Review Article

Integration of advances in social media and mHealth technology are pivotal to successful cancer prevention and control

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Abstract: The successful prevention and treatment of cancer is dependent upon efficient and reliable communication between healthcare workers and patients. Advances in social media and mHealth platforms have provided new ways in which to enhance the sharing of cancer related information. Other benefits of embracing this technology include utilising its analytic capabilities which can process the vast quantity of information generated from genome exploration in a highly efficient manner. The aim of this review is to provide an overview of the rapidly evolving areas through which digital engagement is proving useful in the prevention and control of cancer.

Keywords: Cancer prevention; cancer control; digital engagement

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Introduction

Digital engagement refers to the embracement of social media by healthcare professionals and patients (1). Developments in social media technology have paved the way for a number of advances in cancer prevention and control (2). Cancer itself represents a complex disease process, not only at a genomic and proteomic level, but also in terms of the key treatment decisions that need to be made (3,4). Digital integration with cancer treatment and prevention is proving to be a reliable and efficient strategy in which to overcome the complexity of this disease process (5,6).

The global burden of cancer is predicted to worsen over time with an estimated increase in cancer incidence of 80% in low income and 70% in lower middle income group countries by 2030 (7). This is paralleled by rising rates of mobile phone usage in developing countries (8). This rise in the use of mobile devices can be leveraged to improve awareness, facilitate access to timely screening and ensure proper patient follow-up, overcoming some of the commonest barriers to cancer control (9).

Social media provides a useful opportunity for the dissemination of information to both healthcare providers and patients (10). Microblogging networks such as Twitter® and social networks like Facebook® allow patients to access information regarding cancer treatment and preventative measures to reduce the risk of developing cancer (11,12). Mobile health (mHealth), the practice of medicine and public health supported by mobile devices, is now available in many formats and is proving to be valuable in the prevention and control of cancer (13).

Thus, the aim of this review is to provide an overview of the rapidly evolving areas through which digital engagement is proving useful in the prevention and control of cancer. This paper offers an insight into currently available social networking opportunities for cancer professionals as well as platforms for information dissemination. Big data provides unique avenues to aid cancer prevention and control and these are also reviewed. We also discuss emerging technologies which have a significant impact on cancer prevention and control in the future.

Cancer professionals—social networking opportunities

Social media platforms provide an excellent opportunity for physicians and other health care providers to network and share ideas with their peers. Although Twitter® is limited to small segments of information sharing, websites such as ResearchGate® function as digital repositories for published work as well as forums in which they can be discussed by participating members (14). Users can request reprints of previously published cancer related articles. Users are also encouraged to develop profiles of their professional experience.

Support networks for cancer specialists offer an excellent opportunity for networking with fellow specialists and can also address problems encountered while conducting cancer research. A leading example of this is the American Society for Clinical Oncology community research forum (15). This forum provides a solution oriented venue for researchers based in the community to interact with scientists and helps overcome some of the barriers to conducting clinical trials. It provides a networking and problem sharing platform so that experiences can be shared and problems overcome in a collaborative fashion. It also acts as an online repository of resources and provides online training resources.

Cancer based literature and social media

Evidence based medicine has utilised developments in social media in a constructive manner. Traditional methods through which information were accessed included journal subscriptions, departmental journal meetings, and access to library facilities. Contemporary literature updates are provided by social media platforms such as Twitter® in real time format (16). This provides a new dynamic for information dissemination to patients and for patients to provide feedback to their physicians. Physicians are now privy to new data as soon as it is published online. Microblogging allows access to relevant journals, scientists and physicians who are leaders in their field and allows followers to retweet articles or opinions which they feel is important and should be highlighted to their followers. Controversial topics can also be debated on this platform (17).

There is a need to ensure the accuracy and validity of this information due to the open and inclusive nature of social media and the ease through which inaccurate information can be posted. For example, we recently examined the accuracy of online content with regard to breast cancer (18). Accurate information was difficult to obtain using the Google® search engine due to the presence of a large numbers of unregulated websites.

Advanced technology in cancer prevention and control

Widespread adoption of advanced technology by cancer patients and healthcare providers has changed methods for cancer prevention and control (19,20). Advanced technology has provided a more efficient method in which to conduct certain aspects of preventive trials and clinical trials (21). It has enhanced recruitment of patients and has been able overcome limitations of existing methods through which trials are run and patients are recruited (22,23). Caution is needed, however, when ultra-modern technologies are introduced in the setting of clinical trials to ensure key aspects such as consent are conducted in an appropriate manner (24).

The Metastatic Breast Cancer Project recently reported that they have successfully recruited greater than 2,000 patients from every state in the US over a seven month period using social media and a dedicated website to recruit patients (25). The project has an excellent response rate with 95% of patients having submitted the requested details to the study group, which is examining factors that influence breast cancer metastasis at a genomic level using patient tissue.

Advanced technology may also improve survival of cancer patients. A recent randomized controlled trial used a dedicated app to identify early symptoms of tumour recurrence, complications, and early supportive care for high risk lung cancer patients in patients with stage III/IV disease (26). Patients with access to the app were found to have a significant improvement in disease free survival.

Researchers at Memorial Sloan Kettering Cancer Center developed a cognitive computing app to aid cancer patient decision making (27). Watson for oncology provides a platform for physicians to input certain patient data. It then uses this information to select appropriate treatment options for individual patients based on the information provided. A recent study found that although this is a useful support for informed decision making, it is time consuming (28). However, integrating patient electronic medical records with this system could significantly reduce the time burden.

