

# A Microsoft-Excel-based tool for conducting the DeRmal Exposure Assessment Method (DREAM)

Keneth Masís-Leandro<sup>1</sup>, Hans Kromhout<sup>2</sup> and Berna van Wendel de Joode<sup>1,\*</sup>

<sup>1</sup>Infants' Environmental Health (ISA) Program, Central American Institute for Studies on Toxic Substances (IRET), Universidad Nacional, Heredia, Costa Rica

<sup>2</sup>Institute for Risk Assessment Sciences (IRAS), Utrecht University, Utrecht, Netherlands

\*Corresponding author: Infants' Environmental Health (ISA) Program, Central American Institute for Studies on Toxic Substances (IRET), Campus Omar Dengo, Universidad Nacional, Heredia, Costa Rica. Email: [berendina.vanwendel.dejoode@una.cr](mailto:berendina.vanwendel.dejoode@una.cr)

## Background

The DeRmal Exposure Assessment Method (DREAM) (van Wendel De Joode et al. 2003), based on a conceptual model by Schneider et al. 1999, gives insight in routes, distribution, and relative ranking of potential and actual dermal exposure. DREAM provides reproducible results for a broad range of tasks with dermal exposures to liquids, solids, and vapors (van Wendel De Joode, Vermeulen et al. 2005; van Wendel De Joode, Vermeulen et al. 2005). The method has been adopted as a reference for dermal exposure assessment by the National Institute of Workplace Safety and Hygiene of Spain (Instituto Nacional de Seguridad y Salud en el Trabajo 2011).

The DREAM method has been used to address occupational exposure to pesticides, in both low-, middle-, and high-income countries farming systems (Tielemans et al. 2007; Baharuddin et al. 2011; Hanchenlaksh et al. 2011). It has been recognized for the simplicity of its algorithm and the specificity of the determinants (Fabian and Binder 2015). DREAM has also been used in a multiplicity of industrial activities, including the assessment of exposure to commonly used chemical substances in the industry as semi-synthetic metal working fluids and organic solvents (van Wendel De Joode, Bierman et al. 2005; van Wendel De Joode, Vermeulen et al. 2005) as well as in more specialized sectors as assessing dermal exposure to manufactured nanoparticles (van Duuren-Stuurman et al. 2010). The method has been adapted to estimate the risk associated with oil spill-related chemical exposures of clean-up workers (Gorman Ng et al. 2019; Stewart et al. 2022).

## Dream method

DREAM consists of an inventory and an evaluation part. The inventory part comprises a hierarchically structured questionnaire about determinants and routes of exposure, with 6 modules (company, department, agent, job, task, and exposure) to be applied by an occupational health professional. Each answer represents a score. Subsequently, in the evaluation phase of this method, the scores obtained by the application of the questionnaire are combined in a series of algorithms to obtain indices of potential and actual dermal exposure for 9 body parts and at task level (van Wendel de Joode et al. 2003). The latter allows the characterization of the agent, the probability, and intensity of exposure, as well as hygienic practices, including use of personal protective equipment in the workplace.

## Contribution of the Microsoft-Excel-based tool

To facilitate its use, we programmed a freely available Microsoft-Excel-based tool in the language Visual Basic for Applications that provides a friendly user interface for conducting exposure assessments with the DREAM tool (see [Supplementary Material](#)). A previous version of the tool involved applying the questionnaire in an MS-Access sheet, exporting the file, and running afterwards a code in SAS to obtain DREAM scores, or copying the answers in an excel sheet with a set of formulas to obtain the exposure indices. In the newly MS-Excel-based tool the answers to each question are directly entered by clicking on checkboxes,

Received: March 31, 2023

© The Author(s) 2023. Published by Oxford University Press on behalf of the British Occupational Hygiene Society.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact [journals.permissions@oup.com](mailto:journals.permissions@oup.com)

an action that automatically register the score associated with the selected answer into the corresponding formula and consequently generates the exposure indices with just 1 click (see [Supporting information](#)). Another relevant feature of the tool is the facility to reuse information entered in a previous application of the method; if data from given modules (e.g. the answers related to use of personal protective equipment) are the same for consecutive observations, there will be no need to re-enter this information.

MS-Excel was selected as base platform for the tool due to its wide distribution, being already installed in a vast part of computers, as well for providing the option to work off-online. The English and the Spanish versions of the MS-Excel-based tool for the DREAM method can be downloaded at the web site and at the GitHub repository of the Infants' Environmental Health Program (ISA):

<http://www.isa.una.ac.cr/index.php/es/publicaciones-y-materiales/dream>  
<https://github.com/Programa-ISA/DREAM>.

## Conclusion

We expect this MS-Excel-based tool to facilitate and stimulate dermal exposure assessment in occupational health settings and for epidemiological research.

