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Utility of social media and crowd-sourced data for pharmacovigilance: A scoping review protocol

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3 1 **Utility of social media and crowd-sourced data for pharmacovigilance: A scoping review protocol**
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54 23 **Keywords:** surveillance, adverse event, scoping review, social media, data analytics
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3 24 **ABSTRACT**
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6 25 **Introduction:** Adverse events associated with medications are underreported in the current post-
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8 26 marketing surveillance systems. It is estimated that only 4% to 10% of adverse events identified
9
10 27 between 1995 and 2000 were reported to the Canada Vigilance Program. This scoping review aims to
11
12 28 assess the utility of social media and crowd-sourced data to detect and monitor adverse events related
13
14 29 to health products, which include pharmaceuticals, medical devices, biologics, and natural health
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16 30 products.
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20 31 **Methods and analysis:** This scoping review will be conducted according to the manual published by the
21
22 32 Joanna Briggs Institute for scoping reviews. Literature searches were conducted in MEDLINE, EMBASE,
23
24 33 and the Cochrane Library from inception to May 13, 2016. Additional sources included searches of study
25
26 34 registries, conference abstracts, dissertations, as well as websites of international regulatory authorities
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28 35 (e.g., FDA, World Health Organization, European Medicines Agency). Search results will be
29
30 36 supplemented by scanning the references of relevant reviews. We will include all publication types
31
32 37 including published articles, editorials, websites, and book sections that describe use of social media and
33
34 38 crowd-sourced data for surveillance of adverse events associated with health products, across all
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36 39 populations. Two reviewers will perform study selection and data abstraction independently, and
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38 40 discrepancies will be resolved through discussion. Data analysis will involve quantitative (e.g.,
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40 41 frequencies) and qualitative (e.g., content analysis) methods.
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46 42 **Dissemination:** The summary of results will be sent to Health Canada, who commissioned the review,
47
48 43 and other relevant policy-makers involved with the Drug Safety and Effective Network. We will compile
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50 44 and circulate a 1-page policy brief and host a 1-day stakeholder meeting to discuss the implications, key
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52 45 messages, and finalize the knowledge translation strategy. Findings from this review will ultimately
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46 inform the design and development of a data analytics platform for social media and crowd-sourced
47 data for pharmacovigilance in Canada, and internationally.
48 **Registration details:** Not applicable

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49 INTRODUCTION

50 Social media has gained unprecedented popularity worldwide. Currently, there are over 2.3 billion active
51 social media users, and grows by an estimated 1 million new users every day.¹ Social media platforms
52 such as Twitter, Tumblr and Facebook are increasingly being used to discuss and share health issues.
53 Statistics Canada revealed that over 80% of Canadians were internet users as of 2009,² and almost 70%
54 of these individuals were using the internet to search for medical or health-related information.³ Social
55 media and crowd-sourced data have been used to successfully extract information for surveillance of
56 disease outbreaks,^{4,5} health behaviour,^{6,7} and patient views on health issues.⁸

57 The use of social media to exchange and discuss health information by the general public generates a
58 large volume of unsolicited and real-time information. Health related social networks that focus
59 specifically on issues related to health, such as DailyStrength and MedHelp, attract users daily to discuss
60 their health-related experiences, including use of prescription drugs, health products, side effects and
61 treatments. During the 2004-2005 flu season, social media listening by means of a Google 'click ad',
62 which appeared on the search page when information-seekers typed influenza-specific key words into
63 the Google search engine, closely approximated the incident of influenza cases.⁹ It was revealed that the
64 Google ad click-rate correlated more closely with retrospectively confirmed cases of influenza than the
65 Physicians Sentinel Surveillance system for "influenza-like illness".⁹ Similarly, during the Canadian
66 listeriosis outbreak, online search trends related to listeriosis correlated closely with laboratory-
67 confirmed cases determined retrospectively, and preceded official announcements of an epidemic.¹⁰

68 Given the observed predictive power of social media and crowd-sourced data as an information source
69 for public health surveillance, a lot of interest has been generated about its use for surveillance of
70 adverse events to health products, often referred to as pharmacovigilance.

71 Pharmacovigilance is defined as 'the science and activities relating to the detection, assessment,
72 understanding and prevention of adverse effects or any other drug-related problem'.¹¹ It includes drug

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3 73 safety surveillance activities to monitor incidents of adverse effects in real-life conditions. Adverse
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5 74 reactions, in particular to drug use, are a significant cause of morbidity and mortality, and are the fourth
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7
8 75 most common cause of death in hospitalized patients.¹² Since many adverse events are not captured in
9
10 76 randomised clinical trials, post-marketing surveillance of health and drug products is of paramount
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12 77 importance for drug and health technology industries and regulatory authorities, such as Health Canada,
13
14 78 the US Food and Drug Administration (FDA), and European Medicines Agency (EMA). These
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16 79 governmental agencies require clinicians to report all suspected adverse events, but the voluntary
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18 80 nature of the reporting systems likely contributes to the under-reporting of adverse events.¹³⁻¹⁵ In fact, it
19
20 81 is estimated that between 1995 and 2000, only 4% to 10% of serious adverse events were reported to
21
22 82 the Canada Vigilance Program, Health Canada's post-market surveillance program for suspected adverse
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24 83 events to health products marketed in Canada.¹⁶ In response to the limitations in the current post-
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26 84 marketing surveillance systems, attention is being directed towards using social media and crowd-
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28 85 sourced data to detect unknown adverse events and to improve consumer safety.

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33 86 This scoping review aims to assess the utility of social media and crowd-sourced data to monitor and
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35 87 detect adverse events related to health products. For the purpose of this review, health products
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37 88 include pharmaceuticals and drug products, medical devices, biologics, and natural health products. The
38
39 89 specific research questions are: (1) What social listening and analytics platforms exist internationally to
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41 90 detect adverse events related to health products using social media and crowd-sourced data? What are
42
43 91 their capabilities and characteristics? (2) What is the validity of user-generated data from social media
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45 92 for surveillance of adverse events to health products?

93 **METHODS**

94 **Study Design**

95 Our research objectives will be addressed using the scoping review methodology, which is a type of
96 knowledge synthesis approach used to map the concepts underpinning a research area and the main

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2
3 97 sources and types of evidence available.¹⁷ This scoping review will be conducted in accordance to
4
5 98 standard practices used by the Knowledge Synthesis Team within the Knowledge Translation Program of
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8 99 St Michael's Hospital.¹⁸ Our approach will be informed by the methodological framework proposed by
9
10 100 Arksey and O'Malley,¹⁷ as well as the methodology manual published by the Joanna Briggs Institute for
11
12 101 scoping reviews.¹⁹ This review has been commissioned by the Health Products and Food Branch (HPFB)
13
14 102 of Health Canada and funded by the Canadian Institutes of Health Research Drug Safety and
15
16 103 Effectiveness Network with a 6-month timeline.

19 104 **Protocol**

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21 105 Our protocol was drafted using the Preferred Reporting Items for Systematic Reviews and Meta-analysis
22
23 106 Protocols (PRISMA-P),²⁰ which was revised by the research team and members of Health Canada, and
24
25 107 was disseminated through our program's Twitter account (@KTCanada) and newsletter to solicit
26
27 108 additional feedback. The protocol will be posted on our institutional website.¹⁸

30 109 **Eligibility criteria**

31
32 110 The PICO (Population, Intervention, Comparator, Outcome, Study design)²¹ eligibility criteria is as
33
34 111 follows:

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36 112 **Population:** Patients of all ages with an adverse event related to health products which includes
37
38 113 pharmaceuticals and drug products, biologics, medical devices and natural health products.²² Examples
39
40 114 of pharmaceuticals and drug products include both prescription and non-prescription (over-the-counter)
41
42 115 medicines, disinfectants and sanitizers with disinfectant claims. Biologics can include, but are not limited
43
44 116 to: vaccines, insulin, serums, blood-derived products, hormones, growth factors and enzymes
45
46 117 manufactured in bacterial, yeast or mammalian cell lines; and gene therapy and cell therapy products.
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48 118 Medical devices can include defibrillators, syringes, surgical lasers, hip implants, medical laboratory
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50 119 diagnostic instruments (including X-ray, ultrasound devices), contact lenses, and condoms. Natural
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52 120 health products can include vitamins and minerals, herbal remedies, homeopathic and traditional
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3 121 medicines, probiotics, and other products like amino acids and essential fatty acids. Adverse events,
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5 122 such as addiction and overdose from prescription medical products are also eligible for inclusion.
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8 123 Adverse events related to programs of care, health services, organization of care, public health
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10 124 programs, health promotion programs, and health education programs were excluded.

11
12 125 **Intervention:** Any data analytics or social listening platforms that enable the extraction of user-
13
14 126 generated and crowd-sourced data about adverse events to health products from social media. Social
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16
17 127 media technology is defined as a web-based application that allows for the creation and exchange of
18
19 128 user-generated content. This includes, but is not limited to: websites, web pages, blogs, vlogs, social
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21 129 networks, Internet forums, chat rooms, wikis, and smartphone applications, where users have the ability
22
23 130 to generate content (typically by providing posts and comments, often in an anonymous fashion or with
24
25 131 limited identifying information) and are able to view/exchange content from and with others in an
26
27 132 interactive digital environment.²³ Crowd-sourcing is the practice of obtaining needed services, ideas, or
28
29 133 content by soliciting contributions from a large group of people and especially from the online
30
31 134 community rather than from traditional employees or suppliers.²⁴ Social media listening and data
32
33 135 analytics for public health surveillance related to non-communicable (e.g., disease prevalence) and
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35 136 communicable diseases (e.g., outbreak investigation) were excluded.

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38 137 **Comparators:** Any comparator is relevant for inclusion (e.g., studies comparing one form of social media
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40 138 or crowd-sourced data to another or comparing social media with traditional reporting systems). In
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42 139 addition, studies without a comparator are eligible for inclusion.

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45 140 **Outcomes:** There are two broad categories of outcomes that are of interest: (1) characteristics of social
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47 141 media listening and analytics platform (e.g., data sources, scope of surveillance, capabilities, data
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49 142 extraction, preprocessing data, annotation, text mining methods, computational frameworks, added
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51 143 value to existing surveillance capacities, technical skills required, infrastructure support to implement
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53 144 and sustain, privacy and security of the data); and, (2) validity of user-generated data through social
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3 145 media and crowd-sourcing networks (e.g., relationship between health technologies and adverse events,
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5 146 algorithms or processes used to validate the data, and related results of the evaluation).
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8 147 **Study designs:** All types of publications including published articles, articles in conference proceedings,
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10 148 editorials, websites, and chapters in textbooks are relevant.

