The DARTH initiative: Promoting the Use of Open-Source Software in Medical Decision Making

Eline Krijkamp, PhD(c)

London, July 2018

DARTH is a multi-institutional collaboration of researchers

The aim:

- **expand knowledge** in decision analysis using open-source software (R)

- **develop educational material**

Decision Analysis in R for Technologies in Health (DARTH)

F. Alarid-Escudero PhD

H. Jalal MD PhD

E. Enns PhD

E. Krijkamp PhDc

M. Hunink MD

P. Pechlivanoglou PhD

Health Decision Sciences in the Era of Open-source Software

by **Fernando Alarid-Escudero** on behalf of the Decision Analysis in R for Technologies in Health (DARTH) workgroup

There's no doubt we are in the era of Open-Source Software (OSS), but how much has OSS infiltrated into health decision sciences? A quick search in Wikipedia for "open-source programming language licensing" yielded a list of 80 programs, such as R, Python and Haskell, among others. But what exactly does open-source software mean? According to the Open Source Initiative, "An open-source software can be freely accessed, used, changed, and shared (in modified or unmodified form) by anyone."

OSS has gained significant popularity
disciplines such as statistics and engi
significant developments and exhibitio
Health Decision Sciences, but certainly not enough. Some of the most popu
Decision Sciences are being implemented in either domain-specific or prop
many advantages to this approach, but there are also significant drawbacks
interest in replicating an analysis conducted using a licensed software pack
constrained by not having access to the software. This could be problemati
environments, such as academic fields where financial resources devoted t
higher the entry costs, particularly financial costs, the less likely decision-an
available and understood by a broader audience – an outcome that could th

Eline Krijkamp, MSc

Eva Enns, PhD

An Update on the DARTH Workgroup: The Road So Far

by **Eline Krijkamp** , MSc; Erasmus University at Rotterdam, and **Eva Enns** , PhD; University of Minnesota, on behalf of the Decision Analysis in R for Technologies in Health (DARTH) workgroup

In a previous newsletter , **Fernando Alarid-Escudero** emphasized the increasing popularity of Open-Source Software (OSS), such as the R programming language, in health decision sciences (HDS). The use of R or other open-source programming languages facilitates research transparency, reproducibility, collaboration, and accessibility. However, an important drawback to the use of OSS such as R has been its steep learning curve.

To increase visibility and improve accessibility of R in the HDS community, we created the Decision Analysis in R for Technologies in Health (DARTH) Workgroup during SMDM's 37th Annual North American Meeting. DARTH is an international collaboration of researchers [1] who are committed to enhancing the use of the R programming language in the HDS through tutorial papers, short courses, and the development of new user-friendly, open-source tools for HDS modeling.

To date, DARTH has achieved several accomplishments. We published our first article in *Medical Decision Making* last year summarizing the existing functionality in R for decision analysis. A tutorial paper

