What are the Characteristics of Highly Disseminated Public Health-related Tweets?

Dan Dumbrell  
Discipline of Health Informatics  
University of Sydney  
ddum7449@uni.sydney.edu.au

Robert Steele  
Discipline of Health Informatics  
University of Sydney  
robert.steele@sydney.edu.au

ABSTRACT
Unlike traditional mass media, peer interaction between individuals is of critical importance in the dissemination mechanisms for social media. There is emerging interest in the possible novel application of social media in disseminating public health information or messages. In this paper, we analyze tweet and re-tweet behaviour in the context of Australian public health-related micro-blog posts to provide preliminary insights into the characteristics of widely disseminated tweets (including characteristics of re-tweeting accounts). In this way we also consider the nature and role of human computer-mediated interactions in affecting the level of dissemination of Twitter-based public health messages.

Author Keywords  
Twitter, social media, public health, health dissemination

ACM Classification Keywords  
H5.m. Information interfaces and presentation

INTRODUCTION
Twitter, a widely used micro-blogging service, has characteristics and capabilities that make it a useful tool for information dissemination. The convenience and immediacy of providing information in 140 characters or less has presented many novel and potentially beneficial approaches for dissemination to large numbers of active users. Twitter’s application to public health has recently been considered (Steele, 2011), although mostly in the areas of health surveillance and illness tracking (Achrekar et al., 2011; Sadilek et al., 2012). For this paper, we looked specifically at accounts of Australian health-related organizations utilizing Twitter and analyzed the characteristics of their public health advice dissemination. This paper investigates an example of how organizations are using social media to achieve communication and public outreach, in this case within the Australian public health context.

Health dissemination in Twitter involves re-tweeting, the act whereby a user ‘forwards’ or shares a tweet posted by another user to their followers (and so on). In this work we measure dissemination in Twitter by the number of re-tweets a certain health tweet receives, and also take into consideration the number of followers of re-tweeting accounts. For example, if a certain message was re-tweeted four times by four different users, then the reach of that particular health information would be the sum of the number of followers of those four users. Therefore, a tweet that has been re-tweeted numerous times would generally have a higher dissemination compared to a tweet with a smaller number or no re-tweets.

The purpose of this paper is to examine various public health advice tweets, and analyze and interpret their characteristics and dissemination across the Twitter network. Comparisons of tweet dissemination and re-tweeting activity will also be made within and between three different sectors of health-related organizations: government, for-profit (FP) and not-for-profit (NFP) organizations. Common characteristics of highly disseminated health information will also be discussed, with potential opportunities and insights identified for current and future related research.

RELATED WORK
Throughout the literature there has been few papers directly measuring the broad extent of tweeting activity and tweet dissemination, especially health-related tweeting activity in Australia. A study investigating characterization of the tweeting habits within different countries found that identified active Twitter accounts in Australia had 11.73% of their tweets re-tweeted in the year 2010 (Poblete et al., 2011). However, that particular study did not focus on health-related content, analyzing the sentiment component of tweets (i.e. levels of ‘happiness’) using an algorithmic approach rather than considering the complex semantic content of tweets.

An important factor in dissemination on Twitter includes the tendency of a tweet to be re-tweeted. Cha et al. (2010) found that Twitter accounts with a large number of followers had many one-to-one interactions (i.e. followers were directly communicating with them), and re-tweeting was a more suitable way of representing influence of a user beyond a one-to-one interaction domain (i.e. community interaction and dissemination). Therefore, they suggested that the most influential users were those who had more of their tweets re-tweeted and mentioned, rather than judging the influence of an account based on number of followers.

As mentioned, measuring the reach or dissemination of a certain tweet can also involve identifying the re-tweeting accounts and their number of followers. Kwak et al. (2010) found from their dataset of 41.7 million user
profiles and 106 million tweets that any re-tweeted tweets reached an average of 1,000 users – regardless of the number of followers of the original tweeting account. They suggested that quality, timeliness and coverage were factors of disseminated tweets to be further researched.

The human aspects behind the Twitter accounts however should not be disregarded as the language used within tweets may influence how they are responded to (Quercia et al., 2012). The authors found that in terms of re-tweeting, users or accounts considered influential (or highly re-tweeted) would express emotions that were common to individuals, thus creating a sense of community. They also suggested that using negative aspects of languages drew more re-tweets, and was a characteristic of highly re-tweeted (influential) users. Our paper will focus on organizations that tweet, which also raises the question of whether this is different to individual use investigated in previous literature.

