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Big Social Data in Public Health: A Mixed-Methods Case Study of Sundhed.dk's Facebook Strategy, Engagement, and Performance

Kjeld S Hansen[a,b,c] *, Raghava Mukkamala[a], Abid Hussain[a], Tor-Morten Grønli[b], Henning Langberg[c], and Ravi Vatrapu[a,b]

[a]*Centre for Business Data Analytics, Dept. of IT Management, Copenhagen Business School, Denmark*
[b]*Mobile Technology Laboratory, Westerdals Oslo School of Arts, Communication and Technology, Norway*
[c]*CopenRehab, Dept. of Public Health, University of Copenhagen, Denmark*

Abstract

We introduce the notion of "Socially Shared Health Information" (SSHI) referring to the phenomena of users and health organizations explicitly sharing health related information on social media platforms such as Facebook and Twitter. In order to investigate the phenomena of SSHI, in this paper, we present a multi-method case study of the organizational strategies for and user engagement with the Facebook page of the official portal for the public Danish Healthcare Services (Sundheds.dk). We analysed qualitative data in the form of a semi-structured interview with the social media editor of Sundhed.dk and netnographic observations, and quantitative data from the full historic fetch of the official Facebook wall. Our results show a good alignment between the organizational and social media strategies of the public Danish Healthcare Services but point out the lack of domain-specific metrics to measure its efficacy and effectiveness.

Peer-review under responsibility of the Program Chairs

Keywords: New Public Health, Health Informatics, Big Data Analytics, Social Media, Sundheds.dk

1. Introduction

Social media and mobile information systems makes it increasingly easy and convenient for people to connect and interact. It follows that these new opportunities for interaction and distribution of information within and across organizations can result in new kinds of socially mediated organizations [1]. As such, understanding how

* Corresponding author. E-mail address: hankje@westerdals.no

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organizations spread and how users interact with health information through social media and mobile computing will become increasingly important in the near future. This emphasis on understanding the socio-technical interactional contexts of users and health care organisations is already evident in the new public health paradigm in general and the field of health informatics in particular. Public health has traditionally been understood through its unit of analysis i.e. the public; However, the new public health paradigm *"goes beyond an understanding of human biology and recognizes the importance of those social aspects of health problems, which are caused by life styles. In the new public health the environment is social and psychological as well as physical"* [2] *as quoted in* [3]. Within the public health paradigm, the field of health informatics deals with *"the structures and processes, as well as the outcomes involved in the use of information and information and communication technologies (ICTs) within health"* [4]. Situated within new public health, this paper investigates the organisational strategy for distribution of, and user engagement with health information on the Facebook wall of the official portal for the public Danish Healthcare Services (Sundhed.dk).

Social and health scientists have shown considerable interest in investigating the importance of the connection between our social lives and health situations. Christakis and Fowler [5] have studied how our social networks can influence our health situation as a consequence of "*everything we think, feel, do, or say can spread far beyond the people we know…they can help us to achieve what we could not achieve on our own"* [5]. Facebook is amongst the leading social media network channels globally and counts approximately 1.5 billion monthly active users. Even though users tend to be active on more than one social media network channel, most people consider Facebook their social media home. The widespread societal and individual adoption of Facebook has led to a new kind of relationship between people and information, as Kunst and Vatrapu [6] observe "*not only do the socio-technical affordances of social media amplify the scale of potential reach of sharing, they also induce consumers to interact in new ways and share new types of consumption information, presumably not shared before"*. We term the health information shared on social media platforms as "*Socially Shared Health Information*" (SSHI) and seek to understand the organisational rationale for using SSHI and user interactions with SSHI with special focus on analysing the official Facebook wall of Sundhed.dk (https://www.facebook.com/sundhed.dk). Towards this end, we pose two research questions:

- RQ1: What are Sundhed.dk's organizational strategies for Socially Shared Health Information on Facebook?
- RQ2: What are the structural and temporal aspects of the artifacts resulting from Sundhed.dk's Socially Shared Public Health Information?

The rest of the paper is organised as follows. Section 2, conceptual framework, briefly describes the notion of "Socially Shared Health Information" and links it to the Information-Motivation-Behavioural Skills Model of Adherence (IMB) in public health. Section 3, methodology, discusses the three methods used: netnography, semi-structured interview, and big social data analytics. Section 4, results, reports empirical findings. Finally, Section 5 on discussion provides substantive interpretation of the results, discusses implications for research and practice, identifies study limitations and outlines future research directions.

2. Conceptual Framework

2.1 Socially Shared Health Information

The phenomena of interest are health information shared on public health organizations' social media (Figure 1). Health information management is more conceptually restricted than health informatics and is *"concerned with how information is organized and managed within health, for example by patients and health professionals; […] or nationally (e.g. the level of health literacy within populations"*. [4]. Socially connected organizations are understood as *"institutions that strategically adopt and use social media channels to increase organizational effectiveness, and create value with and for stakeholders."* [1]. We situate the notion of SSHI within *"the position of sharing as a cultural value that highlights the ongoing negotiations of normative aspects of sharing as cultural practice, and the evidential interplay of socio-technical features"* [7] enabled by digital technologies and adopted by health organisations and users at large.