Papers & Tutorials

Jalal et al. 2017

REVIEW

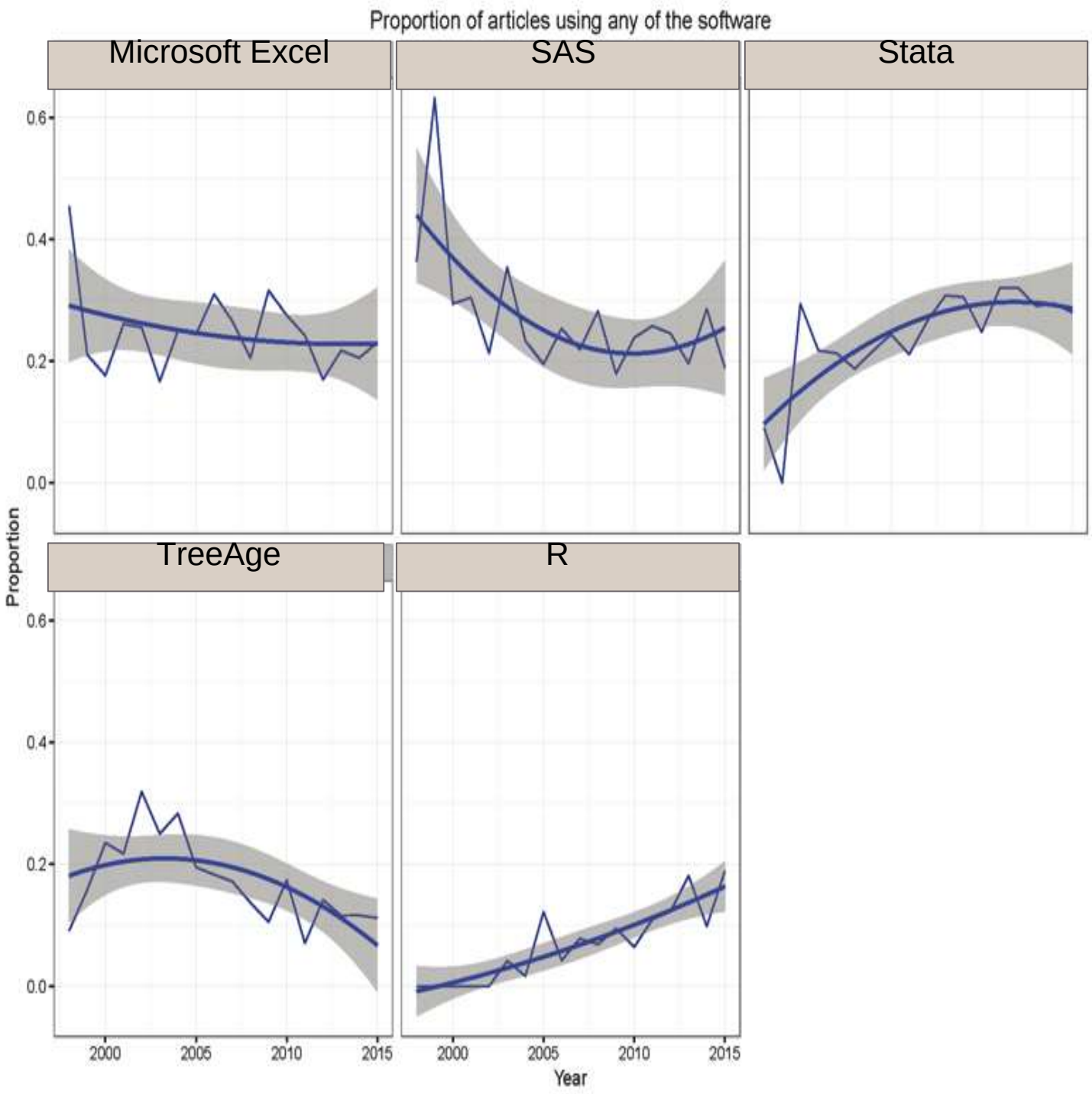
An Overview of R in Health Decision Sciences

Hawre Jalal, MD, PhD, Petros Pechlivanoglou, MSc, PhD, Eline Krijkamp, MSc, Fernando Alarid-Escudero, MSc, Eva Enns, MS, PhD, M. G. Myriam Hunink, MD, PhD

As the complexity of health decision science applications increases, high-level programming languages are increasingly adopted for statistical analyses and numerical computations. These programming languages facilitate sophisticated modeling, model documentation, and analysis reproducibility. Among the high-level programming languages, the statistical programming framework R is gaining increased recognition. R is freely available, cross-platform compatible, and open source. A large community of users who have generated an extensive collection of well-documented packages and functions supports it. These functions facilitate applications of health decision science methodology as well as the visualization and communication of results. Although R's popularity is increasing among health decision scientists, methodological extensions of R in the field of decision analysis remain isolated. The purpose of this article is to provide an overview of existing R functionality that is applicable to the various stages of decision analysis, including model design, input parameter estimation, and analysis of model outputs. **Key words:** *R project; economic evaluation; cost-effectiveness analysis; literature review.* **(Med Decis Making 2017;37: 735–746)**

Jalal H, et al. An Overview of R in Health Decision Sciences. *Med. Decis. Making*. 2017; 37(3): 735-746.

Software used in Decision analysis



Jalal et al. Overview of R in Health Decision Sciences, MDM, 2017

Krijkamp, et al. 2018

Tutorial

Medical Decision Making
2018, Vol. 38(3) 400–422

DOI: 10.1177/0272989X18754513
journals.sagepub.com/home/mdm

Microsimulation Modeling for Health Decision Sciences Using R: A Tutorial

Eline M. Krijkamp, Fernando Alarid-Escudero, Eva A. Enns, Hawre J. Jalal, M. G. Myriam Hunink, and Petros Pechlivanoglou

