



Letter to the Editor

Is Digital Epidemiology the Future of Clinical Epidemiology?

Clinical epidemiology is conventionally defined as a type of research focused on dissecting the impact of precursors, causes, or courses of diseases in the general population [1]. Its ultimate scope is promoting better healthcare in terms of implementing more efficient diagnostic methods, more appropriate therapies, and more reliable prognostication. It is now undeniable that clinical epidemiology has strongly contributed to improve healthcare deliverance during the past decades, and now represents a cornerstone of medical knowledge acquisition [1].

The many recent advances in information technology have catalyzed the diffusion of the Internet across most human domains, including science, medicine, and clinical epidemiology. A reliable definition of digital epidemiology has recently been provided by Salathé [2], as epidemiology based on digital sources data, generated outside the healthcare system. The potential applications of this new discipline are many and multifaceted, including disease monitoring and drug use [3–5]. Google Trends is indeed the mostly used Internet tool for this purpose, since it allows easy and updated analysis of Google searches across different geographical locations. Two recent studies, for example, demonstrate that the real epidemiological data for both West Nile virus [6] and pertussis [7] outbreaks were well correlated with the number of Google searches reflected by Google Trends.

In order to explore the current diffusion and the possible trends of digital epidemiology in science and medicine, we carried out a simple electronic search in Medline (PubMed interface) between 2012 and 2018, using the keyword “Google Trends”, with no

language restriction. The output of this search was then downloaded as a Microsoft Excel file (Microsoft Corporation, Redmond, WA, USA) and finally plotted graphically. The statistical analysis was carried out with Analyse-it (Analyse-it Software Ltd, Leeds, UK). The study was carried out in accordance with the Declaration of Helsinki, under the terms of relevant local legislation.

The results of this analysis showed a Spearman correlation between the number of PubMed documents and their year of publication of 0.990 (95% confidence interval, 0.931–0.999; $p < 0.001$), thus underscoring an acceptable linearly increasing trend. However, a better fit could be found using a third-degree polynomial equation ($r = 0.996$; $p < 0.001$). According to the coefficients of this polynomial equation, the amount of epidemiological research based on Google Trends may reach 15,459 PubMed documents in 2050. Although this number is probably overestimated and unrealistic, the trend toward an exponential increase of articles based on digital epidemiology remains virtually undeniable.

The results of our analysis are consistent with the hypothesis that there is an ongoing paradigm shift in clinical epidemiology. Although the currently available evidence and its potential limitations (e.g., local availability of the Internet, use of keywords in different languages, and Internet searches carried out for nonmedical purposes) do not allow us to conclude that digital epidemiology can replace clinical epidemiology, this innovative discipline shall be now regarded as a valid support, which can be used to generate timely alerts for clinical epidemiologists on disease outbreaks or sudden changes in therapeutic options, much earlier than conventional health epidemiology.

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