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12 149 **Time periods:** All periods of time and duration of follow-up are eligible.

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14 150 **Other:** Given the 6-month timeline, only publications written in English will be considered for inclusion.

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16 151 If time allows, publications other languages may be considered.
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19 152 **Information sources and search strategy**

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21 153 Comprehensive literature search strategies were developed by an experienced librarian for the following
22
23 154 electronic bibliographic databases: MEDLINE, EMBASE, and the Cochrane Library. The search strategy
24
25 155 was peer-reviewed by another expert librarian using the PRESS (Peer Review of Electronic Search
26
27 156 Strategies) checklist.²⁵ The final search strategy incorporated feedback from the peer review process and
28
29 157 the complete search string for MEDLINE can be found in *Appendix A*. A trained library technician
30
31 158 performed the final searches from inception to May 2016, exported the search results into Endnote and
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33 159 removed all duplicates.
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37 160 A grey literature search was conducted according to the CADTH guide.²⁶ Specifically, we searched 59
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39 161 sources and websites of approximately 119 relevant regulatory authorities for additional publications or
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41 162 pre-existing platforms of social media listening and data analytics. Examples of such social media
42
43 163 listening and analytics platform include the MedWatcher Social created in collaboration with the US
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45 164 Food and Drug Administration and WEB-RADR for the European Union regulators.^{27 28} See *Appendix B*
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47 165 for a full list of grey literature sources that were searched. Literature saturation will be ensured by
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49 166 searching the reference lists of relevant reviews.
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52 167 **Study selection process**

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3 168 To ensure high inter-rater reliability, a training exercise will be conducted prior to commencing the
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5 169 screening process. Using our predefined eligibility criteria, a standardized questionnaire for study
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8 170 selection will be developed and tested on a random sample of 50 titles and abstracts (i.e., level 1
9
10 171 screening) by all team members. The same training exercise will be repeated for screening of full-text
11
12 172 articles (i.e., level 2 screening). Subsequently, pairs of reviewers will screen citations and full-text articles
13
14 173 for inclusion, independently, for both level 1 and level 2 screening. Inter-rater discrepancies will be
15
16 174 resolved by discussion or a third adjudicator. All levels of screening will be conducted using Synthesi.SR,
17
18 175 the proprietary online software developed by the Knowledge Synthesis Team.²⁹

19 20 21 22 176 **Data items and data abstraction process**

23
24 177 We will abstract data on characteristics of the articles (e.g., type of article or study, country of
25
26 178 corresponding author), population characteristics (e.g., type of patients, type of adverse events, disease
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28 179 condition), intervention characteristics (e.g., type of social media or crowd-sourced data used), and
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30 180 outcomes (e.g., platform characteristics, data analytics used, validity of social media or crowd-sourced
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32 181 data). A standardized data abstraction will be developed *a priori* and revised, as needed, after the
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34 182 completion of a training exercise.

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37 183 Prior to data abstraction, we will complete a training exercise of the data abstraction form on a random
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39 184 sample of 5 articles. Subsequently, all included studies will be abstracted by pairs of reviewers,
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41 185 independently. Data discrepancies will be resolved by discussion or the involvement of a third reviewer.

42 43 44 186 **Risk of bias assessment or quality appraisal**

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47 187 Since this is a scoping review aiming to map all available evidence, we will not conduct any risk of bias
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49 188 assessment or quality appraisal of included studies. This approach is consistent with the methods
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51 189 manual published by the Joanna Briggs Institute,¹⁹ as well as a database of scoping reviews on clinical
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53 190 topics.³⁰

54 55 56 191 **Synthesis of results**

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3 192 The synthesis will focus on providing a description of all social media and crowd-sourcing platforms that
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5 193 exist internationally, and the validity of data from these platforms when available. This will be achieved
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8 194 by summarizing the literature according to the types of participants, interventions, comparators, and
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10 195 outcomes identified. Quantitative analysis will be conducted using descriptive statistics (e.g.,
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12 196 frequencies, measures of central tendency). As well, we will consider qualitative analysis (e.g., content
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14 197 analysis) for open-text data, as necessary. Two reviewers will conduct the initial categorization coding
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17 198 independently, using NVivo software,³¹ and the results will be discussed by the team. These reviewers
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19 199 will subsequently identify, code, and chart relevant units of text from the articles using the
20
21
22 200 categorization code. Discrepancies will be resolved through team discussion.

201 **DISCUSSION**

202 **Implications**

203 Findings from this scoping review will inform decision-makers of the types of social listening and
204 analytics platforms that exist to extract user-generated data from social media for surveillance of
205 adverse events to health products. This will inform Health Canada and other regulatory authorities
206 internationally about the potential use of social media and crowd-sourced data for post-marketing
207 surveillance.

208 **Dissemination**

209 The summary of results will be sent to Health Canada and other relevant policy-makers and researchers
210 working with the Drug Safety and Effective Network in the form of a 1-page policy brief ([link](#) for an
211 example). As well, a 1-day stakeholder meeting (i.e., consultation exercise)¹⁷ will be held to discuss the
212 implications of our scoping review, key messages, and to finalize the knowledge translation strategy. All
213 relevant stakeholders will be invited to attend, as recommended by members from the Health Canada
214 HPFB. This meeting will be essential to ensure extensive knowledge translation of our findings and to
215 engage stakeholders and promote our research agenda. We will also present our results at an

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216 international conference and publish in an open-access journal. Finally, team members will use their
217 networks to encourage broad dissemination of results.

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3 218 **ETHICS APPROVAL**
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6 219 Since this is a scoping review, ethics approval is not required.
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10 220 **AUTHOR'S CONTRIBUTIONS**

11 221 ACT obtained funding, conceptualized the research, and drafted the protocol. WZ helped write the
12
13 222 protocol. EL and BP reviewed and edited the protocol. SES obtained funding, helped conceptualize the
14
15 223 research, and edited the protocol.
16
17

18
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20

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24
25 227 formatting the manuscript.
26
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28

29
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31

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33
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37
38 232 Research Chair in Knowledge Translation.
39
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42 233 **COMPETING INTERESTS**
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45 234 We have read and understood BMJ Open's policy on declaration of interests and declare that we have
46
47 235 no competing interests.
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Appendix A. MEDLINE search strategy

Interface: Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present

1. social media/
2. Social Networking/
3. blogging/
4. Crowdsourcing/
5. (social adj3 (media or medium* or network* or bookmark*)).tw.
6. (blog* or microblog*).tw.
7. ((patient or discussion or web or chat or internet or online) adj3 (forum* or fora or message board*)).tw.
8. (facebook or twitter or wiki or youtube or web 2* or instagram or foursquare or linkedin or pinterest or lifestream*).tw.
9. (crowdsourc* or crowd sourc*).tw.
10. or/1-9
11. product surveillance, postmarketing/ or adverse drug reaction reporting systems/ or pharmacovigilance/
12. exp "Drug-Related Side Effects and Adverse Reactions"/
13. (side effect* or (adverse adj3 (effect* or event* or reaction*))).tw.
14. (pharmacovigilance or ((postmarketing or post-marketing) adj3 surveillance)).tw.
15. Patient Safety/
16. ae.fs.
17. Pharmacoepidemiology/
18. Medication Errors/
19. Abnormalities, Drug-Induced/
20. ci.fs.
21. (drug* or medication* or pharmaceutical* or medicine* or biologics or vaccine* or herb* or vitamin*).tw.
22. ((medical or health) adj2 (device* or equipment* or instrument* or supply or supplies)).tw.
23. 21 or 22
24. (safe* or harm* or toxicity).tw.
25. 23 and 24
26. or/11-20,25
27. 10 and 26

Appendix B. Sources for Grey Literature Search

Adverse drug reporting / pharmacovigilance

- Australia - <https://www.ebs.tga.gov.au/ebs/ADRS/ADRSRepo.nsf?OpenDatabase>
- Canada - <http://www.hc-sc.gc.ca/dhp-mps/medeff/index-eng.php> AND <http://www.hc-sc.gc.ca/dhp-mps/medeff/report-declaration/index-eng.php>
- European database of ae - <http://www.adrreports.eu/en/>
- European pharmacovigilance database called EudraVigilance - <http://eudravigilance.ema.europa.eu/>
- UK Yellow card - <https://yellowcard.mhra.gov.uk> AND see <http://webarchive.nationalarchives.gov.uk/20141205150130/http://www.mhra.gov.uk/home/groups/pl-p/documents/websitesresources/con408250.pdf>
- US MedWatch - <http://www.fda.gov/Safety/MedWatch/>
- US Sentinel Initiative - <http://www.fda.gov/Safety/FDAsSentinelInitiative/ucm2007250.htm>
- US FAERS - <https://open.fda.gov/data/faers/>
- Vigibase - <http://www.who-umc.org/DynPage.aspx?id=98082&mn1=7347&mn2=7252&mn3=7322&mn4=7326>

Associations

- AIIM - <http://www.aiim.org>
- American Health Information Management Association - <http://www.ahima.org>
- CHIMA - <https://www.echima.ca>
- CIHI – www.cihi.ca
- COACH - <http://www.coachorg.com/en/index.asp>
- The Institute of Electrical and Electronics Engineers, Incorporated - <https://www.ieee.org/index.html>
- HIME - <https://www.efmi.org/index.php/workinggroups/hime-health-information-management-europe>
- HIMSS - <http://www.himss.eu>
- IMS Institute - <http://www.imshealth.com/en/thought-leadership/ims-institute>
- IFHIMA - <https://ifhima.org>
- IMIA - <http://www.imia-medinfo.org/new2/>
- Medicine for Europe - <http://www.medicinesforeurope.com>
- UK Chip - <http://www.ukchip.org>

See also: <http://www.healthinformaticsforum.com/health-informatics-associations-and-societies>

Regulatory authority websites:

Asia and Pacific

World Health Organization	World Health Organization
Pan-American Health Organization	Pan-American Health Organization
WHO Regional Office for Europe	WHO Regional Office for Europe
WHO Regional Office for Africa	WHO Regional Office for Africa

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WHO Regional Office for the Eastern
Mediterranean

[WHO Regional Office for the Eastern
Mediterranean](#)