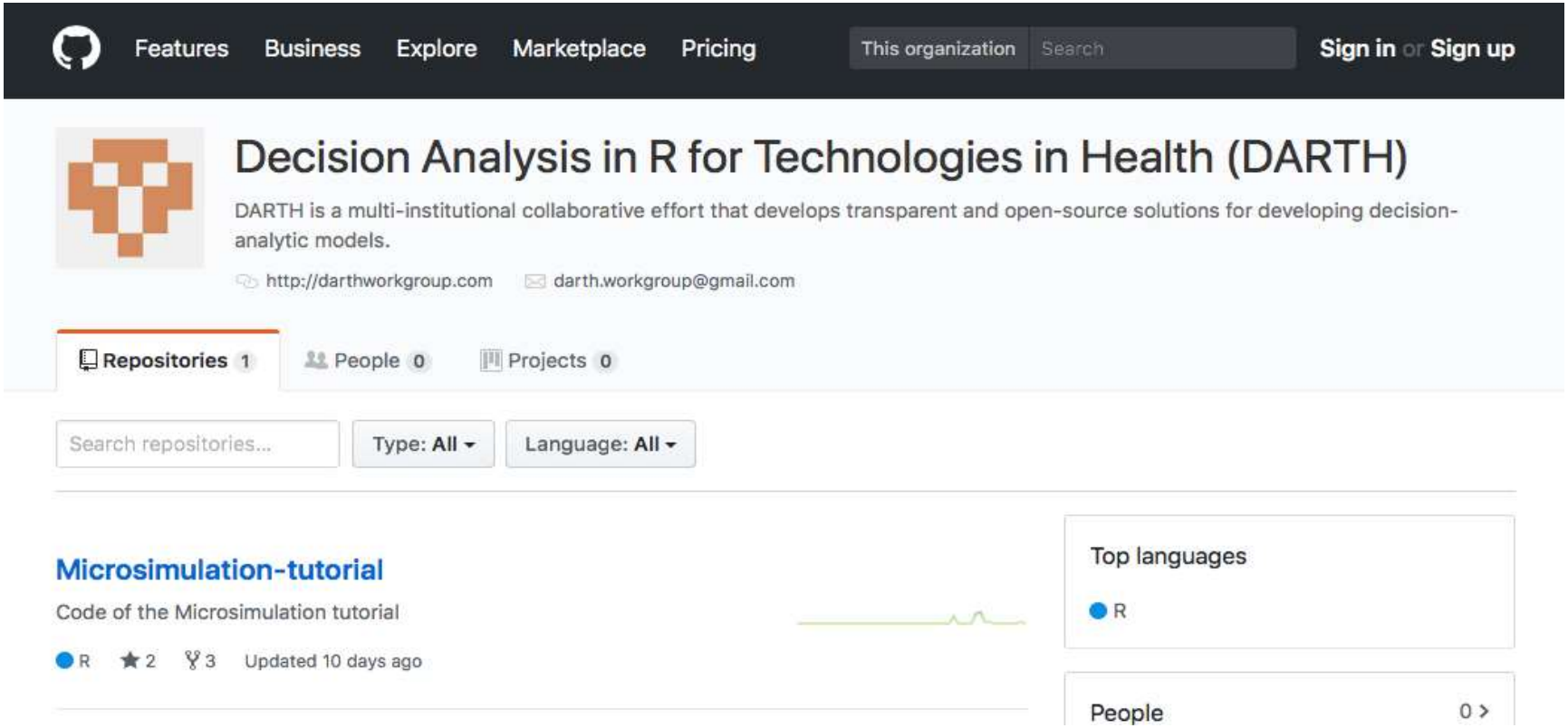
Abstract

Microsimulation models are becoming increasingly common in the field of decision modeling for health. Because microsimulation models are computationally more demanding than traditional Markov cohort models, the use of computer programming languages in their development has become more common. R is a programming language that has gained recognition within the field of decision modeling. It has the capacity to perform microsimulation models more efficiently than software commonly used for decision modeling, incorporate statistical analyses within decision models, and produce more transparent models and reproducible results. However, no clear guidance for the implementation of microsimulation models in R exists. In this tutorial, we provide a step-by-step guide to build microsimulation models in R and illustrate the use of this guide on a simple, but transferable, hypothetical decision problem. We guide the reader through the necessary steps and provide generic R code that is flexible and can be adapted for other models. We also show how this code can be extended to address more complex model structures and provide an efficient microsimulation approach that relies on vectorization solutions.

