because smoking cessation is the most effective tool for risk reduction, be it cancer risk, cardiovascular risk, or progression of COPD. This potentially makes a negative outcome of screening counterproductive because it might be viewed as an incentive to continue smoking. However, smoking cessation remains difficult in any setting. Adherence is low and the outcome of screening has little long-term influence on smoking behavior.[1]

It recently has been shown that cardiovascular risk in smokers is increased, and this increase holds for any CAC score.[2] Whereas the increased risk in smokers might suggest cardiovascular screening is not worthwhile in this population, the same study showed that mortality still increases substantially with higher CAC scores, even in smokers. These findings are corroborated by results from others,[3] even in the setting of nongated chest CT scans used for cancer screening.

Although the cardiovascular risk is increased on average, there is wide variation among smokers, which makes screening potentially useful to specifically detect those at high risk. Because smoking and CAC are independent risk factors, prediction will improve and not worsen when smoking and CAC and non-CAC are combined.

Computed tomography technology currently used for lung cancer screening is limited by lack of electrocardiography gating. While this limitation reduces its value for excluding coronary calcium, the presence of larger amounts of calcium can be reliably detected, and the absolute risk of cardiovascular disease in individuals with high CAC scoring on screening scans is increased. Therefore, screening CT scans can readily establish increased risk. The real question is not whether to use the additional information provided by lung cancer screening but whether a highly positive result will be able to trigger treatment that can actually reduce this increased risk.

For osteoporosis, quantitative CT of the lumbar spine had been superior to DEXA for measuring bone architecture and density.[4] Technical and financial reasons have led to the widespread use of DEXA and to the decline of CT as an investigative tool. While osteoporosis assessment is generally performed on the lumbar spine, the thoracic spine is also affected and is readily assessable by chest CT. Direct implementation is hampered by the limited data[5] available from most individuals, but it is not a reason why CT of the thoracic spine should not be able to detect osteopenia or osteoporosis.

Although it is debated as to whether early diagnosis of COPD is useful, COPD and emphysema are independent predictors of lung cancer; therefore, detection may aid a more personalized and cost-effective lung cancer screening regimen.

Independent of whether or not one supports CT-based lung cancer screening, extending this screening to other diseases that can be detected early by chest CT will provide valuable epidemiological data at least. At best, it may contribute to secondary prevention of some of the most debilitating diseases in the developed world.

Onno M. Mets, MD, PhD
Pim A. de Jong, MD, PhD
Mathias Prokop, MD, PhD

Author Affiliations: Department of Radiology, University Medical Center Utrecht, Utrecht, the Netherlands (Drs Mets and de Jong) (pimdejong@gmail.com); and Department of Radiology, Radboud University Nijmegen Medical Center, Nijmegen, the Netherlands (Dr Prokop).

Conflict of Interest Disclosures: The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Dr Prokop reported receiving grants or having grants pending from Philips Medical Systems and Toshiba Medical Systems; serving on speakers' bureaus for Bracco, Toshiba Medical Systems, Bayer-Schering, CME Science, and Philips Medical Systems; receiving travel expenses from Toshiba Medical Systems, Philips Medical Systems, European School of Radiology, and various conferences; and receiving fees for reading a study from Bracco. Drs Mets and de Jong reported no disclosures.

1. van der Aalst CM, van Klaveren RJ, van den Bergh KA, Willemsen MC, de Koning HJ. The impact of a lung cancer computed tomography screening result on smoking abstinence. *Eur Respir J*. 2011;37(6):1466-1473.
2. McEvoy JW, Blaha MJ, Rivera JJ, et al. Mortality rates in smokers and nonsmokers in the presence or absence of coronary artery calcification. *JACC Cardiovasc Imaging*. 2012;5(10):1037-1045.
3. Shemesh J, Henschke CI, Shaham D, et al. Ordinal scoring of coronary artery calcifications on low-dose CT scans of the chest is predictive of death from cardiovascular disease. *Radiology*. 2010;257(2):541-548.
4. Link TM. Osteoporosis imaging: state of the art and advanced imaging. *Radiology*. 2012;263(1):3-17.
5. Budoff MJ, Hamirani YS, Gao YL, et al. Measurement of thoracic bone mineral density with quantitative CT. *Radiology*. 2010;257(2):434-440.