WHO Regional Office for Southeast Asia

[WHO Regional Office for Southeast Asia](#)

WHO Regional Office for the Western Pacific
Food and Agriculture Organizations of the
United Nations

[WHO Regional Office for the Western Pacific
Food and Agriculture Organizations of the
United Nations](#)

Codex Alimentarius

[Codex Alimentarius](#)

World Trade Organization

[World Trade Organization](#)

Europe

Belgium: Health, Food Chain Safety and
Environment

[Belgium: Health, Food Chain Safety and
Environment](#)

Belgium: Pharmaceutical Inspectorate

Belgium: Pharmaceutical Inspectorate

Croatia: Ministry of Health and Social Care

[Croatia: Ministry of Health and Social Care](#)

Danish Medicines Agency

[Danish Medicines Agency](#)

Denmark: Ministry of Food, Agriculture and
Fisheries

[Denmark: Ministry of Food, Agriculture and
Fisheries](#)

Denmark: Ministry of Health

[Denmark: Ministry of Health](#)

Denmark: Veterinary and Food Administration

Denmark: Veterinary and Food Administration

Estonia: Ministry of Social Affairs

[Estonia: Ministry of Social Affairs](#)

Estonia: State Agency of Medicines

[Estonia: State Agency of Medicines](#)

European Commission Consumer

[European Commission Consumer](#)

Affairs: Medical Devices

[Affairs: Medical Devices](#)

European Commission Directorate General for
Health & Consumers

[European Commission Directorate General for
Health & Consumers](#)

European Commission Directorate General:

[European Commission Directorate General:](#)

Health Notice to Applicants

[Health Notice to Applicants](#)

European Commission Directorate General:

[European Commission Directorate General:](#)

Medicinal Products for Veterinary Use

[Medicinal Products for Veterinary Use](#)

European Medicines Agency

[European Medicines Agency \(EMA\)](#)

Finland: Ministry of Social Affairs and Health

[Finland: Ministry of Social Affairs and Health](#)

Finnish Food Safety Authority Evira

[Finnish Food Safety Authority Evira](#)

Finnish Medicines Agency

[Finnish Medicines Agency](#)

France: National Agency for Veterinary
Medicinal Products

France: National Agency for Veterinary
Medicinal Products

Germany: Federal Institute for Drugs and
Medical Devices

[Germany: Federal Institute for Drugs and
Medical Devices](#)

Germany: Ministry of Health

[Germany: Ministry of Health](#)

Greece: Hellenic Food Authority

Greece: Hellenic Food Authority

Greece: Hellenic Ministry of Agriculture

[Greece: Hellenic Ministry of Agriculture](#)

Greece: National Organization for Medicines

[Greece: National Organization for Medicines](#)

Iceland: The Environment Agency

[Iceland: The Environment Agency](#)

Ireland: Agriculture and Food Development
Authority

[Ireland: Agriculture and Food Development
Authority](#)

Ireland: Department of Health and Children

[Ireland: Department of Health and Children](#)

Ireland: Food Safety Authority

[Ireland: Food Safety Authority](#)

Irish Medicines Board

[Irish Medicines Board](#)

Lithuania: Ministry of Health

[Lithuania: Ministry of Health](#)

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3	Lithuania: State Medicines Control Agency	Lithuania: State Medicines Control Agency
4	Malta: Ministry of Health, Elderly and	Malta: Ministry of Health, Elderly and
5	Community Care	Community Care
6	Netherlands: Ministry of Health, Welfare and	Netherlands: Ministry of Health, Welfare and
7	Sport	Sport
8	Norway: Ministry of Agriculture and Food	Norway: Ministry of Agriculture and Food
9	Norway: Ministry of Health and Care Services	Norway: Ministry of Health and Care Services
10	Norway: Norwegian Board of Health	Norway: Norwegian Board of Health
11	Supervision	Supervision
12	Norway: Norwegian Medicines Agency	Norway: Norwegian Medicines Agency
13	Poland: Drug Institute	Poland: Drug Institute
14	Slovak Republic: Ministry of Agriculture and	Slovak Republic: Ministry of Agriculture and
15	Rural Development	Rural Development
16	Slovenia: Ministry of Agriculture, Forestry and	Slovenia: Ministry of Agriculture, Forestry and
17	Food	Food
18	Sweden: Medical Products Agency	Sweden: Medical Products Agency
19	Sweden: Ministry for Rural Affairs	Sweden: Ministry for Rural Affairs
20	Sweden: National Food Administration	Sweden: National Food Administration
21	Switzerland: Federal Office of Public Health	Switzerland: Federal Office of Public Health
22	Switzerland: Federal Veterinary Office	Switzerland: Federal Veterinary Office
23	UK: Department of Health	UK: Department of Health
24	UK: Food Standards Agency	UK: Food Standards Agency
25	UK: Health Protection Agency	UK: Health Protection Agency
26	UK: Medicines and Healthcare Products	UK: Medicines and Healthcare Products
27	Regulatory Agency	Regulatory Agency
28	UK: National Institute for Biological Standards	UK: National Institute for Biological Standards
29	and Control	and Control
30	UK: Veterinary Medicines Directorate	UK: Veterinary Medicines Directorate
31	Middle East	
32	Israel: Ministry of Health	Israel: Ministry of Health
33	Israel: Ministry of Industry, Trade and Labor	Israel: Ministry of Industry, Trade and Labor
34	Jordan: Ministry of Health	Jordan: Ministry of Health
35	Lebanon: Ministry of Public Health	Lebanon: Ministry of Public Health
36	Saudi Arabia: Ministry of Health	Saudi Arabia: Ministry of Health
37	United Arab Emirates: Ministry of Health	United Arab Emirates: Ministry of Health
38	United Arab Emirates: Federal Department of	United Arab Emirates: Federal Department of
39	Pharmacies	Pharmacies
40	Yemen: Ministry of Public Health & Population	Yemen: Ministry of Public Health & Population
41	Africa	
42	Botswana: Ministry of Health	Botswana: Ministry of Health
43	Egypt: Ministry of Agriculture and Land	Egypt: Ministry of Agriculture and Land
44	Reclamation	Reclamation
45	Ghana: Ministry of Health	Ghana: Ministry of Health
46	Ghana: Ministry of Food and Agriculture	Ghana: Ministry of Food and Agriculture
47	Kenya: Ministry of Health	Kenya: Ministry of Health
48	Maldives: Ministry of Health	Maldives: Ministry of Health
49	Mauritius: Ministry of Health & Quality of Life	Mauritius: Ministry of Health & Quality of Life
50	Mauritius: Ministry of Agro Industry and Food	Mauritius: Ministry of Agro Industry and Food
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3	Security	Security
4	Namibia: Ministry of Health and Social	Namibia: Ministry of Health and Social
5	Services	Services
6	Namibia: Ministry of Fisheries and Marine	Namibia: Ministry of Fisheries and Marine
7	Resources	Resources
8	South Africa: Department of Health	South Africa: Department of Health
9	Swaziland: Ministry of Health and Social	Swaziland: Ministry of Health and Social
10	Welfare	Welfare
11	Tanzania: Ministry of Health	Tanzania: Ministry of Health
12	Uganda: Ministry of Health	Uganda: Ministry of Health
13	Zimbabwe: Ministry of Health and Child	Zimbabwe: Ministry of Health and Child
14	Welfare	Welfare
15		
16	America	
17	Belize: Ministry of Health	Belize: Ministry of Health
18	Bolivia: Ministry of Health and Social Welfare	Bolivia: Ministry of Health and Social Welfare
19	Brazil: Fundacao Oswaldo Cruz	Brazil: Fundacao Oswaldo Cruz
20	Canada: Food Inspection Agency	Canada: Food Inspection Agency
21	Canada: Health Products and Food Branch	Canada: Health Products and Food Branch
22	Guyana: Ministry of Health	Guyana: Ministry of Health
23	Guyana: National Bureau of Standards	Guyana: National Bureau of Standards
24	Jamaica: Ministry of Health	Jamaica: Ministry of Health
25	Mexico: Federal Commission for the	Mexico: Federal Commission for the Protection
26	Protection Against Sanitary Risks	Against Sanitary Risks
27	Netherlands Antilles: Department of Public	Netherlands Antilles: Department of Public
28	Health and Environmental Protection	Health and Environmental Protection
29	St. Lucia: Ministry of Agriculture, Lands	St. Lucia: Ministry of Agriculture, Lands Forestry
30	Forestry and Fisheries	and Fisheries
31	Trinidad & Tobago: Bureau of Standards	Trinidad & Tobago: Bureau of Standards
32	Trinidad and Tobago: Ministry of Health	Trinidad and Tobago: Ministry of Health
33		
34	Multinational	
35	World Health Organization	World Health Organization
36	Pan-American Health Organization	Pan-American Health Organization
37	WHO Regional Office for Europe	WHO Regional Office for Europe
38	WHO Regional Office for Africa	WHO Regional Office for Africa
39	WHO Regional Office for the Eastern	WHO Regional Office for the Eastern
40	Mediterranean	Mediterranean
41	WHO Regional Office for Southeast Asia	WHO Regional Office for Southeast Asia
42	WHO Regional Office for the Western Pacific	WHO Regional Office for the Western Pacific
43	Food and Agriculture Organizations of the	Food and Agriculture Organizations of the
44	United Nations	United Nations
45	Codex Alimentarius	Codex Alimentarius
46	World Trade Organization	World Trade Organization
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53	Crowdsourcing – medical focus	
54	• https://www.crowdfunder.com/discovering-drug-side-effects-with-crowdsourcing/ -	
55	allow researchers to design and submit crowdsourcing tasks	
56	• http://www.sermo.com - a global social crowdsourcing network for physicians and	
57	medical providers	
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- <http://www.medhelp.org>
- <http://curetogether.com>
- <https://www.upwork.com>
- <https://fold.it/portal/>
- <https://www.mturk.com/mturk/welcome>
- <https://www.patientslikeme.com>

Stanford links:

- http://crowdresearch.stanford.edu/w/index.php?title=Introducing_Crowd_Research_Initiative_and_Recap

Resources

- [Relevant Work](#) - used to save relevant articles, links and papers
- [Forums](#) - discussions about this project on external sites. Note that all official announcements and communications will occur via Slack and email.
- [Resources](#) - used to index all platforms and resources as we evolve
- [Infrastructure](#) and [GettingStarted](#)
- [Archives](#) - older meetings, slides and milestones
<http://voxpopuli.stanford.edu>
- <http://stanfordhci.github.io/twitchcrowdsourcing/>
- <https://github.com/crowdresearch/crowdsource-platform>

