APPENDIX A:
IMPACT OF CHANGES IN THE DAWN DRUG VOCABULARY

This issue of *ED Trends from DAWN* introduces major changes in content that were designed to provide more information in better formats. These improvements are a response to feedback received from DAWN consumers. Although not every request could be accommodated, we have tried to address the most common requests raised by users.

Before such dramatic changes were possible, a change in the underlying data was necessary. A critical review and, ultimately, replacement of the DAWN drug vocabulary was essential to our efforts to improve the content of DAWN publications. The drug vocabulary is, quite literally, the language—the codes and terminology—that DAWN uses to record and classify drugs and other substances reported by participating facilities. The "old" DAWN drug vocabulary had evolved but deteriorated over time.

In this section, we describe the new drug vocabulary, discuss the problems it was designed to solve, and demonstrate how it will be used in publications such as *ED Trends from DAWN*. We begin by describing the process we followed to develop a new drug vocabulary, including the objectives that guided our decision making. This is followed by an overview of the new table formats and a description of their content. The impact of the new drug vocabulary on estimates published previously is reviewed in Appendix B. This publication presents revised estimates for the years 1994 through 2000 for the first time using the new drug vocabulary.

BACKGROUND

Every aspect of our initiative to improve DAWN must deal with the tension between consistency and change. On the one hand, maintaining continuity in a statistical series is important, and this argues for keeping things the same. On the other hand, improvements are desirable when the old ways of doing things are limited or flawed. But improvement often means sacrificing continuity. All of our deliberations on redesign issues acknowledge this tension.

The old drug vocabulary contained about 8,000 specific substances reported to DAWN over nearly 3 decades of continuous operation. It also included classification schemes intended for grouping similar drugs into categories for publication of DAWN estimates and for internal analyses. In recent years, our efforts to improve DAWN publications and respond to special requests for information (especially those from Federal agencies such as the Food and Drug Administration and the Office of National Drug Control Policy) provided a growing body of evidence of how poorly the old drug vocabulary carried out these intentions.

To meet the current information needs of DAWN users, a drug vocabulary must meet 4 objectives. It must be:

- Useful for reporting, both for recurring publications and for special requests,
- Accurate,

- User friendly, and
- Easy to maintain.

In 1999, an internal DAWN Workgroup composed of OAS staff and representatives from the two DAWN contractors convened to evaluate the old DAWN drug vocabulary and a design for a replacement that had been proposed in 1997.[19] The workgroup's analysis of the old vocabulary's design, content, and functioning concluded that reclamation was not a viable option.

The old drug vocabulary met none of the 4 objectives for a drug vocabulary. Its major flaws included:

- Multiple classification schemes that required reprogramming for virtually all standard and custom tabulations. The system included:
  - Multiple classification methods, none of which were complete or adequate for reporting, and
  - Significant classification errors (discussed in detail later in this publication).
- Inadequate standards for maintenance that resulted in the inclusion and retention of
  - Ambiguous and nonspecific terms (e.g., "heart pill," "thought organizer"),
  - Obsolete terms (about 4,000 terms last used in the 1970s and 1980s), and
  - Spelling errors (e.g., separate entries for Rohypnol and Rohypnal).

Guided by the 4 objectives, the DAWN Workgroup agreed that a new approach and a new drug vocabulary were required. We concluded that an externally maintained code set—one designed and maintained by subject matter experts apart from DAWN—would serve DAWN's needs better than a system developed and maintained in-house. An external code set would meet the objectives for accuracy and ease of maintenance while minimizing development time and cost.

There were few external code sets from which to choose, and none met DAWN's needs entirely. Deliberations of the Computer-based Patient Records Workgroup (CPR-WG) of the National Committee on Vital and Health Statistics (NCVHS)[20] coincided with our search. Pursuant to the Health Insurance Portability and Accountability Act of 1996, CPR-WG was investigating the standards necessary to facilitate the development of computer-based patient record systems in order to report on these to Congress. In May 1999, the CPRWG held hearings on terminologies and code sets, including those for drugs.[21]

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[19] Originally, the goal was to replace the old drug vocabulary with a new, improved version that would continue to be developed and maintained in-house for DAWN. A conceptual design for this new version was proposed in October 1997. However, its implementation ran into obstacles and that activity stalled. The DAWN Workgroup ultimately rejected the replacement proposed in 1997 because it failed to meet the 4 objectives.

[20] The NCVHS is a public advisory committee to the U.S. Department of Health and Human Services.