## Acknowledgments

The development of the MS-Excel-based tool was supported with funding by the National Institutes of Health Fogarty International Center grant number D43TW011403 entitled 'International Training Program in Environmental Health over the Lifespan' (Claudio L & van Wendel de Joode B, PIs), a grant assigned to the Icahn School of Medicine at Mount Sinai and the Universidad Nacional, Costa Rica.

## Conflict of interest

The authors declare no conflict of interest relating to the material presented in this letter to the editor. Its contents, including any opinions and/or conclusions expressed, are solely those of the authors.

## Data availability

No data were used in this study.

## Supplementary material

Supplementary data are available at *Annals of Work Exposures and Health* online.

## References

- Baharuddin MRB, Sahid IB, Noor MABM, Sulaiman N, Othman F. Pesticide risk assessment: a study on inhalation and dermal exposure to 2,4-D and paraquat among Malaysian paddy farmers. *J Environ Sci Health B*. 2011;46(7):600–607. <https://doi.org/10.1080/03601234.2011.589309>.
- van Duuren-Stuurman B, Pelzer J, Moehlmann C, Berges M, Bard D, Wake D, Mark D, Jankowska E, Brouwer D. A structured observational method to assess dermal exposure to manufactured nanoparticles DREAM as an initial assessment tool. *Int J Occup Environ Health*. 2010;16(4):399–405. <https://doi.org/10.1179/107735210799159978>.
- Fabian CL, Binder CR. Dermal exposure assessment to pesticides in farming systems in developing countries: comparison of models. *Int J Environ Res Public Health*. 2015;12(5):4670–4696. <https://doi.org/10.3390/IJERPH120504670>.
- Gorman Ng M, Cherrie JW, Sleuwenhoek A, Stenzel M, Kwok RK, Engel LS, Cavallari JM, Blair A, Sandler DP, Stewart P. GuLF DREAM: a model to estimate dermal exposure among oil spill response and clean-up workers. *Ann Work Expo Health*. 2019;66((Suppl 1):i218i218–i218i233. <https://doi.org/10.1093/annweh/wxz037>.
- Hanchenlaksh C, Povey A, O'Brien S, de Vocht F. Urinary DAP metabolite levels in Thai farmers and their families and exposure to pesticides from agricultural pesticide spraying. *Occup Environ Med*. 2011;68(8):625–627. <https://doi.org/10.1136/oem.2010.060897>.
- Instituto Nacional de Seguridad e Higiene en el Trabajo. (2011). Exposición dérmica a sustancias químicas: metodología simplificada para su determinación (NTP 896). <https://www.insst.es/documents/94886/328579/896w.pdf/26253c5a-c146-4968-9697-8ce1358e66ba>. Accessed March 30, 2023.
- Schneider T, Vermeulen R, Brouwer DH, Cherrie JW, Kromhout H, Fogh CL. Conceptual model for assessment of dermal exposure. *Occup Environ Med*. 1999;56(11):765–773. <https://doi.org/10.1136/oem.56.11.765>.
- Stewart PA, Gorman Ng M, Cherrie JW, Jones A, Kwok RK, Blair A, Engel LS, Sandler DP, Stenzel MR. Estimation of dermal exposure to oil spill response and clean-up workers after the deepwater horizon disaster. *Ann Work Expo Health*. 2022;66((Suppl 1):I234–I246. <https://doi.org/10.1093/ANNWEH/WXAB073>.
- Tielemans E, Bretveld R, Schinkel J, van Wendel De Joode B, Kromhout H, Gerritsen-Ebben R, Roeleveld N, Preller L. Exposure profiles of pesticides among greenhouse workers: implications for epidemiological studies. *J Expo Sci Environ Epidemiol*. 2007;17(6):501–509. <https://doi.org/10.1038/sj.jes.7500544>.
- van Wendel De Joode B, Bierman EPB, Brouwer DH, Spithoven J, Kromhout H. An assessment of dermal exposure to semi-synthetic metal working fluids by different methods to group workers for an epidemiological study on dermatitis. *Occup Environ Med*. 2005;62(9):633–641. <https://doi.org/10.1136/oem.2004.015396>.
- van Wendel De Joode B, Brouwer DH, Vermeulen R, Van Hemmen JJ, Heederik D, Kromhout H. DREAM: a method for semi-quantitative dermal exposure assessment. *Ann Occup Hyg*. 2003;47(1):71–87. <https://doi.org/10.1093/ANNHYG/MEG012>.

van Wendel De Joode B, van Hemmen JJ, Meijster T, Major V, London L, Kromhout H. Reliability of a semi-quantitative method for dermal exposure assessment (DREAM). *J Expo Anal Environ Epidemiol*. 2005;15(1):111–120. <https://doi.org/10.1038/sj.jea.7500369>.

van Wendel De Joode B, Vermeulen R, van Hemmen JJ, Fransman W, Kromhout H. Accuracy of a semiquantitative method for Dermal Exposure Assessment (DREAM). *Occup Environ Med*. 2005;62(9):623–632. <https://doi.org/10.1136/oem.2004.018564>.