Government drug regulators (this list is key, however, see the WHO list for all countries or EMA for Europe) and related research agencies

- Australia – Therapeutic Good Administration - <http://www.tga.gov.au>
- Canada data - <http://open.canada.ca/en>
- Canada ICES - <http://www.ices.on.ca/About-ICES.aspx>
- European Commission - http://ec.europa.eu/growth/index_en.htm and http://ec.europa.eu/health/human-use/advanced-therapies/index_en.htm
- European Medicines Agency –
http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/document_listing/document_listing_000345.jsp - see guideline and module
 - Full list of European country agencies:
http://www.ema.europa.eu/ema/index.jsp?curl=pages/medicines/general/general_content_000155.jsp
- Finish Medicine Agency - <http://www.fimea.fi/web/en/frontpage>
- France - <http://www.afssaps.fr>
- Germany – Federal Institute for Drugs
http://www.bfarm.de/EN/Home/home_node.html;jsessionid=7CCFCA856FC813AC19DD69E86C4742CB.1_cid322
- Health Canada - <http://www.hc-sc.gc.ca/dhp-mps/index-eng.php>
- NEHI - <http://www.nehi.net>
- Netherland Medicines Evaluation Board - <http://english.cbg-meb.nl>
- New Zealand - <http://www.health.govt.nz>
- PHAC - <http://www.phac-aspc.gc.ca/index-eng.php>
- StatsCan - <http://www.statcan.gc.ca>

- Sweden - <https://lakemedelsverket.se/english/>
- US data - <https://www.data.gov>
- US CDC - <http://www.cdc.gov>
- US IOM - <http://www.nationalacademies.org/hmd/>
- US FDA
 - (FEARS) – <http://www.fda.gov/Drugs/GuidanceComplianceRegulatoryInformation/Surveillance/AdverseDrugEffects/ucm083765.htm>
- US NIH - <https://www.nih.gov>
- US NIMH - <http://www.nimh.nih.gov/>
- UK Medicine and Health products Regulator Agency - <https://www.gov.uk/government/organisations/medicines-and-healthcare-products-regulatory-agency>
- WHO – search site, publications section and WHOLIS database
 - <http://www.who-umc.org/DynPage.aspx?id=98080&mn1=7347&mn2=7252&mn3=7322&mn4=7324>
 - <http://www.who.int/en/>
 - <http://www.who.int/library/databases/en/>
 - **See List of Globally identified Websites of Medicines Regulatory Authorities - http://www.who.int/medicines/areas/quality_safety/regulation_legislation/list_mra_websites_nov2012.pdf OR <https://www.pda.org/scientific-and-regulatory-affairs/regulatory-resources/global-regulatory-authority-websites>**

Pharma-related

- FDABLE - http://www.fdable.com/basic_query/aers
- EudraVigiance: <http://eudravigilance.ema.europa.eu/highres.htm>
- Social Media, Mobile, Wearable News & Views - <http://www.scoop.it/t/pharmaguy-social-media-news-views/?tag=adverse+events>
- Innovative medicine initiative: <http://www.imi.europa.eu>

Software

- Open PHACTS - <https://www.openphacts.org> and <http://www.openphactsfoundation.org>
- DebugIT - <http://www.debugit.com.au>
- Khresmoi - <http://khresmoi.atosresearch.eu>
- EHR4CR - <http://www.ehr4cr.eu>

Articles

Suggest to do 1) an author search on Clark Freifeld and 2) a web of science search of his publications for related articles.

- **Digital pharmacovigilance: The MedWatcher system for monitoring adverse events through automated processing of Internet social media and crowdsourcing (Thesis).**

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- Freifeld, Clark C., Ph.D., BOSTON UNIVERSITY, 2014, 148 pages;
3581025<http://gradworks.umi.com/35/81/3581025.html>
- Freifeld CC, Chunara R, Mekaru SR, Chan EH, Kass-Hout T, et al. (2010) Participatory Epidemiology: Use of Mobile Phones for Community-Based Health Reporting. *PLoS Med* 7(12): e1000376. doi:10.1371/journal.pmed.1000376
 - Freifeld CC, Brownstein JS, Menone CM *et al.* Digital drug safety surveillance: monitoring pharmaceutical products in Twitter. *Drug Safety* 2014;37:343–350.

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- Guidance for Industry Internet/Social Media Platforms with Character Space Limitations— Presenting Risk and Benefit Information for Prescription Drugs and Medical Devices -
<http://www.fda.gov/downloads/drugs/guidancecomplianceregulatoryinformation/guidances/ucm401087.pdf>
- Inman WH: Attitudes to adverse drug-reaction reporting. *Br J Clin Pharmacol* 1996; 41:433-435
 - Lardon J, Abdellaoui R, Bellet F, Asfari H, Souvignet J, Texier N, Jaulent MC, Beyens MN, Burgun A, Bousquet C. Adverse Drug Reaction Identification and Extraction in Social Media: A Scoping Review *J Med Internet Res* 2015;17(7):e171.
<http://www.jmir.org/2015/7/e171/>
 - Lopez- Gonzalez E, Herdeiro MT, Figueiras A: Determinants of under-reporting of adverse drug reactions: a systematic review. *Drug Saf* 2009; 32:19-31; Hugman B. The fatal love of forms. *Drug Saf* 2011; 34 (8): 705-707.
 - R. Edwards and M. Lindquist: Social Media and Networks in Pharmacovigilance. Boon or Bane? *Drug Saf* 2011; 34 (4): 267-271
 - Manhattan Research 2011. Cybercitizen Health Europe v10.0. Manhattan Research 2009. Navigating the European eHealth Landscape.
 - Sai Moturu and Huan Liu. "Quantifying the Trustworthiness of Social Media Content", *Journal of Distributed and Parallel Databases*, Springer, Volume 29, January 4, 2011. DOI: 10.1007/s10619-010-7077-0. Geoffrey Barbier, and Huan Liu. *Information Provenance in Social Media*. SBP 2011: 276-283. Springer-Verlag Berlin, Heidelberg, ISBN: 978-3-642-19655-3
 - The Impact and Use of Social Media in Pharmacovigilance - https://www.sciformix.com/wp-content/uploads/Social_Media_in_PV_Whitepaper.pdf
 - See report WEBAE project (Web Adverse Events) - http://www.imi.europa.eu/webfm_send/912

BMJ Open

Utility of social media and crowd-sourced data for pharmacovigilance: A scoping review protocol

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2016-013474.R1
Article Type:	Protocol
Date Submitted by the Author:	01-Dec-2016
Complete List of Authors:	Tricco, Andrea; St Michael's Hospital, Li Ka Shing Knowledge Institute; University of Toronto, Epidemiology Division, Dalla Lana School of Public Health Zarin, Wasifa; St. Michael's Hospital, Li Ka Shing Knowledge Institute Lillie, Erin; St. Michael's Hospital, Li Ka Shing Knowledge Institute Pham, Ba; St. Michael's Hospital, Li Ka Shing Knowledge Institute Straus, Sharon; St. Michael's Hospital, Li Ka Shing Knowledge Institute; University of Toronto, Department of Geriatric Medicine, Faculty of Medicine
Primary Subject Heading:	Health services research
Secondary Subject Heading:	Pharmacology and therapeutics, Public health, Health policy
Keywords:	surveillance, adverse event, scoping review, social media, data analytics

SCHOLARONE™
Manuscripts

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3 1 **Utility of social media and crowd-sourced data for pharmacovigilance: A scoping review protocol**
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7
8 3 Andrea C. Tricco,^{1,2*} email: TriccoA@smh.ca
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12 5 Erin Lillie,¹ email: LillieE@smh.ca
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48 21 Phone: 416-864-6060 ext. 77521, e-mail: TriccoA@smh.ca
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52 22 **Word count:** 300 (abstract), 2,292 (main text)
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54 23 **Keywords:** surveillance, adverse event, scoping review, social media, data analytics
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3 24 **ABSTRACT**
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5 25 **Introduction:** Adverse events associated with medications are underreported in post-marketing
6
7
8 26 surveillance systems. A systematic review of published data from 37 studies worldwide (including
9
10 27 Canada) found the median underreporting rate of adverse events to be 94% in spontaneous reporting
11
12 28 systems. This scoping review aims to assess the utility of social media and crowd-sourced data to detect
13
14 29 and monitor adverse events related to health products including pharmaceuticals, medical devices,
15
16 30 biologics, and natural health products.
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19
20 31 **Methods and analysis:** Our review conduct will follow the Joanna Briggs Institute scoping reviews
21
22 32 methods manual. Literature searches were conducted in MEDLINE, EMBASE, and the Cochrane Library
23
24 33 from inception to May 13, 2016. Additional sources included searches of study registries, conference
25
26 34 abstracts, dissertations, as well as websites of international regulatory authorities (e.g., FDA, World
27
28 35 Health Organization, European Medicines Agency). Search results will be supplemented by scanning the
29
30 36 references of relevant reviews. We will include all publication types including published articles,
31
32 37 editorials, websites, and book sections that describe use of social media and crowd-sourced data for
33
34 38 surveillance of adverse events associated with health products. Two reviewers will perform study
35
36 39 selection and data abstraction independently, and discrepancies will be resolved through discussion.
37
38 40 Data analysis will involve quantitative (e.g., frequencies) and qualitative (e.g., content analysis) methods.
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43 44 **Dissemination:** The summary of results will be sent to Health Canada, who commissioned the review,
45
46 47 and other relevant policy-makers involved with the Drug Safety and Effective Network. We will compile
47
48 49 and circulate a 1-page policy brief and host a 1-day stakeholder meeting to discuss the implications, key
49
50 51 messages, and finalize the knowledge translation strategy. Findings from this review will ultimately
51
52 53 inform the design and development of a data analytics platform for social media and crowd-sourced dat
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54 55 for pharmacovigilance in Canada, and internationally.
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47 **Registration details:** Our protocol was registered prospectively with the Open Science Framework
48 (<https://osf.io/kv9hu/>).