[21] The work of the CPR-WG, in particular, these hearings were instrumental in our search for a drug vocabulary for DAWN. More information on the hearings is available at http://ncvhs.hhs.gov/990517ag.htm. The final report of the CPR-WG underscores the

The CPR-WG identified 3 terminologies for drugs. Of these, only the terminology produced by Multum Information Services met all 4 of our objectives and provided a framework onto which components that are unique to substance abuse and DAWN could be added. The latter include street names for illicit substances, metabolites commonly reported in DAWN mortality data, household products and other non-medicinal substances, and substances classified based on their route of administration as "inhalants."

DAWN'S NEW DRUG REFERENCE VOCABULARY

We adopted the Multum *Lexicon*, a drug vocabulary and classification tool developed and maintained by Multum Information Services, Inc., a private sector firm.[22] Multum distributes the *Lexicon* (a complete database in Microsoft Access format) and regular updates through its website. At the time of its adoption, Multum permitted use of its *Lexicon* free of charge; a license agreement specified the terms required of users. We identified no impediments to our use of the *Lexicon* or compliance with the Multum license agreement, which permitted redistribution and modification of the *Lexicon*. In accordance with the license agreement, DAWN publications, tabulations, and software applications cite the Multum *Lexicon* as the source and basis for the DAWN drug vocabulary. A copy of the license agreement is reproduced in Appendix G.

DAWN actually uses only a fraction of the Multum *Lexicon* because DAWN case reports typically lack the most precise drug product information. For example, DAWN case reports supply drug names, but not strength or dosage, so it is not feasible to code drugs at the granularity of National Drug Codes (NDCs), even though the Multum *Lexicon* includes such detail. On the other hand, the specificity of drug information reported to DAWN varies depending on the detail available in the source documents, that is, ED medical records or death investigation files. The Multum *Lexicon* not only accommodates such variability but it provides a consistent method for aggregating very detailed information (such as brands) into consistent generic drug categories.

To accommodate DAWN data on substances that are not part of the Multum *Lexicon*, we have adopted the Multum *Lexicon* structure and designed a drug database that:

- Incorporates Multum *Lexicon* content for:
  - generic names—e.g., ibuprofen,
  - brand or trade names—e.g., Advil
  - 3-level nested categories—e.g., for ibuprofen:

    central nervous system agents (level 1)
    analgesics (level 2)
    nonsteroidal anti-inflammatory agents (level 3)
- Adds other DAWN reportable substances in a compatible structure.

limitations of extant terminologies for drugs. The final report of the CPR-WG, *Uniform Data Standards for Patient Medical Record Information*, is available at http://ncvhs.hhs.gov/hipaa000706.pdf. The discussion of drug terminologies is found on pages 33-34.

[22] Multum Information Services is a subsidiary of the Cerner Corporation and a developer of clinical drug information systems and a drug knowledge base. More information is available at http://www.multum.com.

The result of this combination of the Multum *Lexicon* and DAWN-specific substances is referred to as the DAWN *Drug Reference Vocabulary*.

All drug entries in DAWN were translated into the new vocabulary. When possible, automated procedures were used to make this translation. When necessary, drug entries were assigned manually. All assignments were subjected to multiple, iterative layers of quality control. At each iteration, multiple years of DAWN data were translated into the new vocabulary and estimates produced; then, the components of each new drug and drug category were evaluated for validity and consistency. Then, all necessary changes were implemented, and the process repeated. When necessary, early decisions about assignment and classification of DAWN-specific substances were revisited, reevaluated, and revised. For example, the method for coding and classifying inhalants was revised several times. Rules for maintenance became a natural by-product of the assignment and quality control process.

The final step in this development process was to create new DAWN analytic files from 1994 forward with all drug information recoded to the new reference vocabulary using a cross-reference developed for this purpose.[23] These became the basis of estimates reported here and in subsequent publications.[24]

IMPACT OF THE DRUG VOCABULARY ON DAWN PUBLICATIONS

Changing the way DAWN codes and classifies drugs provided the optimal opportunity to improve the content in recurring DAWN publications. The format of the tables presented here for the first time is quite different from that used in prior DAWN publications. We are replacing several old table formats (all containing similar information arrayed in different ways) with one standard format. Overall, this standardization will make maintenance and production of DAWN publications more efficient. More importantly, it will make finding information easier for consumers.

In general, the new tables and this new publication were designed to address specific problems or limitations of the previous table and publication formats. They are designed to achieve 5 goals:

1. HIGHLIGHT ILLICIT DRUGS OF SPECIAL INTEREST

Issues

- Illicit drugs of special policy interest (e.g., cocaine, marijuana, heroin, methamphetamine) were scattered in published tables, and the locations of these drugs varied from table to table. It was difficult for users to locate and compare these drugs of interest.

