 9      | 9      |
| People covered by the universal complementary health insurance‡ (%) | 7       | 5     | 6     |
| Number of crimes and offences per 10 000 inhabitants | 81     | 58     | 49     |
| **Health characteristics**       |        |        |        |
| Obesity (%)                      | 12     | 12     | 14     |
| Tobacco consumption over 1 cigarette/day (%) | 29     | 27     | 31     |
| Alcohol consumption over 10 times per month (%) | 8       | 9      | 9      |
| Drunkenness over 3 times/year (%) | 24     | 28     | 27     |
| Cannabis consumption over 10 times per month (%) | 10     | 7      | 7      |

*Proportion of the population living in the 3 principal cities
†Proportion of individuals under the poverty threshold (60% of the median standing of living)
‡The universal complementary health insurance is a free complementary health insurance for poor people
ance (a GHI program dedicated to people with little or no income) showed that the economic and social situation was more unfavorable in PACA than in RA and in MP in 2008 (Table 3). Many factors could influence drug abuse and traffic, one of them is the proximity of trade areas such as ports (like Marseille and Nice in PACA) and the borders with Italy for PACA and RA and Spain for MP.

Results found in this study cannot be extrapolated to the whole of France even though areas under study are 3 nearby regions representing 14 million inhabitants and 22% of the French population. However, a future study could apply the doctor shopping method to the entire French territory in order to confirm that this method is efficient in detecting emergent abuse signal in regions. In such a study, geographical variations observed in this study are likely to be amplified and specific cases such as those observed with dihydrocodeine and oxycodone would be multiplied.

Product-Specific Analysis

Opioids for Mild to Moderate Pain

The most used oral prescription opioids were dextropropoxyphene and tramadol. They were respectively second and fourth of all oral opioids regarding their DSQ. However, the DSI for dextropropoxyphene and tramadol was relatively low (respectively 0.8% and 1.1%). In fact, the threshold value of DSI is estimated at 1% with the doctor shopping method, therefore below this value, there is no signal of abuse (27,34). Dextropropoxyphene and tramadol DSI are close to this threshold. Further studies using other abuse indicators are needed in order to confirm or exclude a signal of abuse.

In our study, dihydrocodeine has the second highest DSI in RA and MP. In a study by Pauly et al (36), using several drug abuse-related indicators, dihydrocodeine was first regarding the number of forged prescriptions per million reimbursed DDD in 2008. However, it was seventh regarding the rate of illegal acquisition by OPPIDUM users and fifth regarding the abuse/dependence suspicion rate by OPPIDUM users (36). It was only eighth regarding the DSI. However, first DSI was calculated based on data from PACA only, second the doctor shopping methods used in the 2 studies were not exactly the same. In fact, in the study by Pauly et al (31), a fixed interruption period threshold was used (35 days), while we used a threshold which varied according to the observed period between 2 dispensings.

Opioids for Moderately Severe to Severe Pain

Our study showed that opioids for moderately severe to severe pain represented 5.0% of all opioids dispensed; contrary to the US, where 84.9% of the prescriptions of opioid analgesics are for hydrocodone and oxycodone-containing products (37).

Oral morphine was the opioid for moderately severe to severe pain with the highest dispensed quantity, DSQ, and DSI (Table 2). This is consistent with results of a survey among patients seen in care centers, where 56% of the oral morphine was illegally obtained (38). This is also consistent with the multi-indicator study where morphine was the only opioid to obtain the highest values for several drug abuse-related indicators (36).

The second opioid for moderately severe to severe pain according to its DSQ and the third according to its DSI was oxycodone. In MP it had the highest DSI of all oral opioids. It has been on the market in France since 2001. Its use increased fourfold from 2004 to 2008 (29). To our knowledge, no abuse signal has ever been detected regarding oxycodone in France. In 2008, oxycodone was fifth of all opioid analgesics regarding the number of forged prescriptions per million reimbursed DDD and its use was not declared by any patients seen in centers dedicated to drug users in the OPPIDUM survey (36).

If our results are validated by further analyses on oxycodone and dihydrocodeine abuse, they could suggest that the doctor shopping method allowed the detection of an emerging signal of abuse at a geographically specific level. Moreover, further research could assess whether the signals of abuse are transient or not using data from 2009 and 2010.

Opioid Maintenance Treatments

Concerning opioid maintenance treatments, buprenorphine maintenance had the highest magnitude of abuse (DSQ=50.3DDD/1,000) and abuse corrected for use (DSI=8.0%) of all opioids. In France, abuse of buprenorphine is acknowledged and has been extensively studied (39,40). Several reasons could explain the higher DSQ and DSI of buprenorphine compared to methadone. Firstly, methadone is registered as a narcotic whereas buprenorphine is not. Secondly, buprenorphine maintenance can be prescribed by every physician without any training. On the contrary, the initiation of methadone treatment is only authorized in specialized care centers for substance abuse or in hospitals. Third, the buprenorphine maintenance formula-
tion is a tablet (which can be crushed, snorted, or injected) whereas methadone was only available as syrup until April 2008, when a tablet form was introduced. As a consequence, methadone is less used in France than buprenorphine.

