

EPA's Exposure Assessment Toolbox (EPA-Expo-Box)

L. Phillips^{1,*}, M. Johnson¹, K. Deener¹, and C. Bonanni²

¹ U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Washington, DC 20460, USA

² University of Michigan Law School, Ann Arbor, MI 48109, USA

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ABSTRACT. The U.S. Environmental Protection Agency's (EPA) Office of Research and Development (ORD), National Center for Environmental Assessment (NCEA) recently released an on-line toolbox for exposure and risk assessors, called EPA EXPOsure toolBOX or EPA-Expo-Box. It is laid out as a series of "Tool Sets" that will guide users through the exposure assessment process from multiple perspectives. The Tool Sets include: Exposure Assessment Approaches, Media, Exposure Routes, Potentially Exposed Populations, Tiers and Types of Exposure Assessment, and Chemical Classes. Each Tool Set provides annotated links to databases, models, guidance documents, and reference materials (i.e., 'tools') which will be useful to scientists involved in human exposure assessment. Included is a search interface that allows users to identify relevant tools using key words or topics. This paper highlights some of the unique features of the toolbox. EPA-Expo-Box is available at: <http://www.epa.gov/risk/expobox>.

Keywords: exposure assessment, on-line tools, toolbox, resource links

1. Introduction

Exposure assessment is one of four major steps in human health risk assessment; others include hazard identification, dose-response assessment, and risk characterization (NRC, 1983, 2009). As defined in the EPA Guidelines for Exposure Assessment, "exposure to a chemical is the contact of that chemical with the outer boundary of the body (i.e., skin and the openings into the body such as the mouth, the nostrils, and punctures and lesions in the skin), and an exposure assessment is the quantitative or qualitative evaluation of that contact" (U.S. EPA 1992). Data, models, and other resources are needed for conducting exposure assessments. Many of these resources are available as reports, journal articles, or databases from government and non-government entities. However, there was no publically available comprehensive on-line resource for exposure assessment tools and information. To meet this need, EPA's National Center for Environmental Assessment (NCEA) - a leader in the science of human health risk assessment - developed an on-line tool-box called EPA-Expo-Box that contains links to more than 800 tools relevant to exposure assessment.

On-line toolboxes have become convenient and popular ways to organize resources and present information on vari-

ous subjects. The advantages provided by these toolboxes are numerous. They catalog tools alphabetically, topically, or by use or need, and may be kept up to date as new developments or tools in the relevant field of study are added. Toolboxes have been developed by federal and state governments, educational institutions, and private organizations to cover a wide range of topics (e.g., engineering, finance, journalism, science, etc.). On-line toolboxes have also been used by the public health community as a way to share resources on various topics, but toolboxes that specifically address resources for exposure assessors were not available. EPA-Expo-Box fulfills this need and is consistent with the National Research Council's (NRC) recent recommendations for "promoting greater access to, and sharing of data and resources" (NRC, 2012). This paper provides an overview of the design and structure of EPA-Expo-Box, describes its potential benefits to the scientific community, and discusses its current availability and possible future directions.

2. EPA-Expo-Box Design

EPA-Expo-Box was designed by EPA/NCEA, with input from other EPA scientists. EPA-Expo-Box is a compendium of exposure assessment tools that many EPA scientists are already using. The toolbox provides organized links to a variety of information sources (i.e., databases, models, guidance documents, and reference materials). EPA built EPA-Expo-Box to assist individuals from within government, industry, academia, and the general public with assessing exposure, based on tasks they are likely to perform in conducting an exposure assessment. The toolbox's easy-to-understand struc-

* Corresponding author. +1 7033470366; fax: +1 7033478690.

E-mail address: phillips.linda@epa.gov (L. Phillips).

Table 1. EPA-Expo-Box Tool Sets

<u>Approaches</u> Direct Measurement (Point of Contact) Indirect Estimation (Scenario Evaluation) Dose Reconstruction (Biomonitoring and Reverse Dosimetry)	<u>Media</u> Air Water and Sediment Soil and Dust Food Aquatic Biota Consumer Products	<u>Routes</u> Inhalation Ingestion Dermal
<u>Tiers and Types</u> Screening Level and Refined Deterministic and Probabilistic Cumulative and Aggregate	<u>Life stages and Populations</u> General Residential Consumers Occupational Workers Life stages Highly Exposed	<u>Chemical Classes</u> Pesticides Other Organics Inorganics and Fibers Nanomaterials

ture and navigation is key to making this a viable resource for any individual who is interested in finding information that could be used to assess human exposure. The Toolbox is easy to access from EPA's Human Health Risk Assessment website (<http://epa.gov/healthrisk>) and EPA's risk portal (<http://epa.gov/risk>). It can also be accessed directly at <http://www.epa.gov/risk/expobox>.

