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ScienceDirect

Procedia Engineering 162 (2016) 576 – 584

Procedia Engineering

www.elsevier.com/locate/procedia

International Conference on Efficient & Sustainable Water Systems Management toward Worth Living Development, 2nd EWaS 2016

Quantifying the Online Behavior Towards Organic Micropollutants of the EU Watchlist: The Cases of Diclofenac & the Macrolide Antibiotics

Amaryllis Mavragani[a], Alexia Sampri[a], Konstantinos P. Tsagarakis[a,*]

[a]*Business and Environmental Technology Economics Lab, Department of Environmental Engineering, School of Engineering, Democritus University of Thrace, Xanthi 67100, Greece*

Abstract

This study aims at quantifying and analyzing the online interest in the micropollutants Diclofenac and the Macrolide Antibiotics (Azithromycin, Clarithromycin and Erythromycin) included in the watchlist of the EU Decision 2015/495. Using online search traffic data from Google Trends, we examine the change in interest from 2004 to 2015 in five EU countries. The results show an increased Worldwide percentage change in interest in Diclofenac, Azithromycin and Clarithromycin over the selected period, in contrary to Erythromycin, that is declining. In the examined EU countries, Germany and the UK show the highest online interest with mostly increasing rates, while in France, Italy and Spain, the interest in all four substances is significantly lower.

Peer-review under responsibility of the organizing committee of the EWaS2 International Conference on Efficient & Sustainable Water Systems Management toward Worth Living Development

Keywords: Azithromycin; Big Data; Clarithromycin; Diclofenac; Erythromycin; Google Trends; Macrolide Antibiotics; Micropollutants

* Corresponding author. Tel.: +30 2541079397; fax: +30 2541079397.
E-mail address: ktsagar@env.duth.gr

Peer-review under responsibility of the organizing committee of the EWaS2 International Conference on Efficient & Sustainable Water Systems Management toward Worth Living Development
doi:10.1016/j.proeng.2016.11.103

1. Introduction

According to Decision 2015/495/EU [1] issued on the 20th of March, 2015, the established watchlist for the EU monitoring of Environmental Quality Standards in the field of Water Policy consists of 17 substances; 17-Alpha-ethinylestradiol, 17-Beta-estradiol Estrone, Diclofenac, 2,6-di-tetr-butyl-4-methylphenol, 2-ethylhexyl-4-methoxycinnamate, Macrolide Antibiotics (consisting of Azithromycin, Clarithromycin and Erythromycin), Methiocrab, Neonicotinoids (consisting of Imidacloprid, Thiacloprid, Thimamethoxam, Clothianidin and Acetamiprid), Oxadiazon, and Triallate.

Diclofenac, included in the EU watchlist and the 2nd most studied substance of the list over the course of the last ten years [2], is a non-steroidal anti-inflammatory and one of the most commonly used drugs [3], mostly as an analgesic, which is both orally and dermally administrated [4-5]. Diclofenac is not highly biodegradable [5] and not completely removed through biological wastewater treatment [2-3, 5-6]; in specific, Diclofenac's removal in the wastewater treatment plants (WWTPs) varies from 0%-80% [6]. This results in its detection, in high frequencies [6], in WWTP effluents [7] and in the aqueous environment [3], i.e. surface water and groundwater [6], caused mainly through human and veterinary use [4]. Diclofenac is regarded to be harmful for environmental health [2], thus its concentrations in the water environment should be monitored in order to obtain water quality [3], even though there exist no legal limits for its discharge.

The Macrolide Antibiotics, i.e. Azithromycin, Clarithromycin and Erythromycin, are antibacterial antibiotics [8] used for the treating and preventing of various infections [8-9] in humans, animals, and agriculture [8]. They have become the focus of attention, as bacteria can develop resistance to the antibiotics [8]. As the Macrolide Antibiotics cannot be fully degraded [9], they are detected in the aquatic environment: in wastewater, surface water and groundwater [8]. Even at low concentrations, they are viewed as possibly harmful to the environment [8], thus these substances require monitoring.

The micropollutants' impacts on the environment and human health need to be further evaluated [2]. Given the increasing scientific interest in micropollutants, and in order to explore the online interest in Diclofenac and the Macrolide Antibiotics included in the EU watchlist, large volumes of data and a wide variety of datasets are needed; namely Big Data. A popular tool to access these kinds of data is Google Trends [10], which is an open tool provided by Google that measures 'What's trending'. In general, online search traffic data has significant potential in improving forecastings [11] and in analyzing online interest [12]. Google Trends, as a tool for analyzing online behavior, has been highly integrated in academic research over the course of the last few years, with the validity of the Google Trends' data [13] and its contribution to forecasting [14] being widely accepted and highlighted. If the terms are carefully selected, data from Google can be useful in accurately measuring various aspects of public interest [15].

As Google Trends is becoming popular in scientific research, much focus is given in health related issues, with all the more studies integrating data from Google in their research. Previous work on the subject includes the detection of Tuberculosis outbreaks [16], the showing of the seasonality of the restless-legs symptoms [17], the examining of the change in online searches for Multiple Sclerosis [18], and the connections between online searches and dementia incidence [19]. Furthermore, Google Trends has been useful in examining the online changes in searches of keywords related to epilepsy [20] and in providing a quantitative analysis of epilepsy related searches [21]. Google Trends' data have also been used to show that the online searches in Bariatric surgery are declining [22], to explore the online interest in cancer screening examinations in the US [23], and to examine searches related to skin diseases [24], snoring [25], lung cancer [26], tobacco use [27], and flu predictions [28] and spreading [29].

As is suggested, Google Trends has the potential of becoming a valuable tool for the measurement of online interest, as it uses the revealed instead of the stated data [30], thus more accurately reflecting the public's online behavior. Our aim is to look into online searches in Google, in order to examine and quantify at first the change in the Worldwide interest in Diclofenac, Azithromycin, Clarithromycin, Erythromycin, and then in the five most populated EU countries, i.e. Germany, France, UK, Italy and Spain, over the last 12 years. The rest of the paper is structured as follows: Section 2 consists of the research methodology used to evaluate the online interest, section 3 consists of the results and discussion, and section 4 consists of the overall conclusions and further research suggestions.