Big 'Cancer' data—storage and analytics

Big data is a term used to describe the computational

analysis of large healthcare based datasets in order to reveal patterns, trends and associations (29). Big data storage and analytics play a major role in cancer research and the development of tailored treatment strategies and personalised medical care for cancer patients. In addition, big data allows for retrospective analysis of oncology data to measure parameters such as quality of care and can also facilitate the delivery of quality care by healthcare professionals din real-time (30).

Publically available databases containing genome data from tumours that have previously been sequenced in laboratories worldwide provide an important resource for researchers. Through this genomic based research it is possible to generate consensus profiles that identify genes that are commonly dysregulated across multiple independent datasets generated from different research institutes internationally. However, efforts to examine the genome of individual tumours yield a large amount of data. The usefulness of big data in the setting of cancer prevention and control lies in the ability to store and analyze large amounts of information in an efficient and reliable manner. In breast cancer, for example, this approach has yielded a 21 gene based prognostic indicator to identify patients that would benefit from adjuvant chemotherapy (31). This test, known as Oncotype DX, has been used to identify patients who would most benefit from adjuvant chemotherapy (32). This approach has also been used in colon cancer (33).

Big data is also proving useful in cancer prevention. Ayers *et al*. recently used big data analytics to optimize a campaign targeted at smoking cessation (34). Through rapid, cost effective and efficient analysis of the data generated from the campaign, further campaigns were modified to ensure that they were targeted at the correct demographic at the correct time of day.

Telemedicine

Telemedicine is a growing area of digitalization which is leading to a more efficient manner in which to deliver healthcare. It overcomes geographic and socioeconomic limitations which previously limited access for a large number of patients (35). Teledermoscopy was established in order to facilitate detection of melanomas. Patients can forward a picture of a suspicious lesion to their dermatologist and have an assessment based on the appearance on the image sent. Horsham *et al*. recently investigated the patient acceptance of this modality and their research demonstrates that this is is a favourable approach, partly due to the convenience of avoiding an outpatient clinic visit (36). This highlights the convenience that can be associated with using a high definition, high quality image as part of the referral system.

mHealth and cancer

Text messaging is a useful method for reminding patients about the importance of maintaining a healthy lifestyle. Text messaging can also be a useful educational modality. Lee *et al*. recently examined the effects of educational text messages regarding HPV vaccination and its benefits and noted a significant rise in HPV vaccination uptake among targeted populations (37).

Cancer screening programs have also utilized text messaging in an effort to address screening uptake. Colorectal cancer screening is generally directed at populations over 50 years of age. Weaver *et al*. recently examined how receptive elderly patients would be to text messages designed to encourage participation in a screening program. Older populations were found to be very receptive to this type of intervention (38).

Wearable technology

Wearable technology is a fast growing area of the digitalization era in which increasingly available devices and sensors can be used by patients to record parameters central to health and the environment around a patient. Wearable technology is expected to enhance clinical trial participation and treatment compliance rates. Devices include glasses, watches and fabrics capable of monitoring heart rate and temperature. Schwenk *et al*. recently utilized wearable technology in the form of a balance sensor which could assist patients suffering with chemotherapy induced peripheral neuropathy. In their randomized controlled trial, they demonstrated successful utilization of this technology in patients (39). Surgical oncology is also seeking to adopt the advantages of wearable technology. Google glasses combined with a fluorescence imaging system are being developed to ensure complete resection of tumours and ensuring margins are clear (40). Tests in an *ex vivo* model have shown that this technology may be used to identify residual tumor deposits and reduce the risk of cancer recurrence.

Telemonitoring solutions through provision of near field communication have been successfully implemented in paediatric oncology. Using this technology, Duregger *et al*.

implemented a prototype for electronic patient reported outcomes using 9 different health parameters and toxicities (41). The technology was successfully used by the same group to measure patient toxicities at home in paediatric oncology patients with the goal of improving quality of life for these patients. This approach allowed them (where appropriate) to have chemotherapy at home and avoid the hospital setting while being carefully monitored for toxicity with near field communication technology (42).

Future directions

There are a number of ongoing digital based projects relating to cancer control and prevention. In silico trials are being explored to provide a virtual arena through which clinical trials of novel anti-cancer therapies can be tested (43). In such trials, a virtual patient would be given a virtual treatment and the outcomes of treatment can be measured (44). Although the intention is not to completely replace actual clinical trials involving real patients, in silico trials have the potential to reduce the number of patients required to perform a clinical trial as well as limiting the exposure of patients to adverse effects of trial medications (45).

Surgical technologies are also beginning to incorporate digital advances. For example the iKnife represents an intelligent surgical scalpel which utilises rapid evaporative ionization mass spectrometry technology (46). Recently, this device was shown to be capable of differentiating between normal and malignant tissues in real time. This technology is still in the development phase and future studies are required to examine its clinical utility

Conclusions

Digital engagement with healthcare providers and cancer patients is providing highly efficient and reliable methods though which cancer can be prevented and controlled. The complexity associated with cancer as a disease process makes it an ideal target upon which digital technology can make a significant impact. Ease of communication allows rapid dissemination of information between cancer specialists as well as with their patients. At both a molecular and clinical level, big data analytics are identifying new patterns and pathways through which patient treatment can be individually tailored and optimised. We are only at the beginning of the digital revolution in cancer care and there are many exciting digital projects on the horizon which may enhance cancer control and prevention in the future.

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Footnote

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