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For peer review only

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3 50 **STRENGTHS AND LIMITATIONS**
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- 6 51 ▪ *We will conduct a comprehensive literature search of multiple electronic databases and sources for*
7
8 52 *difficult to locate and unpublished studies (or grey literature).*
9
10 53 ▪ *Our scoping review will conform to the methodologically rigorous methods manual by the Joanna*
11
12 54 *Briggs Institute.*
13
14 55 ▪ *Numerous strategies will be used to disseminate our results widely.*
15
16 56 ▪ *To increase the feasibility of our scoping review, we will limit to English and have one data abstractor*
17
18 57 *and one verifier.*
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59 INTRODUCTION

60 Social media has gained unprecedented popularity worldwide. Currently, there are over 2.3 billion active
61 social media users, and grows by an estimated 1 million new users every day.¹ Social media platforms
62 such as Twitter, Tumblr and Facebook are increasingly being used to discuss and share health issues.
63 Statistics Canada revealed that over 80% of Canadians were internet users as of 2009,² and almost 70%
64 of these individuals were using the internet to search for medical or health-related information.³ Social
65 media and crowd-sourced data have been used to successfully extract information for surveillance of
66 disease outbreaks,^{4,5} health behaviour,^{6,7} and patient views on health issues.⁸

67 The use of social media to exchange and discuss health information by the general public generates a
68 large volume of unsolicited and real-time information. Health related social networks, such as
69 DailyStrength and MedHelp, attract users daily to discuss their health-related experiences, including use
70 of prescription drugs, health products, side effects and treatments. During the 2004-2005 flu season,
71 social media listening by means of a Google 'click ad', which appeared on the search page when
72 information-seekers typed influenza-specific key words into the Google search engine, closely
73 approximated the incident of influenza cases.⁹ It was revealed that the Google ad click-rate correlated
74 more closely with retrospectively confirmed cases of influenza than the Physicians Sentinel Surveillance
75 system for "influenza-like illness".⁹ Other researchers have also examined the use of social media for
76 influenza outbreaks.¹⁰⁻¹² Similarly, during the Canadian listeriosis outbreak, online search trends related
77 to listeriosis correlated closely with laboratory-confirmed cases determined retrospectively, and
78 preceded official announcements of an epidemic.¹³

79 And more recently, researchers evaluated the types of information¹⁴ including the prevalence of
80 misinformation¹⁵ posted on Twitter and the Sina Weibo Chinese microblog platform related to the
81 2014-2015 Ebola epidemic. Given the observed predictive power of social media and crowd-sourced

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3 82 data as an information source for public health surveillance, a lot of interest has been generated about
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5 83 its use for surveillance of adverse events to health products, often referred to as pharmacovigilance.
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8 84 Pharmacovigilance is defined as ‘the science and activities relating to the detection, assessment,
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10 85 understanding and prevention of adverse effects or any other drug-related problem’.¹⁶ It includes drug
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12 86 safety surveillance activities to monitor incidents of adverse effects in real-life conditions. Adverse
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14 87 events, in particular to drug use, are a significant cause of morbidity and mortality, and are the fourth
15
16 88 most common cause of death in hospitalized patients.¹⁷ Since many adverse events are not captured in
17
18 89 randomised clinical trials, post-marketing surveillance of health and drug products is of paramount
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20 90 importance for drug and health technology industries and regulatory authorities, such as Health Canada,
21
22 91 the US Food and Drug Administration (FDA), and European Medicines Agency (EMA). These
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24 92 governmental agencies require clinicians to report all suspected adverse events, but the voluntary
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26 93 nature of the reporting systems likely contributes to the under-reporting of adverse events.¹⁸⁻²⁰ A
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28 94 systematic review of published data from 37 studies worldwide (including Canada) found the median
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30 95 under-reporting rate of adverse events to be 94% in spontaneous reporting systems. In response to the
31
32 96 limitations in the current post-marketing surveillance systems, attention is being directed towards using
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34 97 social media and crowd-sourced data to detect adverse events and to improve consumer safety.
35
36 98 Reviews have been conducted assessing social media for pharmacovigilance, such as a systematic review
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38 99 including 51 studies²² and a scoping review including 24 studies,²³ but this is a rapidly evolving field and
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40 100 an updated scoping review with a comprehensive grey literature search may provide more clarity to the
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42 101 field. As well, these previous reviews did not summarize pre-existing platforms that exist on this topic,
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44 102 which was requested by our knowledge user, Health Canada.
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46 103 As such, we aim to assess the utility of social media and crowd-sourced data to monitor and detect
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48 104 adverse events related to health products. For the purpose of this review, health products include
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3 105 pharmaceuticals and drug products, medical devices, biologics, and natural health products. The specific
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5 106 research questions are:

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8 107 (1) What social listening and analytics platforms exist internationally to detect adverse events related to
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10 108 health products using social media and crowd-sourced data? What are their capabilities and
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12 109 characteristics?

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15 110 (2) What is the validity and reliability of user-generated data from social media for surveillance of
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17 111 adverse events to health products?

18 19 20 112 **METHODS**

21 22 113 **Study Design**

23
24 114 Our research objectives will be addressed using the scoping review methodology, which is a type of
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26 115 knowledge synthesis approach used to map the concepts underpinning a research area and the main
27
28 116 sources and types of evidence available.²⁴ This scoping review will be conducted in accordance to
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30 117 standard practices used by the Knowledge Synthesis Team within the Knowledge Translation Program of
31
32 118 St Michael's Hospital.²⁵ Our approach will be informed by the methodological framework proposed by
33
34 119 Arksey and O'Malley,²⁴ as well as the methodology manual published by the Joanna Briggs Institute for
35
36 120 scoping reviews.²⁶ This review has been commissioned by the Health Products and Food Branch (HPFB)
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38 121 of Health Canada and funded by the Canadian Institutes of Health Research Drug Safety and
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40 122 Effectiveness Network with a 6-month timeline.

41 42 43 123 **Protocol**

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46 124 Our protocol was drafted using the Preferred Reporting Items for Systematic Reviews and Meta-analysis
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48 125 Protocols (PRISMA-P; see *Appendix A*),²⁷ which was revised by the research team and members of
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50 126 Health Canada, and was disseminated through our program's Twitter account (@KTCanada) and
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52 127 newsletter to solicit additional feedback. The final protocol was registered prospectively with the Open
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54 128 Science Framework on September 6, 2016 (<https://osf.io/kv9hu/>).

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3 129 **Eligibility criteria**
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5 130 The PICO (Population, Intervention, Comparator, Outcome, Study design)²⁸ eligibility criteria is as
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8 131 follows:

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10 132 **Population:** Patients of any age with an adverse event related to health products including
11
12 133 pharmaceuticals and drug products, biologics, medical devices and natural health products.²⁹ Examples
13
14 134 of pharmaceuticals and drug products include both prescription and non-prescription (over-the-counter)
15
16 135 medicines, disinfectants and sanitizers with disinfectant claims. Biologics can include, but are not limited
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18 136 to: vaccines, insulin, serums, blood-derived products, hormones, growth factors and enzymes
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20 137 manufactured in bacterial, yeast or mammalian cell lines; and gene therapy and cell therapy products.
21
22 138 Medical devices can include defibrillators, syringes, surgical lasers, hip implants, medical laboratory
23
24 139 diagnostic instruments (including X-ray, ultrasound devices), contact lenses, and condoms. Natural
25
26 140 health products can include vitamins and minerals, herbal remedies, homeopathic and traditional
27
28 141 medicines, probiotics, and other products like amino acids and essential fatty acids. Adverse events,
29
30 142 such as addiction and overdose from prescription medical products are also eligible for inclusion.
31
32 143 Adverse events related to programs of care, health services, organization of care, public health
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34 144 programs, health promotion programs, and health education programs were excluded.
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38 145 **Intervention:** Any data analytics or social listening platforms that enable the extraction of user-
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40 146 generated and crowd-sourced data about adverse events to health products from social media. Social
41
42 147 media technology is defined as a web-based application that allows for the creation and exchange of
43
44 148 user-generated content. This includes, but is not limited to: websites, web pages, blogs, vlogs, social
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46 149 networks, Internet forums, chat rooms, wikis, and smartphone applications, where users have the ability
47
48 150 to generate content (typically by providing posts and comments, often in an anonymous fashion or with
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50 151 limited identifying information) and are able to view/exchange content from and with others in an
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52 152 interactive digital environment.³⁰ Crowd-sourcing is the practice of obtaining needed services, ideas, or
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3 153 content by soliciting contributions from a large group of people and especially from the online
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5 154 community rather than from traditional employees or suppliers.³¹ Social media listening and data
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8 155 analytics for public health surveillance related to non-communicable (e.g., disease prevalence) and
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10 156 communicable diseases (e.g., outbreak investigation) were excluded.

11
12 157 **Comparators:** Any comparator is relevant for inclusion (e.g., studies comparing one form of social media
13
14 158 or crowd-sourced data to another or comparing social media with traditional reporting systems). In
15
16 159 addition, studies without a comparator are eligible for inclusion.

17
18 160 **Outcomes:** There are two broad categories of outcomes that are of interest: (1) characteristics of social
19
20 161 media listening and analytics platform (e.g., data sources, scope of surveillance, capabilities, data
21
22 162 extraction, preprocessing data, annotation, text mining methods, computational frameworks, added
23
24 163 value to existing surveillance capacities, technical skills required, infrastructure support to implement
25
26 164 and sustain, privacy and security of the data); and, (2) validity and reliability of user-generated data
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28 165 captured through social media and crowd-sourcing networks (e.g., relationship between medications
29
30 166 and adverse events, algorithms or processes used to validate the data from social media, and related
31
32 167 results of the evaluation).

33
34 168 **Study designs:** All types of publications including published articles, articles in conference proceedings,
35
36 169 editorials, websites, and chapters in textbooks are relevant.

37
38 170 **Time periods:** All periods of time and duration of follow-up are eligible.

39
40 171 **Other:** Given the 6-month timeline, only publications written in English will be considered for inclusion.

41
42 172 If time allows, publications other languages may be considered.

43 44 173 **Information sources and search strategy**

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46 174 Comprehensive literature search strategies were developed by an experienced librarian for the following
47
48 175 electronic bibliographic databases: MEDLINE, EMBASE, and the Cochrane Library. The search strategy
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50 176 was peer-reviewed by another expert librarian using the PRESS (Peer Review of Electronic Search
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3 177 Strategies) checklist.³² The final search strategy incorporated feedback from the peer review process and
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5 178 the complete search string for MEDLINE can be found in *Appendix B*. The full search terms for the other
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7
8 179 databases can be obtained by contacting the corresponding author. A trained library technician
9
10 180 performed the final searches from inception to May 2016, exported the search results into Endnote and
11
12 181 removed all duplicates.