Figure 1 illustrates the homepage for the Toolbox. The homepage provides links to resources organized within six Tool Sets: (1) Exposure Assessment Approaches, (2) Media, (3) Exposure Routes, (4) Potentially Exposed Populations, (5) Tiers and Types of Exposure Assessment, and (6) Chemical Classes. Within each Tool Set is a series of modules (see Table 1), each pertaining to an exposure assessment topic. This nested design allows users to drill down deeper into the topics and subtopics until they are at the list of related tools in the Toolbox. For example, the Media Tool Set contains modules addressing air, water and sediment, soil and dust, food, aquatic biota, and consumer products. Within each of the media modules, the following topics are addressed: sources of contamination, fate and transport, concentrations of contaminants (measuring concentration, modeling concentrations, and available concentration data), exposure scenarios, exposure factors, calculation tools, and guidance. Each module also provides brief descriptions of the topic areas covered and annotated links to databases, models, guidance documents, and reference materials.

In addition to the Tool Sets, EPA-Expo-Box contains resources and links to other overarching topics relevant to exposure assessment. For example, tutorials from EPA's training on exposure assessment are provided as a series of slide presentations, instructors' notes, student reading packets, and relevant training exercises. These tutorials were originally developed as part of EPA's Risk Assessment Training and Experience (RATE) program to train EPA employees and stakeholders. RATE program material was developed to cover scientific subject matter and methodologies considered to be essential knowledge and skills for Integrated Risk Information System (IRIS) chemical managers and risk assessors within and outside of the Agency. RATE training materials were developed on the topics of general risk assessment,

human health risk assessment, exposure assessment, the IRIS process, and specific IRIS methodologies. The RATE materials provided in EPA-Expo-Box will be updated as new information becomes available. Also, new RATE tutorials may be developed for additional subjects should stakeholder needs and interests exist. Other overarching topics for which links are provided include: data quality, uncertainty and variability, and environmental justice. Additional features include: links to resources such as unit conversion charts, exposure assessment glossaries, and bibliographic citations from EPA's Health and Environmental Research Online (HERO) database (<http://hero.epa.gov/>). Another important feature of the Toolbox is its search capabilities. A user-friendly interface can be used to filter the underlying tools database, based on keywords or topics that are used throughout the toolbox. The search results provide the name, description, and link to the tool(s) that meet the search criteria. These are the same resources that are available by drilling through the website.

Over the past several years, EPA/NCEA has published several of their own useful resources for exposure assessment, including, most recently, the Exposure Factors Handbook: 2011 Edition and Highlights of the Exposure Factors Handbook (U.S. EPA, 2011a, b). During the review of the Handbook, it was suggested that EPA provide the Handbook and related documents as web-accessible, hyperlinked documents. In response to this suggestion, EPA included an exclusive module on exposure factors in the Toolbox. The exposure factors module provides links to specific chapters and tables in the Exposure Factors Handbook: 2011 Edition; links to highlights of the data and recommendations for each factor; nearly 300 data tables in downloadable MS Excel spreadsheet format; links to over 700 source references via EPA's HERO database; links to related resources; and a separate search interface in the Toolbox that searches for relevant sections and tables based on keywords or phrases. Figure 2 provides a screenshot of the exposure factors module.

3. Potential Benefits

There are several key advantages that the on-line Toolbox has over a hardcopy document or a software program that



Figure 1. EPA-Expo-Box homepage.

can be installed on a personal computer. First, the Tool-box provides “one-stop shopping” for links to exposure assessment tools. Second, users can access the Toolbox from any device that can connect to the internet without having to download specific software (i.e., it will be easily accessed with smart-phones, tablets, and computers). Another important advantage of using an on-line format is that the Toolbox can be easily updated as new tools become available. This versatility is important in the ever-changing field of exposure assessment as it will allow the user to access the most current information available. Another potential advantage of EPA-Expo-Box is that it may encourage communication and collaboration between exposure assessors which could seed future improvements to the Toolbox. By organizing exposure assessment resources in a toolbox, exposure and risk assessors may identify tools that could be shared or integrated to address cross-cutting issues, which could improve uniformity in risk assessment. Additionally, users of EPA-Expo-Box may find that tools developed for one purpose may be suitable for another.

4. Current Availability and Future of EPA-Expo-Box

EPA released Version 1 of EPA-Expo-Box in the Fall of 2013. It will continue to be updated as new tools become available.



Figure 2. Exposure factors module web-page (located within the indirect estimation section of the Exposure Assessment Approaches Tool Set).

table. As noted in a recent National Research Council (NRC) report, Sustainability and the U.S. EPA, stakeholder involvement is a key feature of sustainability (NRC, 2011). Users of EPA-Expo-Box can provide input or suggestions by filling out the form on the ‘Contact Us’ page. By joining a mailing list, Toolbox users will receive news and website updates. Additionally, the Agency plans to host some public webinars designed to demonstrate the utility of EPA-Expo-Box and different ways the Toolbox can be used. By building a stakeholder base outside of EPA and maintaining the user community within EPA, future versions of EPA-Expo-Box will address the data needs identified by multiple stakeholders and become an invaluable resource for anyone conducting exposure or human health risk assessments.

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