RESEARCH LETTER

Pharmaceutical Overdose Deaths, United States, 2010

To the Editor: Data recently released by the National Center for Health Statistics show drug overdose deaths increased for the 11th consecutive year in 2010.[1] Pharmaceuticals, especially opioid analgesics, have driven this increase.[2] Other pharmaceuticals are involved in opioid overdose deaths, but their involvement is less well characterized. Using 2010 mortality data, we describe the specific drugs involved in pharmaceutical and opioid-related overdose deaths.

Methods. Data are from the National Vital Statistics System multiple cause-of-death file, which is based on death certificates submitted by medical examiners or coroners.[1] Drug overdose deaths were those assigned an underlying cause of death using the *International Classification of Diseases, Tenth Revision (ICD-10)* codes X40-X44 (unintentional), X60-X64 (suicide), X85 (homicide), and Y10-Y14 (undetermined intent). Pharmaceutical-related overdose deaths were those assigned specific *ICD-10* codes T36-T39, T40.2-T40.4, T41-T43.5, and T43.8-T50.8; psychotherapeutic and central nervous system pharmaceuticals were defined as T40.2-T40.4, T42, T43.0-T43.5, T43.8, T43.9; and opioid analgesics were those assigned codes T40.2-T40.4. Pharmaceutical deaths by this definition are predominately due to prescription drugs; a small minority involve over-the-counter or illicit drugs combined with prescription drugs in the same *ICD-10* T codes. Institu-

tional review board approval was waived because no personal identifiers were involved.

Results. In 2010, there were 38 329 drug overdose deaths in the United States; most (22 134; 57.7%) involved pharmaceuticals; 9429 (24.6%) involved only unspecified drugs. Of the pharmaceutical-related overdose deaths, 16 451 (74.3%) were unintentional, 3780 (17.1%) were suicides, and 1868 (8.4%) were of undetermined intent. Opioids (16 651; 75.2%), benzodiazepines (6497; 29.4%), antidepressants (3889; 17.6%), and antiepileptic and antiparkinsonism drugs (1717; 7.8%) were the pharmaceuticals (alone or in combination with other drugs) most commonly involved in pharmaceutical overdose deaths (**Table**). Among overdose deaths involving opioid analgesics, the pharmaceuticals most often also involved in these deaths were benzodiazepines (5017; 30.1%), antidepressants (2239; 13.4%), antiepileptic and antiparkinsonism drugs (1125; 6.8%), and antipsychotics and neuroleptics (783; 4.7%).

Opioids were frequently implicated in overdose deaths involving other pharmaceuticals. They were involved in the majority of deaths involving benzodiazepines (77.2%), antiepileptic and antiparkinsonism drugs (65.5%), antipsychotic and neuroleptic drugs (58.0%), antidepressants (57.6%), other analgesics, antipyretics, and antirheumatics (56.5%), and other psychotropic drugs (54.2%). Among overdose deaths due to psychotherapeutic and central nervous system pharmaceuticals, the proportion involving only a single class of such drugs was highest for opioids (4903/16 651; 29.4%) and lowest for benzodiazepines (239/6497; 3.7%) (**Figure**).