[23] Users of DAWN raw data will receive copies of the recoded analytic files, the cross-reference, and a copy of the reference vocabulary, with updates as they occur. The reference vocabulary is maintained in Microsoft Access.

[24] Since this activity has proceeded in parallel with a larger initiative to evaluate major design aspects of DAWN (with the ultimate goal being a redesigned DAWN), an important question is whether this new vocabulary will serve the needs of the new DAWN. For example, the DAWN redesign is considering changes to the case definition that would make adverse drug reactions reportable. We believe that the Multum *Lexicon* will be an even greater asset, given such a change, because the Multum vocabulary is comprehensive, its framework is robust, and it is updated as new pharmaceuticals come to market. Moreover, a reference vocabulary such as this is essential for the electronic data collection technologies that will be an integral component of DAWN's future.

- Many low-frequency and/or emerging drugs of abuse did not appear in published tables at all. As a result, we received many special requests for unpublished estimates. Also, many users believed that DAWN collected data on a relatively limited list of drugs.

- Some drugs (e.g., heroin and morphine) were reported in combinations that obscured their content.

New approach

- "Major Substances of Abuse" are presented in a separate panel at the top of the standard table. Included are:

  - alcohol-in-combination, the most frequently reported substance in DAWN,

  - the most common illicit drugs (e.g., cocaine, heroin, marijuana),

  - illicit drugs of particular interest (e.g., amphetamines, methamphetamine, MDMA, Ketamine, Rohypnol, GHB/GBL, LSD, PCP, other hallucinogens), regardless of their frequency,

  - non-pharmaceutical inhalants, and

  - illicit combinations (e.g., speedball, a mix of cocaine and heroin).

- Combinations that obscured content (e.g., heroin/morphine) have been split to make the data more useful.[25] Users can recombine such categories by summing mentions from the detail provided.

2. CLASSIFY PHARMACEUTICALS AND OTHER LICIT SUBSTANCES USING A CONSISTENT AND MEANINGFUL CLASSIFICATION SCHEME

Issues

- Some DAWN tables listed drugs without any useful groupings and in no apparent order. Other tables classified drugs into categories erroneously called "therapeutic classes."

- Content of tables was static so that, over time, high numbers of mentions accumulated into "other/unspecified" categories, and combination drugs were handled inconsistently.

- The category inhalants/solvents/aerosols included many nonpharmaceutical products that were unlikely to have been inhaled (because they lacked psychoactive effects) and for which the route of administration was undocumented or did not involve inhalation.

[25] In *Mortality Data from DAWN*, we will continue to tabulate mentions of heroin and morphine together. Although heroin may be the ingested drug, it metabolizes to morphine so that, depending on the toxicology testing protocols used, heroin and morphine may not be distinguishable in a given decedent. For this reason, both heroin and morphine will continue to be reported in a single category in DAWN mortality data.

New approach

- The Multum *Lexicon's* 3-level nested categories will be used to classify substances. On that basis, we will:

  - Report the most detail (3-level) for the most commonly abused drugs (e.g., psychotherapeutic agents and CNS agents),

  - Report detail (2-level) for respiratory and cardiovascular agents, and

  - Report categories, such as alternative medicines, anti-infectives, gastrointestinal agents, with relatively low numbers of mentions.

- For reference, the complete classification structure will be extracted from the Multum *Lexicon* and published online.

- For substances that could be classified into multiple categories,[26] we adopted a hierarchy, so that each drug is classified only once in published tables.

- For combinations (compounds) of multiple substances, we followed the Multum *Lexicon* approach. Several prescription and over-the-counter substances are compounds of multiple substances (e.g., acetaminophen with codeine), and are classified as such in the Multum *Lexicon*, and some compounds (e.g., narcotic analgesic combinations) have dedicated categories. We adopted a similar approach for the major substances of abuse. Compounds containing two or more major substances have a dedicated category (e.g., speedball, a combination of cocaine and heroin, is classified under combinations of major substances). However, compounds containing a major substance of abuse and another substance are classified with the major substance (e.g., heroin with scopolamine is classified under heroin). The relative frequency of all major substance compounds is documented in Table 2.3.0.

- For nonpharmaceutical inhalants, which are unique to DAWN and not part of the original Multum *Lexicon*, we established new rules for inclusion. Inhalants now include anesthetic gases and nonpharmaceuticals for which the documented route of administration was inhalation. In addition, to be classified as an inhalant a nonpharmaceutical substance must have a psychoactive effect when inhaled and fall into one of the following subcategories:

  - Volatile solvents: adhesives (model airplane glue, rubber cement, household glue), aerosols (spray paint, hairspray, air freshener, deodorant, fabric protector), solvents and gases (nail polish remover, paint thinner, correction fluid and thinner, toxic markers, pure toluene, cigar lighter fluid, gasoline, carburetor cleaner, octane booster), cleaning agents (dry cleaning fluid, spot remover, degreaser), food products (vegetable cooking spray, dessert topping spray such as whipped cream, whippets), and gases (nitrous oxide, butane, propane, helium).[27]

[26] For example, cough preparations containing codeine can be classified according to their therapeutic use as respiratory agents or, because of their codeine content, as narcotic analgesics. In published tables, codeine cough syrups are classified only as respiratory agents. However, the multiple categories have been preserved in the underlying data for use in special analyses.