13
14 182 A grey literature search was conducted according to the CADTH guide.³³ Specifically, we searched 59
15
16 183 sources and websites of approximately 119 relevant regulatory authorities for additional publications or
17
18 184 pre-existing platforms of social media listening and data analytics. Examples of such social media
19
20 185 listening and analytics platforms include the MedWatcher Social created in collaboration with the US
21
22 186 Food and Drug Administration and WEB-RADR for the European Union regulators.^{34 35} See *Appendix C*
23
24 187 for a full list of grey literature sources that were searched. Literature saturation will be ensured by
25
26 188 searching the reference lists of relevant reviews^{22 23 36}.

30 31 189 **Study selection process**

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33 190 To ensure high inter-rater reliability, a training exercise will be conducted prior to commencing the
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35 191 screening process. Using our predefined eligibility criteria, a standardized questionnaire for study
36
37 192 selection will be developed and tested on a random sample of 50 titles and abstracts (i.e., level 1
38
39 193 screening) by all team members. The same training exercise will be repeated for screening of full-text
40
41 194 articles (i.e., level 2 screening). Subsequently, pairs of reviewers will screen citations and full-text articles
42
43 195 for inclusion, independently, for both level 1 and level 2 screening. Inter-rater discrepancies will be
44
45 196 resolved by discussion or a third adjudicator. All levels of screening will be conducted using Synthesi.SR,
46
47 197 the proprietary online software developed by the Knowledge Synthesis Team.³⁷

50 51 198 **Data items and data abstraction process**

52
53 199 We will abstract data on characteristics of the articles (e.g., type of article or study, country of
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55 200 corresponding author), population characteristics (e.g., type of patients, type of adverse events, disease
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3 201 condition), intervention characteristics (e.g., type of social media or crowd-sourced data used), and
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5 202 outcomes (e.g., data analytics/listening platform characteristics, data analytics used, validity and
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8 203 reliability of social media or crowd-sourced data). A standardized data abstraction form will be
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10 204 developed *a priori* and revised, as needed, after the completion of a training exercise.

11
12 205 Prior to data abstraction, we will complete a training exercise of the data abstraction form on a random
13
14 206 sample of 5 articles. Subsequently, all included studies will be abstracted by pairs of reviewers,
15
16
17 207 independently, with conflicts resolved by a third reviewer. If a large number of studies is identified
18
19 208 (>25), we will conduct data abstraction with one reviewer and one verifier.

21 209 **Risk of bias assessment or quality appraisal**

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24 210 Since this is a scoping review aiming to map all available evidence, we will not conduct any risk of bias
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26 211 assessment or quality appraisal of included studies. This approach is consistent with the methods
27
28 212 manual published by the Joanna Briggs Institute,²⁶ as well as a database of scoping reviews on clinical
29
30 213 topics.³⁸

31 214 **Synthesis of results**

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34 215 The synthesis will focus on providing a description of all social media listening platforms that exist
35
36 216 internationally, and the validity and reliability of data from these social listening platforms, when
37
38 217 available. This will be achieved by summarizing the literature according to the types of participants,
39
40 218 interventions, comparators, and outcomes identified. Quantitative analysis will be conducted using
41
42 219 descriptive statistics (e.g., frequencies, measures of central tendency). As well, we will consider
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44 220 qualitative analysis (e.g., content analysis) for open-text data, as necessary. Two reviewers will conduct
45
46 221 the initial categorization coding independently, using NVivo software,³⁹ and the results will be discussed
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48 222 by the team. These reviewers will subsequently identify, code, and chart relevant units of text from the
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50 223 articles using the categorization code. Discrepancies will be resolved through team discussion.
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54 224 **DISCUSSION**

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3 225 **Implications**
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5 226 Findings from this scoping review will inform decision-makers of the types of social listening and
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7 227 analytics platforms that exist to extract user-generated data from social media for surveillance of
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10 228 adverse events to health products. This will inform Health Canada and other regulatory authorities
11
12 229 internationally about the potential use of social media and crowd-sourced data for post-marketing
13
14 230 surveillance.

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17 231 **Dissemination**
18

19 232 The summary of results will be sent to Health Canada and other relevant policy-makers and researchers
20
21 233 working with the Drug Safety and Effective Network in the form of a 1-page policy brief ([link](#) for an
22
23 234 example). As well, a 1-day stakeholder meeting (i.e., consultation exercise)²⁴ will be held to discuss the
24
25 235 implications of our scoping review, key messages, and to finalize the knowledge translation strategy. All
26
27 236 relevant stakeholders will be invited to attend, as recommended by members from the Health Canada
28
29 237 HPFB. This meeting will be essential to ensure extensive knowledge translation of our findings and to
30
31 238 engage stakeholders and promote our research agenda. We will also present our results at an
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33 239 international conference and publish in an open-access journal. Finally, team members will use their
34
35 240 networks to encourage broad dissemination of results.
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3 241 **ETHICS APPROVAL**
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6 242 Since this is a scoping review, ethics approval is not required.
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9 243 **AUTHOR'S CONTRIBUTIONS**
10

11 244 ACT obtained funding, conceptualized the research, and drafted the protocol. WZ helped write the
12
13 245 protocol. EL and BP reviewed and edited the protocol. SES obtained funding, helped conceptualize the
14
15 246 research, and edited the protocol.
16
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18

19 247 **ACKNOWLEDGMENTS**
20

21
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23
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25
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27
28
29

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31

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33
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35
36 254 Network (CIHR/DSEN) New Investigator Award in Knowledge Synthesis. SES is funded by a Tier 1 Canada
37
38 255 Research Chair in Knowledge Translation.
39
40
41

42 256 **COMPETING INTERESTS**
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44
45 257 We have read and understood BMJ Open's policy on declaration of interests and declare that we have
46
47 258 no competing interests. The study funder had no input into the study design; in the collection, analysis,
48
49 259 and interpretation of data; in the writing of the report; and in the decision to submit the paper for
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51 260 publication.
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3 261 **SUPPLEMENTARY FILES**
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5 262 **Appendix A.** PRISMA checklist
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7 263 **Appendix B.** MEDLINE search strategy
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10 264 **Appendix C.** Sources for Grey Literature Search
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For peer review only

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Appendix A: PRISMA-P 2015 Checklist

This checklist has been adapted for use with protocol submissions to *Systematic Reviews* from Table 3 in Moher D et al: Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic Reviews* 2015 4:1

Section/topic	#	Checklist item	Information reported		Line number(s)
			Yes	No	
ADMINISTRATIVE INFORMATION					
Title					
Identification	1a	Identify the report as a protocol of a systematic review	<input checked="" type="checkbox"/>	<input type="checkbox"/>	1
Update	1b	If the protocol is for an update of a previous systematic review, identify as such	<input type="checkbox"/>	<input type="checkbox"/>	NA
Registration	2	If registered, provide the name of the registry (e.g., PROSPERO) and registration number in the Abstract	<input checked="" type="checkbox"/>	<input type="checkbox"/>	47-48
Authors					
Contact	3a	Provide name, institutional affiliation, and e-mail address of all protocol authors; provide physical mailing address of corresponding author	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3-21
Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review	<input checked="" type="checkbox"/>	<input type="checkbox"/>	243-246
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	<input type="checkbox"/>	<input type="checkbox"/>	NA
Support					
Sources	5a	Indicate sources of financial or other support for the review	<input checked="" type="checkbox"/>	<input type="checkbox"/>	251-255
Sponsor	5b	Provide name for the review funder and/or sponsor	<input checked="" type="checkbox"/>	<input type="checkbox"/>	252
Role of sponsor/funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	<input checked="" type="checkbox"/>	<input type="checkbox"/>	258-260
INTRODUCTION					
Rationale	6	Describe the rationale for the review in the context of what is already known	<input checked="" type="checkbox"/>	<input type="checkbox"/>	70-102
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	103-111

Section/topic	#	Checklist item	Information reported		Line number(s)
			Yes	No	
METHODS					
Eligibility criteria	8	Specify the study characteristics (e.g., PICO, study design, setting, time frame) and report characteristics (e.g., years considered, language, publication status) to be used as criteria for eligibility for the review	<input checked="" type="checkbox"/>	<input type="checkbox"/>	129-172
Information sources	9	Describe all intended information sources (e.g., electronic databases, contact with study authors, trial registers, or other grey literature sources) with planned dates of coverage	<input checked="" type="checkbox"/>	<input type="checkbox"/>	173-188
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	<input checked="" type="checkbox"/>	<input type="checkbox"/>	178 (Appendix B)
STUDY RECORDS					
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	<input checked="" type="checkbox"/>	<input type="checkbox"/>	179-181
Selection process	11b	State the process that will be used for selecting studies (e.g., two independent reviewers) through each phase of the review (i.e., screening, eligibility, and inclusion in meta-analysis)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	189-197
Data collection process	11c	Describe planned method of extracting data from reports (e.g., piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	<input checked="" type="checkbox"/>	<input type="checkbox"/>	203-208
Data items	12	List and define all variables for which data will be sought (e.g., PICO items, funding sources), any pre-planned data assumptions and simplifications	<input checked="" type="checkbox"/>	<input type="checkbox"/>	199-203
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	<input checked="" type="checkbox"/>	<input type="checkbox"/>	160-167
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	<input checked="" type="checkbox"/>	<input type="checkbox"/>	209-213
DATA					
Synthesis	15a	Describe criteria under which study data will be quantitatively synthesized	<input checked="" type="checkbox"/>	<input type="checkbox"/>	214-223
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data, and methods of combining data from studies, including any planned exploration of consistency (e.g., I^2 , Kendall's tau)	<input type="checkbox"/>	<input type="checkbox"/>	NA
	15c	Describe any proposed additional analyses (e.g., sensitivity or subgroup analyses, meta-regression)	<input type="checkbox"/>	<input type="checkbox"/>	NA
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	<input type="checkbox"/>	<input type="checkbox"/>	NA
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (e.g., publication bias across studies, selective	<input type="checkbox"/>	<input type="checkbox"/>	NA

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Section/topic	#	Checklist item	Information reported		Line number(s)
			Yes	No	
		reporting within studies)			
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (e.g., GRADE)	<input type="checkbox"/>	<input type="checkbox"/>	NA

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Appendix B. MEDLINE search strategy