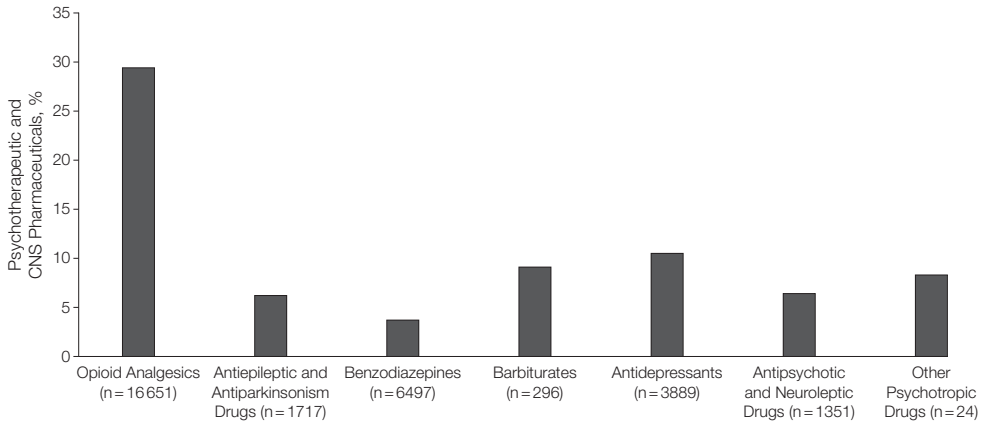
Comment. Death certificate data have limitations,[3] but they are the sole source for detailed death information at the national level. This analysis is limited by the 25% of death certificates in which the type of drugs involved was not specified, an omission due to lack of toxicological testing or failure to record the results of such tests on the death certificate. Therefore, the numbers reported in this analysis are undercounts. Additionally, the degree to which drugs are specified on death certificates might vary across the United States and therefore differentially undercount types of drugs more common in areas in which death certificates are less complete. This might affect the ranking of some pharmaceuticals in the Table.

Table. Specific Drug Involvement in Pharmaceutical Overdose Deaths, United States, 2010

Drug or Drug Class	No. (%)[a]		Opioid Analgesic Involvement in Deaths for Specific Drugs, No./Total (%)
	Drug Involvement in Pharmaceutical Overdose Deaths	Specific Drug Involvement in Opioid Analgesic–Related Overdose Deaths	
All pharmaceuticals (T36-T39, T40.2-T40.4, T41-T43.5, T43.8-T50.8)	22 134 (100.0)	NA	16 651/22 134 (75.2)
Opioid analgesics (T40.2-T40.4)	16 651 (75.2)	16 651 (100.0)	16 651/16 651 (100.0)
Benzodiazepines (T42.4)	6497 (29.4)	5017 (30.1)	5017/6497 (77.2)
Antidepressants (T43.0-T43.2)	3889 (17.6)	2239 (13.4)	2239/3889 (57.6)
Antiepileptic and antiparkinsonism drugs (T42.0-T42.2, T42.5-T42.8)	1717 (7.8)	1125 (6.8)	1125/1717 (65.5)
Systemic and hematological drugs (T45)	1591 (7.2)	699 (4.2)	699/1591 (43.9)
Antipsychotic and neuroleptic drugs (T43.3-T43.5)	1351 (6.1)	783 (4.7)	783/1351 (58.0)
Acetaminophen (T39.1)	881 (4.0)	405 (2.4)	405/881 (46.0)
Respiratory drugs (T48.3-T48.7)	487 (2.2)	143 (0.9)	143/487 (29.4)
Cardiovascular drugs (T46)	354 (1.6)	57 (0.3)	57/354 (16.1)
Barbiturates (T42.3)	296 (1.3)	148 (0.9)	148/296 (50.0)
Autonomic nervous system drugs (T44)	263 (1.2)	110 (0.7)	110/263 (41.8)
Nonsteroidal anti-inflammatory drugs (T39.0, T39.2, T39.3)	228 (1.0)	53 (0.3)	53/228 (23.2)
Anesthetics and therapeutic gases (T41)	195 (0.9)	49 (0.3)	49/195 (25.1)
Hormones, insulins, glucocorticoids (T38)	147 (0.7)	10 (0.1)	10/147 (6.8)
Anti-infectives (T36-T37)	114 (0.5)	44 (0.3)	44/114 (38.6)
Diuretics and other drugs, medicaments, and biological substances (T50.0-T50.8)	56 (0.3)	27 (0.2)	27/56 (48.2)
Topical drugs (T49)	34 (0.2)	6 (0.04)	6/34 (17.6)
Other psychotropic drugs (T43.8, T43.9)	24 (0.1)	13 (0.1)	13/24 (54.2)
Muscle relaxants (T48.0-T48.2)	24 (0.1)	4 (0.02)	4/24 (16.7)
Other analgesics, antipyretics, antirheumatics (T39.4, T39.8, T39.9)	23 (0.1)	13 (0.1)	13/23 (56.5)
Gastrointestinal drugs (T47)	6 (0.03)	2 (0.01)	2/6 (33.3)