iterative vs vectorized

	Time to run (in seconds)	
Sample size	**sample()**	**samplev()**
1,000	5.42	0.16
10,000	38.41	1.21
100,000	378.76	11.71
1,000,000	4538.80	128.79

Github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Decision Analysis in R for Technologies in Health (DARTH)
DARTH is a multi-institutional collaborative effort that develops transparent and open-source solutions for developing decision-analytic models.
http://darthworkgroup.com
darth.workgroup@gmail.com
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Code & Courses

Universities

Past Workshops & Short Courses

Decision Modelling Using R: A 3-day course

When: April 4th, 5th & 6th, 2018

Where: The Hospital for Sick Children Research Institute, Toronto, ON, Canada

Industry

SMDM
Society for Medical Decision Making
Better Health through Better Decisions

37th Annual Meeting of the Society for Medical Decision Making
October 18 - 21, 2015

AM07 DECISION MODELLING USING R

Sunday, October 18, 2015: 9:00 AM - 12:30 PM
Mills Studio 5 (Hyatt Regency St. Louis at the Arch)

Course Director:
Petros Pechlivanoglou, MSc, PhD

Decision Modeling Using R
LEIDEN, THE NETHERLANDS 7 - 8 JUNE 2018

Speakers


Petros Pechlivanoglou PhD
The Hospital for Sick Children (SickKids)
Child Health Evaluative Sciences


Eva Enns PhD
University of Minnesota
Health Policy and Management


Fernando Alarid-Escudero PhD
University of Minnesota
Health Policy and Management


Eline Krijkamp MSc
Erasmus University Medical Center
Netherlands Institute for Health Sciences, Erasmus MC


Hawre Jalal MD, PhD
University of Pittsburgh
Health Policy and Management

Topics

- Introduction to Decision Modeling
- Decision Trees
- Markov Modelling
- Microsimulation Modelling
- Metamodelling
- Probabilistic Analysis
- Value of Information Analysis
- Calibration

Location

Leiden University Medical Center (LUMC)

* For novice R users, a 1-day "intro to R" course will be offered on June 6, 2018

Registration: http://www.cvent.com/d/mlqlh1

petros.pechlivanoglou@sickkids.ca
lauren.hunter@sickkids.ca

SickKids | Dalla Lana School of Public Health | Erasmus MC Netherlands Institute for Health Sciences | University of Pittsburgh Graduate School of Public Health | LUMC Leiden University Medical Center

SMDM
Society for Medical Decision Making
Better Health through Better Decisions

39TH ANNUAL NORTH AMERICAN MEETING
October 22 - 25, 2017 | Pittsburgh, PA

SHORT COURSE

PM4: Microsimulation Modeling in R

Sunday, October 22, 2017 02:00 PM - 05:30 PM

Wyndham Grand Pittsburgh Downtown - Benedum

7-9 FEB 2017 Decision Modeling Using R

Course topics

- Intro to R for decision modellers
- Decision Trees
- Cohort modeling
- Microsimulation modeling
- Discrete event simulations
- Calibration
- Value of Information
- Survival analysis
- Meta-modeling
- Parallel processing and code improvements