This paper considers a set of re-tweeted public health tweets of various active Twitter health accounts in Australia (with varying amounts of followers) to determine common characteristics. This is a preliminary study with interesting implications for further research in issues and aspects of effective health information dissemination.

METHODOLOGY
Relevant Twitter accounts were identified and selected via a three-step process. First, through utilizing the Twitter search function, accounts were found by searching health-related keywords (e.g. “health”, “doctor”, “cancer”, “heart” etc.). Further accounts were identified in the second step via searches using Google (www.google.com), such as typing in “dementia Australia twitter” and similar phrases. Third, already identified Twitter accounts’ feeds and followers were examined to find further relevant users. All accounts had to meet inclusion criteria, that is: active in the month of February 2012, having 150 or more followers, and representing health-related bodies or organizations based in Australia.

The manual approach to identify and analyze accounts was chosen after considering available Twitter analytics tools such as Twitonomy or TweetVolume for example. The reason for this chosen manual methodology was that these Twitter analytics tools did not automatically identify health-related accounts, could not process complex concepts such as a ‘public health-related’ tweet, nor did they provide an effective method of examining and summing the followers of re-tweeting users (reach).

We reviewed the Twitter feeds of each of the identified accounts for public health-related tweets posted during February 2012. Public health-related tweets (and their respective hyperlinks) were those we defined as delivering health advice to those reading the tweet, whilst providing enough information for a consumer (or reader) to potentially use to change any relevant aspect/s of their current health behaviours. Therefore, tweets that were public health-related were not merely awareness-related (i.e. “tomorrow is world cancer day”) as this type of tweet did not contain information that would indicate change in health behaviour, rather it just raised awareness of an upcoming event or occasion. From our criteria, only tweets that were categorized as public health-related were expanded. The number of re-tweets for each tweet was captured, as well as the types of users re-tweeting the information (e.g. government, FP/NFP organizations, and individuals). The total number of followers for re-tweeters of each public health advice tweet was also calculated, to demonstrate the reach of the tweet (i.e. how many accounts on Twitter would potentially receive it).

GENERAL CHARACTERISTICS OF SECTORS
From the methodology outlined, a total of 114 health-related Australian organization Twitter accounts were identified for this paper. The identified Twitter accounts were categorized into three sectors – government (16), FP (27) and NFP (71) organizations. Out of these 114 accounts, it was identified that 12 government accounts, 13 FP accounts and 42 NFP accounts had public health-related tweets that were re-tweeted – resulting in a total of 67 identified accounts that had some re-tweeting of public health information.

When looking at the 67 identified accounts with re-tweeting, government and FP accounts had a similar total number of followers with 30,605 and 25,547 respectively. When looking at the average number of followers per account however, it could be seen that government accounts had a larger average follower number (2,550) than FP accounts (1,965). Comparing public health advice tweet dissemination, both government and FP accounts had similar raw numbers of the total number of followers their tweets were re-tweeted to, with 241,320 for government accounts and 223,444 for FP accounts. Though again when considering averages, government accounts were more powerful at disseminating public health advice to other Twitter users with an average of 19,877 Twitter users seeing re-tweeted tweets. FP accounts had an average reach of 17,103 users per account. Therefore, from the identified sample, public health advice tweeted by government accounts was shared with nearly 2,800 more users throughout Twitter (per account) when compared to the tweets from FP accounts.

Across the whole 114 identified health-related organizations, 772 public health tweets (re-tweeted and non re-tweeted) were identified, with a total of 359 of these tweets re-tweeted. NFP accounts had 176 public health advice tweets that were re-tweeted. This was the largest raw number of re-tweets in the sample. This could probably have been due to the fact that during February 2012, NFP organizations recorded the largest raw number of public health-related tweets (403 out of the total 772). Therefore, more than two-fifths of public health-related tweets (176 out of 403, or 43.7%) made by NFP were re-tweeted by other Twitter users. FP health-related organizations had the smallest raw number of re-tweets (84) as well as the smallest proportion of re-tweeted public health advice (37.2%) considering 226 of their tweets in February 2012 were public health-related. Out of all three-health sectors analyzed, FP organizations had the smallest proportion of their health-related tweets that were re-tweeted/disseminated.