Interface: Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946 to Present

1. social media/
2. Social Networking/
3. blogging/
4. Crowdsourcing/
5. (social adj3 (media or medium* or network* or bookmark*)).tw.
6. (blog* or microblog*).tw.
7. ((patient or discussion or web or chat or internet or online) adj3 (forum* or fora or message board*)).tw.
8. (facebook or twitter or wiki or youtube or web 2* or instagram or foursquare or linkedin or pinterest or livestream*).tw.
9. (crowdsourc* or crowd sourc*).tw.
10. or/1-9
11. product surveillance, postmarketing/ or adverse drug reaction reporting systems/ or pharmacovigilance/
12. exp "Drug-Related Side Effects and Adverse Reactions"/
13. (side effect* or (adverse adj3 (effect* or event* or reaction*))).tw.
14. (pharmacovigilance or ((postmarketing or post-marketing) adj3 surveillance)).tw.
15. Patient Safety/
16. ae.fs.
17. Pharmacoepidemiology/
18. Medication Errors/
19. Abnormalities, Drug-Induced/
20. ci.fs.
21. (drug* or medication* or pharmaceutical* or medicine* or biologics or vaccine* or herb* or vitamin*).tw.
22. ((medical or health) adj2 (device* or equipment* or instrument* or supply or supplies)).tw.
23. 21 or 22
24. (safe* or harm* or toxicity).tw.
25. 23 and 24
26. or/11-20,25
27. 10 and 26

Appendix C. Sources for Grey Literature Search

Adverse drug reporting / pharmacovigilance

- Australia - <https://www.ebs.tga.gov.au/ebs/ADRS/ADRSRepo.nsf?OpenDatabase>
- Canada - <http://www.hc-sc.gc.ca/dhp-mps/medeff/index-eng.php> AND <http://www.hc-sc.gc.ca/dhp-mps/medeff/report-declaration/index-eng.php>
- European database of ae - <http://www.adrreports.eu/en/>
- European pharmacovigilance database called EudraVigilance - <http://eudravigilance.ema.europa.eu/>
- UK Yellow card - <https://yellowcard.mhra.gov.uk> AND see <http://webarchive.nationalarchives.gov.uk/20141205150130/http://www.mhra.gov.uk/home/groups/pl-p/documents/websitesresources/con408250.pdf>
- US MedWatch - <http://www.fda.gov/Safety/MedWatch/>
- US Sentinel Initiative - <http://www.fda.gov/Safety/FDAsSentinelInitiative/ucm2007250.htm>
- US FAERS - <https://open.fda.gov/data/faers/>
- Vigibase - <http://www.who-umc.org/DynPage.aspx?id=98082&mn1=7347&mn2=7252&mn3=7322&mn4=7326>

Associations

- AIIM - <http://www.aiim.org>
- American Health Information Management Association - <http://www.ahima.org>
- CHIMA - <https://www.echima.ca>
- CIHI - www.cihi.ca
- COACH - <http://www.coachorg.com/en/index.asp>
- The Institute of Electrical and Electronics Engineers, Incorporated - <https://www.ieee.org/index.html>
- HIME - <https://www.efmi.org/index.php/workinggroups/hime-health-information-management-europe>
- HIMSS - <http://www.himss.eu>
- IMS Institute - <http://www.imshealth.com/en/thought-leadership/ims-institute>
- IFHIMA - <https://ifhima.org>
- IMIA - <http://www.imia-medinfo.org/new2/>
- Medicine for Europe - <http://www.medicinesforeurope.com>
- UK Chip - <http://www.ukchip.org>

See also: <http://www.healthinformaticsforum.com/health-informatics-associations-and-societies>

Regulatory authority websites:

Asia and Pacific

World Health Organization

[World Health Organization](#)

Pan-American Health Organization

[Pan-American Health Organization](#)

WHO Regional Office for Europe

[WHO Regional Office for Europe](#)

WHO Regional Office for Africa

[WHO Regional Office for Africa](#)

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4	WHO Regional Office for the Eastern	WHO Regional Office for the Eastern
5	Mediterranean	Mediterranean
6	WHO Regional Office for Southeast Asia	WHO Regional Office for Southeast Asia
7	WHO Regional Office for the Western Pacific	WHO Regional Office for the Western Pacific
8	Food and Agriculture Organizations of the	Food and Agriculture Organizations of the
9	United Nations	United Nations
10	Codex Alimentarius	Codex Alimentarius
11	World Trade Organization	World Trade Organization
12		
13	Europe	
14	Belgium: Health, Food Chain Safety and	Belgium: Health, Food Chain Safety and
15	Environment	Environment
16	Belgium: Pharmaceutical Inspectorate	Belgium: Pharmaceutical Inspectorate
17	Croatia: Ministry of Health and Social Care	Croatia: Ministry of Health and Social Care
18	Danish Medicines Agency	Danish Medicines Agency
19	Denmark: Ministry of Food, Agriculture and	Denmark: Ministry of Food, Agriculture and
20	Fisheries	Fisheries
21	Denmark: Ministry of Health	Denmark: Ministry of Health
22	Denmark: Veterinary and Food Administration	Denmark: Veterinary and Food Administration
23	Estonia: Ministry of Social Affairs	Estonia: Ministry of Social Affairs
24	Estonia: State Agency of Medicines	Estonia: State Agency of Medicines
25	European Commission Consumer	European Commission Consumer
26	Affairs: Medical Devices	Affairs: Medical Devices
27	European Commission Directorate General for	European Commission Directorate General for
28	Health & Consumers	Health & Consumers
29	European Commission Directorate General:	European Commission Directorate General:
30	Health Notice to Applicants	Health Notice to Applicants
31	European Commission Directorate General:	European Commission Directorate General:
32	Medicinal Products for Veterinary Use	Medicinal Products for Veterinary Use
33	European Medicines Agency	European Medicines Agency (EMA)
34	Finland: Ministry of Social Affairs and Health	Finland: Ministry of Social Affairs and Health
35	Finnish Food Safety Authority Evira	Finnish Food Safety Authority Evira
36	Finnish Medicines Agency	Finnish Medicines Agency
37	France: National Agency for Veterinary	France: National Agency for Veterinary
38	Medicinal Products	Medicinal Products
39	Germany: Federal Institute for Drugs and	Germany: Federal Institute for Drugs and
40	Medical Devices	Medical Devices
41	Germany: Ministry of Health	Germany: Ministry of Health
42	Greece: Hellenic Food Authority	Greece: Hellenic Food Authority
43	Greece: Hellenic Ministry of Agriculture	Greece: Hellenic Ministry of Agriculture
44	Greece: National Organization for Medicines	Greece: National Organization for Medicines
45	Iceland: The Environment Agency	Iceland: The Environment Agency
46	Ireland: Agriculture and Food Development	Ireland: Agriculture and Food Development
47	Authority	Authority
48	Ireland: Department of Health and Children	Ireland: Department of Health and Children
49	Ireland: Food Safety Authority	Ireland: Food Safety Authority
50	Irish Medicines Board	Irish Medicines Board
51	Lithuania: Ministry of Health	Lithuania: Ministry of Health
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4	Lithuania: State Medicines Control Agency	Lithuania: State Medicines Control Agency
5	Malta: Ministry of Health, Elderly and	Malta: Ministry of Health, Elderly and
6	Community Care	Community Care
7	Netherlands: Ministry of Health, Welfare and	Netherlands: Ministry of Health, Welfare and
8	Sport	Sport
9	Norway: Ministry of Agriculture and Food	Norway: Ministry of Agriculture and Food
10	Norway: Ministry of Health and Care Services	Norway: Ministry of Health and Care Services
11	Norway: Norwegian Board of Health	Norway: Norwegian Board of Health
12	Supervision	Supervision
13	Norway: Norwegian Medicines Agency	Norway: Norwegian Medicines Agency
14	Poland: Drug Institute	Poland: Drug Institute
15	Slovak Republic: Ministry of Agriculture and	Slovak Republic: Ministry of Agriculture and
16	Rural Development	Rural Development
17	Slovenia: Ministry of Agriculture, Forestry and	Slovenia: Ministry of Agriculture, Forestry and
18	Food	Food
19	Sweden: Medical Products Agency	Sweden: Medical Products Agency
20	Sweden: Ministry for Rural Affairs	Sweden: Ministry for Rural Affairs
21	Sweden: National Food Administration	Sweden: National Food Administration
22	Switzerland: Federal Office of Public Health	Switzerland: Federal Office of Public Health
23	Switzerland: Federal Veterinary Office	Switzerland: Federal Veterinary Office
24	UK: Department of Health	UK: Department of Health
25	UK: Food Standards Agency	UK: Food Standards Agency
26	UK: Health Protection Agency	UK: Health Protection Agency
27	UK: Medicines and Healthcare Products	UK: Medicines and Healthcare Products
28	Regulatory Agency	Regulatory Agency
29	UK: National Institute for Biological Standards	UK: National Institute for Biological Standards
30	and Control	and Control
31	UK: Veterinary Medicines Directorate	UK: Veterinary Medicines Directorate
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33	Middle East	
34	Israel: Ministry of Health	Israel: Ministry of Health
35	Israel: Ministry of Industry, Trade and Labor	Israel: Ministry of Industry, Trade and Labor
36	Jordan: Ministry of Health	Jordan: Ministry of Health
37	Lebanon: Ministry of Public Health	Lebanon: Ministry of Public Health
38	Saudi Arabia: Ministry of Health	Saudi Arabia: Ministry of Health
39	United Arab Emirates: Ministry of Health	United Arab Emirates: Ministry of Health
40	United Arab Emirates: Federal Department of	United Arab Emirates: Federal Department of
41	Pharmacies	Pharmacies
42	Yemen: Ministry of Public Health & Population	Yemen: Ministry of Public Health & Population
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44	Africa	
45	Botswana: Ministry of Health	Botswana: Ministry of Health
46	Egypt: Ministry of Agriculture and Land	Egypt: Ministry of Agriculture and Land
47	Reclamation	Reclamation
48	Ghana: Ministry of Health	Ghana: Ministry of Health
49	Ghana: Ministry of Food and Agriculture	Ghana: Ministry of Food and Agriculture
50	Kenya: Ministry of Health	Kenya: Ministry of Health
51	Maldives: Ministry of Health	Maldives: Ministry of Health
52	Mauritius: Ministry of Health & Quality of Life	Mauritius: Ministry of Health & Quality of Life
53	Mauritius: Ministry of Agro Industry and Food	Mauritius: Ministry of Agro Industry and Food
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3	Security	Security
4	Namibia: Ministry of Health and Social	Namibia: Ministry of Health and Social
5	Services	Services
6	Namibia: Ministry of Fisheries and Marine	Namibia: Ministry of Fisheries and Marine
7	Resources	Resources
8	South Africa: Department of Health	South Africa: Department of Health
9	Swaziland: Ministry of Health and Social	Swaziland: Ministry of Health and Social
10	Welfare	Welfare
11	Tanzania: Ministry of Health	Tanzania: Ministry of Health
12	Uganda: Ministry of Health	Uganda: Ministry of Health
13	Zimbabwe: Ministry of Health and Child	Zimbabwe: Ministry of Health and Child
14	Welfare	Welfare
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16	America	
17	Belize: Ministry of Health	Belize: Ministry of Health
18	Bolivia: Ministry of Health and Social Welfare	Bolivia: Ministry of Health and Social Welfare
19	Brazil: Fundacao Oswaldo Cruz	Brazil: Fundacao Oswaldo Cruz
20	Canada: Food Inspection Agency	Canada: Food Inspection Agency
21	Canada: Health Products and Food Branch	Canada: Health Products and Food Branch
22	Guyana: Ministry of Health	Guyana: Ministry of Health
23	Guyana: National Bureau of Standards	Guyana: National Bureau of Standards
24	Jamaica: Ministry of Health	Jamaica: Ministry of Health
25	Mexico: Federal Commission for the	Mexico: Federal Commission for the Protection
26	Protection Against Sanitary Risks	Against Sanitary Risks
27	Netherlands Antilles: Department of Public	Netherlands Antilles: Department of Public
28	Health and Environmental Protection	Health and Environmental Protection
29	St. Lucia: Ministry of Agriculture, Lands	St. Lucia: Ministry of Agriculture, Lands Forestry
30	Forestry and Fisheries	and Fisheries
31	Trinidad & Tobago: Bureau of Standards	Trinidad & Tobago: Bureau of Standards
32	Trinidad and Tobago: Ministry of Health	Trinidad and Tobago: Ministry of Health
33		
34	Multinational	
35	World Health Organization	World Health Organization
36	Pan-American Health Organization	Pan-American Health Organization
37	WHO Regional Office for Europe	WHO Regional Office for Europe
38	WHO Regional Office for Africa	WHO Regional Office for Africa
39	WHO Regional Office for the Eastern	WHO Regional Office for the Eastern
40	Mediterranean	Mediterranean
41	WHO Regional Office for Southeast Asia	WHO Regional Office for Southeast Asia
42	WHO Regional Office for the Western Pacific	WHO Regional Office for the Western Pacific
43	Food and Agriculture Organizations of the	Food and Agriculture Organizations of the
44	United Nations	United Nations
45	Codex Alimentarius	Codex Alimentarius
46	World Trade Organization	World Trade Organization
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53	Crowdsourcing – medical focus	
54	• https://www.crowdfunder.com/discovering-drug-side-effects-with-crowdsourcing/ -	
55	allow researchers to design and submit crowdsourcing tasks	
56	• http://www.sermo.com - a global social crowdsourcing network for physicians and	
57	medical providers	
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- <http://www.medhelp.org>
- <http://curetogether.com>
- <https://www.upwork.com>
- <https://fold.it/portal/>
- <https://www.mturk.com/mturk/welcome>
- <https://www.patientslikeme.com>