Abbreviation: NA, data not applicable.
[a]Deaths are not mutually exclusive. Deaths involving more than 1 drug or drug class are counted multiple times.

Figure. Percentage of Overdose Deaths for Specific Psychotherapeutic and Central Nervous System (CNS) Pharmaceuticals That Involved Only a Single Drug Class, United States, 2010



This analysis confirms the predominant role opioid analgesics play in pharmaceutical overdose deaths, either alone or in combination with other drugs. It also, however, highlights the frequent involvement of drugs typically prescribed for mental health conditions such as benzodiazepines, antidepressants, and antipsychotics in overdose deaths. People with mental health disorders are at increased risk for heavy therapeutic use, nonmedical use, and overdose of opioids.[4-6] Screening, identification, and appropriate management of such disorders is an important part of both behavioral health and chronic pain management. Tools such as prescription drug monitoring programs and electronic health records can help clinicians to identify risky medication use and inform treatment decisions, especially for opioids and benzodiazepines.

Christopher M. Jones, PharmD
Karin A. Mack, PhD
Leonard J. Paulozzi, MD

Author Affiliations: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, Atlanta, Georgia (fjr0@cdc.gov).
Author Contributions: Dr Jones had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Jones, Paulozzi.
Acquisition of data: Jones.
Analysis and interpretation of data: Jones, Mack, Paulozzi.
Drafting of the manuscript: Jones.
Critical revision of the manuscript for important intellectual content: Jones, Mack, Paulozzi.
Statistical analysis: Jones.
Administrative, technical, or material support: Mack, Paulozzi.
Study supervision: Jones.
Conflict of Interest: The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.
Funding/Support: The US Centers for Disease Control and Prevention funded this study.
Role of the Sponsor: The US Centers for Disease Control and Prevention supported the staff responsible for the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript.
Disclaimer: The views expressed in this article are those of the authors and do not necessarily reflect the official position of the US Centers for Disease Control and Prevention.

1. Centers for Disease Control and Prevention. *National Vital Statistics System. 2010 Multiple Cause of Death File.* Hyattsville, MD: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2012.
2. Paulozzi LJ, Jones C, Mack K, Rudd R; Centers for Disease Control and Prevention (CDC). Vital signs: overdoses of prescription opioid pain relievers—United States, 1999-2008. *MMWR Morb Mortal Wkly Rep*. 2011;60(43):1487-1492.
3. Wysowski DK. Surveillance of prescription drug-related mortality using death certificate data. *Drug Saf*. 2007;30(6):533-540.
4. Edlund MJ, Martin BC, Fan MY, Braden JB, Devries A, Sullivan MD. An analysis of heavy utilizers of opioids for chronic noncancer pain in the TROUP study. *J Pain Symptom Manage*. 2010;40(2):279-289.
5. Becker WC, Sullivan LE, Tetrault JM, Desai RA, Fiellin DA. Non-medical use, abuse and dependence on prescription opioids among US adults: psychiatric, medical and substance use correlates. *Drug Alcohol Depend*. 2008;94(1-3):38-47.
6. Bohnert AS, Valenstein M, Bair MJ, et al. Association between opioid prescribing patterns and opioid overdose-related deaths. *JAMA*. 2011;305(13):1315-1321.