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The government health-related Twitter accounts we identified were found to be the most successful in disseminating health information to the public. Of the 143 government posted public health-related tweets identified in February 2012, 99 were re-tweeted. That is, approximately 70% of government public health-related information was re-tweeted amongst Twitter users during February 2012. In fact, if taking into account the number of Twitter accounts per sector, it could be seen that although government accounts had the lowest raw numbers of total public health tweets, they recorded on average a higher reach of followers with their public health advice (as they recorded higher re-tweet rates).

RE-TWEETING ACCOUNTS
It is also interesting to note that government accounts did minimal re-tweeting of public health advice tweets in comparison to FP and NFP accounts. Overall, government accounts made up only 44 of the 890 (or 4.9%) re-tweeting accounts identified, which was the lowest of the three sectors. More than half of the re-tweets from government accounts (23) were actually public health tweets from the health-related government Twitter accounts identified. These numbers not only show how government accounts have low re-tweet numbers (potentially due to selectiveness), but also that they tend to re-tweet information from other government bodies rather than from FP and NFP organizations.

On the other hand, accounts that represented various individual users (i.e. non organization or non group-based bodies) recorded the highest proportion of the 890 re-tweeting accounts, with 561 or 63.0% of identified public health information re-tweets being from individual users. NFP accounts had re-tweeted public health tweets only 88 times, and FP accounts were found to have a higher rate of re-tweeting activity at 125 FP re-tweeting accounts identified. The remaining 72 re-tweeting accounts were ambiguous as to whether they were associated with organizations or individuals, and hence were classified as ‘other’. These numbers are interesting, as they show low activity of government Twitter accounts when it comes to re-tweeting public health advice – but illustrate the high proportion of interaction of individual users who disseminate this kind of information.

CHARACTERISTICS OF HIGHLY RE-TWEETED TWEETS
We manually examined the public health advice-related tweets (re-tweeted and non re-tweeted). As an example, Table 1 provides a list of the top 10 most re-tweeted public health tweets – we limit to showing this example set for space reasons. The list was compiled by re-tweet frequency according to absolute number (e.g. if a tweet was re-tweeted 5 times and another was re-tweeted 7 times the latter was considered more re-tweeted) rather than relatively (i.e. compared to the number of followers that specific account had) as during the analysis we discovered there was a large overlap between these two measurement metrics. We then identified the common and shared characteristics of these oft-re-tweeted tweets.

Through manual analysis of the identified re-tweeted tweets, the following characteristics are identified and initially posited as possible characteristics conducive to public health advice tweets being re-tweeted.

Actionable
A majority of the highly re-tweeted tweets contained health advice that was actionable. We defined actionable tweets as those that had information one reading could ‘act’ on to alter their current health behaviour or habits in the real world. For example, the tweet about sleep hygiene provides tips on how to “improve the tranquility of [one’s] bedroom & improve on sleep”. This is actionable as the consumer would be able to act on the provided information to alter their sleeping environment and thus their sleep-related health. Another example – “health & safety tips from Dr James Smith for those cleaning up in flood affected areas” – also promotes similar actionable advice to those cleaning up affected areas by providing information that decreases potential health risks.

Time Relevant
In the example of the flood-related tweet (see Table 1), the tweet, albeit useful, would not be generalised to the public as it was directed specifically to those affected by the Queensland floods of early 2012. Many of the tweets that were highly re-tweeted were found to have significant time-relevance. This matches the nature of Twitter, as it is able to provide up to date information on events or topics of timely interest. Similar characteristics can be seen in the tweets about “going back to school” as well as during certain events (e.g. organ donation-related public health information around DonateLife Week, two in the top 10). Therefore, highly re-tweeted public health advice often is time-relevant leading to larger dissemination of up-to-date information to following Twitter accounts.

Perceived Health Risk
The re-tweeted tweets that were highly disseminated also included many that had high perceived health risks. The perceived acute health risks could have been environmentally-related (i.e. re-tweeting information about the floods) or they could have been lifestyle-related health issues (e.g. “#HeartMyth Eggs are bad for heart health #HeartFact Eggs are v nutritious…” or “…assoc between consumption of sugar sweetened drinks and excessive weight gain…”). These tweets were disseminated due to the re-tweeting accounts finding significance in the sharing of such health information. A hypothesised possible factor of why these tweets are most re-tweeted can be due to the re-tweeting user having a feeling of social obligation associated with the tweet subject matter. This raises the interesting possibilities of a potential relationship between group/population values and norms and the operation of dissemination in social networking systems. Another possible reason is that individuals may want to gain influence through concerted efforts of re-tweeting tweets with a perceived health risk.