Stanford links:

- http://crowdresearch.stanford.edu/w/index.php?title=Introducing_Crowd_Research_Initiative_and_Recap

Resources

- [Relevant Work](#) - used to save relevant articles, links and papers
- [Forums](#) - discussions about this project on external sites. Note that all official announcements and communications will occur via Slack and email.
- [Resources](#) - used to index all platforms and resources as we evolve
- [Infrastructure](#) and [GettingStarted](#)
- [Archives](#) - older meetings, slides and milestones
<http://voxpopuli.stanford.edu>
- <http://stanfordhci.github.io/twitchcrowdsourcing/>
- <https://github.com/crowdresearch/crowdsource-platform>

Government drug regulators (this list is key, however, see the WHO list for all countries or EMA for Europe) and related research agencies

- Australia – Therapeutic Good Administration - <http://www.tga.gov.au>
- Canada data - <http://open.canada.ca/en>
- Canada ICES - <http://www.ices.on.ca/About-ICES.aspx>
- European Commission - http://ec.europa.eu/growth/index_en.htm and http://ec.europa.eu/health/human-use/advanced-therapies/index_en.htm
- European Medicines Agency –
• http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/document_listing/document_listing_000345.jsp - see guideline and module
 - Full list of European country agencies:
http://www.ema.europa.eu/ema/index.jsp?curl=pages/medicines/general/general_content_000155.jsp
- Finish Medicine Agency - <http://www.fimea.fi/web/en/frontpage>
- France - <http://www.afssaps.fr>
- Germany – Federal Institute for Drugs
http://www.bfarm.de/EN/Home/home_node.html;jsessionid=7CCFCA856FC813AC19DD69E86C4742CB.1_cid322
- Health Canada - <http://www.hc-sc.gc.ca/dhp-mps/index-eng.php>
- NEHI - <http://www.nehi.net>
- Netherland Medicines Evaluation Board - <http://english.cbg-meb.nl>
- New Zealand - <http://www.health.govt.nz>
- PHAC - <http://www.phac-aspc.gc.ca/index-eng.php>
- StatsCan - <http://www.statcan.gc.ca>

- Sweden - <https://lakemedelsverket.se/english/>
- US data - <https://www.data.gov>
- US CDC - <http://www.cdc.gov>
- US IOM - <http://www.nationalacademies.org/hmd/>
- US FDA
 - (FEARS) – <http://www.fda.gov/Drugs/GuidanceComplianceRegulatoryInformation/Surveillance/AdverseDrugEffects/ucm083765.htm>
- US NIH - <https://www.nih.gov>
- US NIMH - <http://www.nimh.nih.gov/>
- UK Medicine and Health products Regulator Agency - <https://www.gov.uk/government/organisations/medicines-and-healthcare-products-regulatory-agency>
- WHO – search site, publications section and WHOLIS database
 - <http://www.who-umc.org/DynPage.aspx?id=98080&mn1=7347&mn2=7252&mn3=7322&mn4=7324>
 - <http://www.who.int/en/>
 - <http://www.who.int/library/databases/en/>
 - **See List of Globally identified Websites of Medicines Regulatory Authorities - http://www.who.int/medicines/areas/quality_safety/regulation_legislation/list_mra_websites_nov2012.pdf OR <https://www.pda.org/scientific-and-regulatory-affairs/regulatory-resources/global-regulatory-authority-websites>**

Pharma-related

- FDABLE - http://www.fdable.com/basic_query/aers
- EudraVigiance: <http://eudravigilance.ema.europa.eu/highres.htm>
- Social Media, Mobile, Wearable News & Views - <http://www.scoop.it/t/pharmaguy-social-media-news-views/?tag=adverse+events>
- Innovative medicine initiative: <http://www.imi.europa.eu>

Software

- Open PHACTS - <https://www.openphacts.org> and <http://www.openphactsfoundation.org>
- DebugIT - <http://www.debugit.com.au>
- Khresmoi - <http://khresmoi.atosresearch.eu>
- EHR4CR - <http://www.ehr4cr.eu>

Articles

Suggest to do 1) an author search on Clark Freifeld and 2) a web of science search of his publications for related articles.

- **Digital pharmacovigilance: The MedWatcher system for monitoring adverse events through automated processing of Internet social media and crowdsourcing (Thesis).**

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- Freifeld, Clark C., Ph.D., BOSTON UNIVERSITY, 2014, 148 pages;
3581025<http://gradworks.umi.com/35/81/3581025.html>
- Freifeld CC, Chunara R, Mekaru SR, Chan EH, Kass-Hout T, et al. (2010) Participatory Epidemiology: Use of Mobile Phones for Community-Based Health Reporting. *PLoS Med* 7(12): e1000376. doi:10.1371/journal.pmed.1000376
 - Freifeld CC, Brownstein JS, Menone CM *et al.* Digital drug safety surveillance: monitoring pharmaceutical products in Twitter. *Drug Safety* 2014;37:343–350.

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- Guidance for Industry Internet/Social Media Platforms with Character Space Limitations— Presenting Risk and Benefit Information for Prescription Drugs and Medical Devices -
<http://www.fda.gov/downloads/drugs/guidancecomplianceregulatoryinformation/guidances/ucm401087.pdf>
- Inman WH: Attitudes to adverse drug-reaction reporting. *Br J Clin Pharmacol* 1996; 41:433-435
 - Lardon J, Abdellaoui R, Bellet F, Asfari H, Souvignet J, Texier N, Jaulent MC, Beyens MN, Burgun A, Bousquet C. Adverse Drug Reaction Identification and Extraction in Social Media: A Scoping Review *J Med Internet Res* 2015;17(7):e171.
<http://www.jmir.org/2015/7/e171/>
 - Lopez- Gonzalez E, Herdeiro MT, Figueiras A: Determinants of under-reporting of adverse drug reactions: a systematic review. *Drug Saf* 2009; 32:19-31; Hugman B. The fatal love of forms. *Drug Saf* 2011; 34 (8): 705-707.
 - R. Edwards and M. Lindquist: Social Media and Networks in Pharmacovigilance. Boon or Bane? *Drug Saf* 2011; 34 (4): 267-271
 - Manhattan Research 2011. Cybercitizen Health Europe v10.0. Manhattan Research 2009. Navigating the European eHealth Landscape.
 - Sai Moturu and Huan Liu. "Quantifying the Trustworthiness of Social Media Content", *Journal of Distributed and Parallel Databases*, Springer, Volume 29, January 4, 2011. DOI: 10.1007/s10619-010-7077-0. Geoffrey Barbier, and Huan Liu. *Information Provenance in Social Media*. SBP 2011: 276-283. Springer-Verlag Berlin, Heidelberg, ISBN: 978-3-642-19655-3
 - The Impact and Use of Social Media in Pharmacovigilance -
https://www.sciformix.com/wp-content/uploads/Social_Media_in_PV_Whitepaper.pdf
 - See report WEBAE project (Web Adverse Events) -
http://www.imi.europa.eu/webfm_send/912