dampack

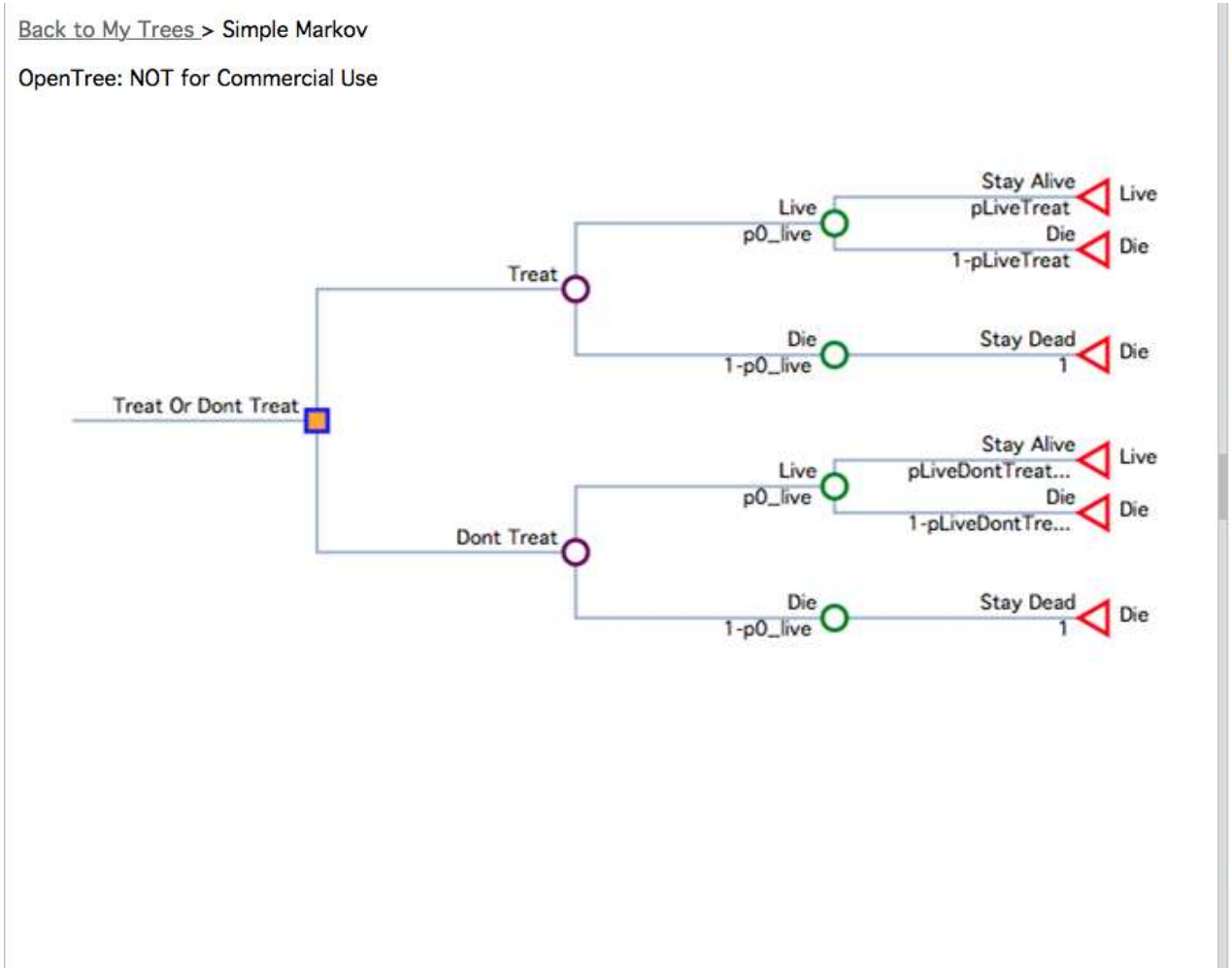
dampack: an R package for decision-analytic modeling

The `dampack` R package implements useful functions to develop and analyze decision-analytic models in R. The current functions compute cost-effectiveness acceptability curves (CEAC) and frontier (CEAF), expected value of perfect information (EVPI), expected value of partial perfect information (EVPPI), sensitivity analysis (SA) using linear regression metamodeling including one- and two-way.

The package also includes functions to simulate state-transition models and produce expected outcomes of interested.

In addition, this package includes useful functions to obtain parameters of commonly used distributions

myopentree.com



What’s next

Working Papers

1. **Decision Tree** Modeling for Health Decision Sciences Using R: a Tutorial

1. **OpenTree**: An Open-Source Visual Tool for Decision Modeling and Cost-Effectiveness Analysis in R

1. Introduction to **cohort-based decision analytic modelling** using R: a Tutorial

1. **Improving performance** in decision modeling in health using R

Twitter & LinkedIn

DARTH Collaboration

Fernando Alarid-Escudero, PhD[1]
Eva A. Enns, MS, PhD[1]
M.G. Myriam Hunink, MD, PhD[2,3]
Hawre J. Jalal, MD, PhD[4]
Eline M. Krijkamp, MSc[2]
Petros Pechlivanoglou, PhD[5]

In collaboration of:
[1] University of Minnesota School of Public Health, Minneapolis, MN, USA
[2] Erasmus MC, Rotterdam, The Netherlands
[3] Harvard T.H. Chan School of Public Health, Boston, USA
[4] University of Pittsburgh Graduate School of Public Health, Pittsburgh, PA, USA
[5] The Hospital for Sick Children, Toronto and University of Toronto, Toronto ON, Canada

http://darthworkgroup.com/

https://github.com/organizations/DARTH-git

https://www.linkedin.com/groups/8635339

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