The Prevalence of Fentanyl in Drug-Related Deaths in Philadelphia 2004–2006

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Abstract Fentanyl is an increasingly common drug of abuse. The Philadelphia Medical Examiner's Office reported 252 drug-related deaths in Philadelphia that tested positive for fentanyl during the year 2006 in comparison to 22 and 19 in 2005 and 2004, respectively. We reviewed the data from 2004 to 2006 from the Philadelphia Medical Examiner's office. Key words such as fentanyl, drug, cocaine, ethanol, medic (medication), tox (intoxication), or poison were used as search words. In comparison to 2004 and 2005 data, there was a statistically significant increase in number of drug-related deaths (DRDs) and the percentage of DRDs that tested positive for fentanyl in 2006. We postulate that the

increase in DRDs in 2006 may be related to increase use or abuse of fentanyl, lack of general public awareness that fentanyl is a potent opioid, inadequate dose of naloxone and/or the surge of clandestinely manufactured fentanyl.

Keywords Fentanyl · Drug-related deaths

Introduction

New patterns of drug abuse emerge frequently, as has been seen with widespread use of ecstasy, Oxycontin, and, more recently, fentanyl. Fentanyl is a synthetic opioid with higher potency than morphine and heroin that was first used in the USA in 1968 as an intravenous anesthetic/analgesic medication [1]. It binds to mu-receptors producing analgesia and sedation. Other opioid effects include euphoria, respiratory depression, hypotension, and bradycardia. Due to fentanyl's high potency, a larger dose of naloxone may be required to reverse its effects following overdose.

The abuse potential of fentanyl was first recognized in the mid-1970s among health care professionals [1, 2]. In the beginning of 1979, an analog of fentanyl (alpha-methylfentanyl) was synthesized and distributed as a substitute for heroin, known as China White [1, 3]. In 2006, the US Department of Justice National Drug Intelligence Center reported that hundreds of non-fatal and fatal overdose cases were related to clandestinely produced fentanyl. There were at least nine US clandestine fentanyl laboratories seized between 1990 and 2005. Seven of these laboratories were found in California, Kansas, and Pennsylvania. Mexico was also reported to be another source of clandestinely produced fentanyl and US intelligence agencies believed that this might have contributed to the recent rise of fentanyl-related deaths in the USA [4, 5].

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In April 2006, the Philadelphia Medical Examiner's Office noted a surge in death cases which tested positive for fentanyl. Our purpose is to report the number of fentanyl-positive death cases in 2006 compared to 2004 and 2005.

Methods

We reviewed the 2004 to 2006 data from the Philadelphia Medical Examiner's office. All drug-related deaths (DRDs) and deaths that tested positive for fentanyl were included. DRDs are defined as deaths caused by adverse effects from medication overdose, illicit drug use, and/or alcohol poisoning. All deaths tested positive for fentanyl includes any death where fentanyl was present. The data were stored and organized in Coroners and Medical Examiners (VertiQ Software LLC, Morgan Hill, CA, USA). Key words such as fentanyl, drug, cocaine, ethanol, medic (medication), tox (intoxication), or poison were used as search words. An one-way ANOVA was used to test for significant differences in DRDs tested positive for fentanyl and all deaths that tested positive for fentanyl in 2004, 2005, and 2006.

Results

In 2006, there were 295 deaths tested positive for fentanyl and 252 of them (84%) were DRDs compared to 37 deaths tested positive for fentanyl and 22 of them (59%) were DRDs in 2005; 40 deaths tested positive for fentanyl and 19 of them (48%) were DRDs in 2004. We found statistical significant differences (p value=0.000) in fentanyl-positive deaths and fentanyl-positive DRDs (p value=0.001) among the 3 years.

Discussion

Comparing 2006 and 2005 data, the number of fentanyl-positive deaths and number of fentanyl-positive DRDs increased by eight- and 11-fold, respectively. Comparing 2006 and 2004 data, the number of fentanyl-positive deaths and number of fentanyl-positive DRDs increased by seven- and 13-fold, respectively. We postulate that the increase in fentanyl-positive deaths and fentanyl-positive DRDs may be caused by: increase use or abuse of fentanyl, lack of general public awareness that fentanyl is a potent opioid, inadequate dose of naloxone and/or the surge of clandestinely manufactured fentanyl.

Schumann et al. reported 338 fentanyl-related deaths at the Cook County Medical Examiner's Office during the period of April 2005 to December 2006. A surge of

fentanyl-related deaths was also reported during the period of April to July 2006 with an average of 39.5 cases per month [6]. In a retrospective study of 112 fentanyl-related deaths from 2002 to 2004, Martin et al. reported blood concentration of fentanyl (3.0–383 $\mu\text{g/L}$) in 54 cases and the cause of death was reported as fentanyl intoxication. Routes of administration included transdermal, oral/trans-mucosal, intravenous (IV) injection, and inhalation of the fentanyl patches [7]. In 2003, Kuhlman et al. reported a fourfold increase (three in 2000 to 12 in 2002) of fentanyl-related medical examiner cases in southwestern Virginia. Decedents' fentanyl blood concentration ranged from 2 to 48 $\mu\text{g/L}$ [8]. Overall, the blood concentration reported in the above studies exceeded the mean maximal concentration 2.5 ng/mL ($\mu\text{g/L}$) of fentanyl patch 100 $\mu\text{g/h}$ reported by the manufacturer [9].

Limitations

1. We did not report the blood concentration of fentanyl in this study. Even though there is a marked increase in DRDs as shown in our data, we were unable to definitely conclude that fentanyl was the sole cause of death in the decedents.
2. Limited medical histories of decedents were available to the Philadelphia Medical Examiner's Office, which may mislead the medical examiner's decision on performing toxicology screen on the decedents. As a result, the number of deaths deemed drug related and tested for fentanyl may be falsely low.

Conclusion

The number of fentanyl-positive deaths and fentanyl-positive DRDs increased significantly in 2006 compared to 2004 and 2005.

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