**Strengths and Limitations**

The GHI reimbursement database is a large database that includes 77% of the French population (32). We cannot exclude the risk of underestimation of doctor shopping if doctor shoppers do not ask for opioid reimbursement to avoid checks by the GHI fraud department. Moreover, it is probable that poor people could not afford to pay the entire cost of their medication. So, people living in a lower socio-economic area may request reimbursement more frequently than those living in a higher socio-economic area, leading to a risk of selection bias. However, the general health insurance and other public health insurances cover every French inhabitant, whatever the socio-economic status. Consequently, to pay for medication in cash and not ask for reimbursement would be highly suspect for a pharmacist, particularly in the case of opioid dispensing. Therefore, we assumed that selection bias has a negligible impact on our results.

Additional validity regarding dispensed quantities is provided by a study that assessed the trend in opioid use from 2004 to 2008 using data from the national GHI database. In this study, the total reimbursed opioid quantity was 8712 DDD/1,000 in 2008 (29), whereas in our study it was 7851DDD/1000. The difference corresponds to the non-oral reimbursed opioids quantity.

The doctor shopping method has been slightly modified in this study. In the previous studies using the doctor shopping method, the main assumption was the threshold defining prescription interruption, fixed at 35 days (27). In a study where the doctor shopping method was applied to benzodiazepines, sensitive analyses using different threshold values showed no major variations (27). However, we consider that this threshold value should not be applied to all opioids. Indeed their indications are very different, which suggests that the modalities of use could vary between opioids. Moreover, the maximal dispensing duration for opioids is limited to 28 days except for methadone (14 days) and buprenorphine painkiller (30 days). Thus, in this study, the threshold value was a function of the observed periods between 2 consecutive dispensings (and therefore less arbitrary).

A limitation of doctor shopping to estimate abuse is that part of the DSQ may have been received by individuals for legitimate reasons, such as loss of prescription or the patient or physician being on vacation for instance. In addition, doctor shopping is not the only source for prescription drug diversion, although most studies suggested that it is one of the principal means (12,13,41). Moreover, federal agencies in the US considered that diverted drugs enter the illegal market primarily through “doctor shoppers”, inappropriate prescribing practices by physicians, and improper dispensing by pharmacists (1).

**Conclusion**

Magnitude of abuse and abuse corrected for use (estimated respectively by DSQ and DSI) provide different and complementary information. First, these results confirm important variations among the 3 French regions although they are geographically close. Next, they highlight different rates of opioid abuse between opioids for mild to moderate pain, opioids for moderately severe to severe pain, and opioid maintenance treatments, as well as differences within these groups. This methodology should be extended to a wider geographical area including the northern half of France, and even overseas territories, to assess these variations between all French regions. Should oxycodone and dihydrocodeine abuse be confirmed by these analyses, it would confirm that the doctor shopping method is efficient in detecting regional emergent abuse signals.

**Acknowledgements**

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Appendix

Example of calculation of the Doctor Shopping Quantity

**Step 1**: determination of prescription periods (from the first to the last prescription by a prescriber)

<table>
<thead>
<tr>
<th>Time (days)</th>
<th>Period of prescription by prescriber A = 56 days</th>
<th>Period of prescription by prescriber B = 56 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Step 2**: calculation of \( n_i \) (number of simultaneous prescription periods at the date of dispensing \( i \)) for each dispensing

For example, \( n_i = 2 \) at days 14, 28, 42 and 56 because of overlap of prescription periods from prescribers A and B and \( n_i = 1 \) at days 0 and day 70.

<table>
<thead>
<tr>
<th>Time (days)</th>
<th>( n_i )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>28</td>
<td>2</td>
</tr>
<tr>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>56</td>
<td>2</td>
</tr>
<tr>
<td>70</td>
<td>1</td>
</tr>
</tbody>
</table>

**Step 3**: calculation of quantities

**Dispensed quantity (\( Q_i \))**
- Prescriber A: \( 3 \times 8 \text{mg} = 24 \text{mg} \)
- Prescriber B: \( 3 \times 8 \text{mg} = 24 \text{mg} \)

\( Q_i = 24 + 24 = 48 \text{mg} \)

**Doctor Shopping Quantity (DSQ)**

To take into account that a proportion of the quantity of M is medically legitimate, at each dispensation date \( i \), the DSQ is computed using this formula

\[
\text{DSQ} = \sum \left( \frac{n_i - 1}{n_i} \right) Q_i
\]

It is null when \( n_i = 1 \) (at dates of dispensing 0 and 70)

It is equal to \( \frac{1}{2} Q_i \) when \( n_i = 2 \) (at dates of dispensing 14, 28, 42 and 56)

For each patient

\[
\text{DSQ} = \sum \left( \frac{n_i - 1}{n_i} \right) Q_i = (1/2*8) \text{ (day 14)} + (1/2*8) \text{ (day 28)} + (1/2*8) \text{ (day 42)} + (1/2*8) \text{ (day 56)} = 16 \text{mg}
\]
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References


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