Personally-directed Style
The highly re-tweeted tweets analyzed not only have contextual and relevant characteristics, they also display
### Tweet

<table>
<thead>
<tr>
<th>Tweet</th>
<th>Re-Tweets</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>#Tip: Kids who have a #pet before the age of three are less likely to develop pet #allergies. <a href="http://bit.ly/xxnftQ">http://bit.ly/xxnftQ</a></td>
<td>40</td>
<td>FP</td>
</tr>
<tr>
<td>Fact file: #Crohn's disease and ulcerative colitis are two of the best known types of inflammatory bowel disease. #IBD <a href="http://bit.ly/wLnwQR">http://bit.ly/wLnwQR</a></td>
<td>18</td>
<td>FP</td>
</tr>
<tr>
<td>Sleep hygiene - what's that?!! Helpful tips on how to improve the tranquility of your room &amp; improve on sleep here: <a href="http://ow.ly/97GpT">http://ow.ly/97GpT</a></td>
<td>17</td>
<td>NFP</td>
</tr>
<tr>
<td>Identifying your strengths can help you feel good about yourself &amp; are important for resilience &amp; wellbeing! Start now: <a href="http://ow.ly/9cYtM">http://ow.ly/9cYtM</a></td>
<td>15</td>
<td>NFP</td>
</tr>
<tr>
<td>Today we launched #fatfreetv guide. Find out what your child’s daily TV junk ad intake is by visiting <a href="http://www.fattree.tv.com.au">http://www.fattree.tv.com.au</a></td>
<td>14</td>
<td>NFP</td>
</tr>
<tr>
<td>Health &amp; safety tips from Dr James Smith for those cleaning up in flood affected areas: <a href="http://tinyurl.com/7b9w4jq">http://tinyurl.com/7b9w4jq</a> #bigwet #floodassist</td>
<td>14</td>
<td>GOV</td>
</tr>
<tr>
<td>#HeartMyth Being active means high-intensity exercise #HeartFact Just walking for 30 mins a day can cut #heartdisease risk by 50%&quot;</td>
<td>11</td>
<td>NFP</td>
</tr>
<tr>
<td>Do you know if your loved ones want to be an organ and tissue donor? Feb 19-26 is DonateLife Week <a href="http://www.donatelife.gov.au">http://www.donatelife.gov.au</a> #organdonor</td>
<td>11</td>
<td>GOV</td>
</tr>
<tr>
<td>Do you loved ones know if you want to be an organ and tissue donor? Feb 19-26 is DonateLife Week <a href="http://www.donatelife.gov.au">http://www.donatelife.gov.au</a></td>
<td>11</td>
<td>GOV</td>
</tr>
<tr>
<td>If you or a person close to you are remembering a loved one, here are some tips on helping someone experiencing grief <a href="http://ow.ly/91Idi">http://ow.ly/91Idi</a></td>
<td>10</td>
<td>NFP</td>
</tr>
</tbody>
</table>

Table 1. The 10 most re-tweeted public health-related tweets from study sample

stylistic attributes that possibly affect their level of dissemination. We found highly re-tweeted tweets were often written in a personally-directed manner, for example using direct references to the reader such as ‘...stand up for your health...’, ‘...if you’re affected by #floods...’ or asking personal rhetorical questions such as “having a baby?...” or “...want to be an organ and tissue donor?...”. This may explain why individuals did the majority of re-tweeting, as the public health tweets may have felt more personal to an individual rather than an organization.

### FUTURE RESEARCH IMPLICATIONS

The paper presents various possible implications for future research. Areas of potential future research may be the investigation of the relative contribution to dissemination of tweet content, the originating account and sector. Further, is characterizing the distribution curve for dissemination of public health advice and other health-related tweets. Finally, and interestingly, the tweet characteristic of ‘perceived health risk’ suggests possible links between population value norms and dissemination.

### CONCLUSION

In this paper we have analyzed the re-tweeting of organization-posted public health advice tweets in Australia during February 2012. The results demonstrate differences related to sector and a number of common characteristics of highly disseminated tweets have been identified. Government accounts were found to be most successful in having their public health information posts disseminated. However, they also re-tweeted the least amount of public health information when compared to FP and NFP accounts. On the other hand, individual users were found to re-tweet such information the most. It was identified that common characteristics amongst highly disseminated public health-related tweets were that they were actionable, time relevant, contained a high perceived health risk and were written in a personally-directed style. This paper thus provides initial insights into the complex interactions of human and computer components implicit in social media communications systems.

### REFERENCES