[27] See http://www.inhalants.org/.

- Nitrites: amyl nitrites ("poppers," "snappers") and butyl nitrites ("rush," "locker room," "bolt," "climax," "video head cleaner").

- Chlorofluorohydrocarbons: Freons.

In addition, anesthetic gases are extracted from the category CNS agents, general anesthetics, to be classified as inhalants. These substances have the physical property at room temperature of being a gas or are delivered as a gas and therefore are presumed to have been inhaled. The anesthetic gases include nitrous oxide, ether, and chloroform.

3. ITEMIZE THE SPECIFIC SUBSTANCES REPORTED TO DAWN

Issues

- Many users want to know about mentions of specific substances, and these substances of interest change with changing patterns of drug use.

- Previously, published tables from DAWN were static, and adding new rows to accommodate new drugs could not be accomplished easily. Over time, the usefulness of the list of specific substances degraded as new substances became common (but were not displayed) and old substances decreased in frequency (but were not eliminated from the display).

New approach

- Major substances of abuse: Specific names (including street names) as they are reported to DAWN are itemized in a separate table. The content of this table is dynamic, so it will change as the illicit substances reported to DAWN change. Example:

  - Table 2.1.0 summarizes mentions of cocaine. Table 2.3.0 shows mentions for “cocaine,” “coke,” “crack,” and other terms used to report cocaine to DAWN.

- Other substances of abuse: Specific substances reported in the 4 most commonly reported categories (e.g., psychotherapeutic agents, CNS agents, respiratory agents, and cardiovascular agents) are itemized in separate tables. Example:

  - Table 2.1.0 summarizes mentions of narcotic analgesics. Table 2.5.0 shows mentions for codeine, meperidine, methadone, and all other drugs that make up the narcotic analgesic category.

4. SUPPLY A MAP FROM GENERIC TO BRAND (TRADE) NAMES, BUT DO NOT ATTRIBUTE MENTIONS TO PARTICULAR BRANDS (EVEN AS EXAMPLES)

Issues

- DAWN depends on source records and the specificity of drug information varies with the medical documentation. For example, patients may report to ED clinicians a common brand name (e.g., a trade name such as “Tylenol”) even when a generic (acetaminophen) or another brand was actually consumed. Conversely, a medical chart may indicate a generic name when a particular brand was consumed.

- The use of brand (trade) names in previous publications has been inconsistent and may be misleading.

- Pharmaceutical firms may object to having one brand cited over another, even if the brand is cited only as an example.

- However, a translation between generic and brand (trade) names is a useful aid for readers who may be more familiar with brand than generic names (e.g., Prozac may be a more familiar name than fluoxetine).

New approach

- Identification of substances by brand (trade) name has been eliminated from the new tables and text because brand-level information from DAWN is unreliable.

- Specific substances by generic substance name are itemized in separate tables (e.g., Tables 2.4.0 - 2.7.0).

- For reference, two indexes—generic-to-brand and brand-to-generic—have been extracted from the *Multum Lexicon* and published in Appendix I and online.

5. PROVIDE STATISTICAL TESTS FOR LONG- AND SHORT-TERM TRENDS AND MAKE IT EASIER FOR USERS TO KNOW THE MAGNITUDE OF A CHANGE

Issues

- Users are interested in long-term as well as short-term trends. Previous DAWN publications provide statistical tests only for short-term trends.

- DAWN findings are usually discussed in terms of percentage changes, but this information was never displayed in the published tables.

- In previous publications, statistical tests are provided for differences in estimates of episodes and mentions, but not for rates per 100,000 population.

New approach

- New trend tables highlight statistically significant differences based on 3 comparisons:

  - The first and last periods shown on the table (in this issue of *ED Trends*, the first and last years are 1994 and 2000),

  - The second-to-last and last periods shown on the table (1998 and 2000 here), and

  - The last 2 periods shown on the table (1999 and 2000 here).

- Statistically significant differences expressed in terms of percentages are displayed in the published tables for each of the 3 comparison periods.

- Statistical tests are included now in the tables displaying estimated rates per 100,000 population (Tables 12.1.0 through 14.12.0).