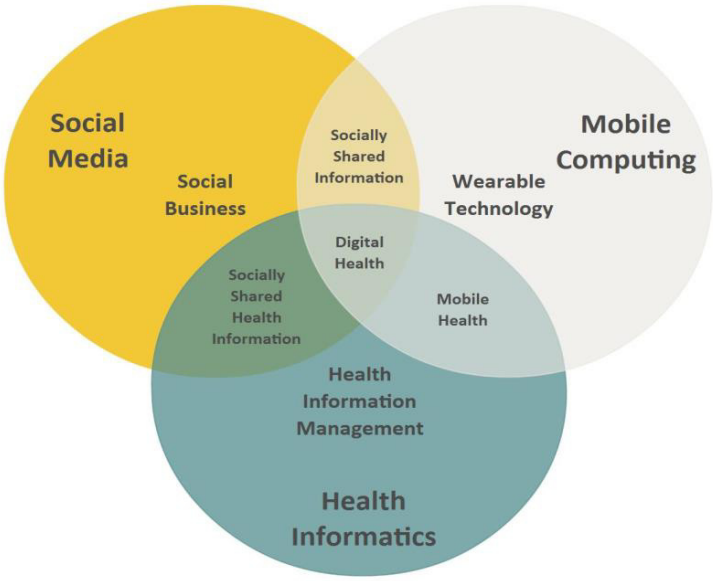


Fig. 1: Overview of Socially Shared Health Information

2.2 Information-Motivation-Behavioral (IMB) Skills Model of Adherence

We link the individual's perception of action-taking possibilities and appropriation of meaning-making opportunities created by SSHI with the process of adhering to a specific public health goal by applying the information-motivation-behavioural (IMB) skills model of adherence. The IMB model of adherence *"focusses comprehensively on the information, motivation and behavioral skills factors that are conceptually and empirically linked to adherence and specifies situational and personal factors that may moderate the relation."* [8]. In its most abstract form, the IMB model asserts that information, motivation and behavioral skills are fundamental determinants to adherence to public health goals. We have applied blue circles in Figure 2 to indicate that this paper is primarily concerned with the appropriation of information and only peripherally with the motivation for and tools to generate behavioural change.

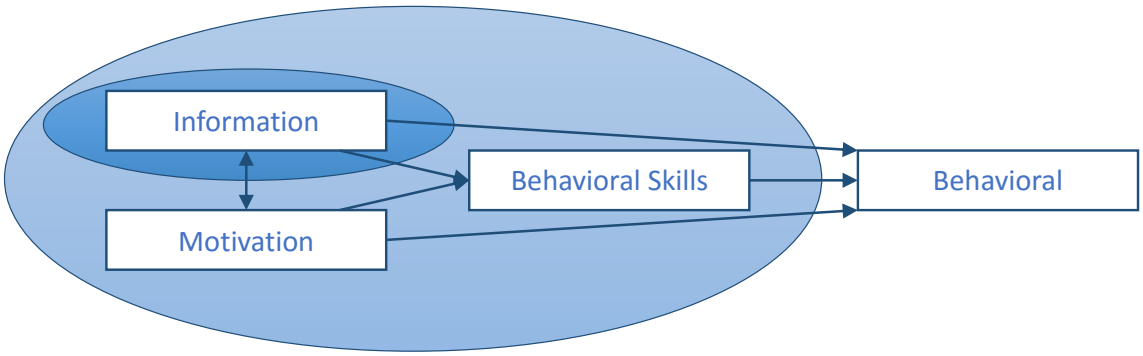


Fig. 2: Information-Motivation-Behavioural Model

3. Methodology

In order to understand the information dissemination strategies and performance of the Facebook page of the official portal for the public Danish Healthcare Services (Sundhed.dk), we adopted the research design of convergent parallel mixed method [9] involving (a) qualitative data in the form of a semi-structured interview with the social media editor of Sundhed.dk and netnographic observations, and (b) quantitative data from the Facebook wall.

3.1. Qualitative Data Collection

Qualitative data collection consisted of a field visit to the offices of Sundhed.dk, two semi-structured interviews with the social media editor of Sundhed.dk; one of which was conducted on site, and the other was conducted through the phone to discuss elements of the first interview. The interviews followed Kvale's [10] guidelines for research interviews, which – in accordance with the traditions of phenomenological method - seek to understand a phenomenon from the interviewee's professional "life world". The qualitative analysis of big social data from Sundhed.dk's Facebook page followed Hine's [11] guidelines for netnographic analysis of virtual worlds.

3.2 Quantitative Data Collection

Quantitative data consisted of the full historic fetch of Sundhed.dk's Facebook page between 2012 – 2015 which was collected using the Social Data Analytics Tool, SODATO [12]. SODATO enables the systematic collection, storage, and retrieval of the entire corpus of social data for a public Facebook wall (in our case, the official Facebook wall of Sundhed.dk).

3.3 Data Processing

We used data warehousing and on-line analytical processing (OLAP) technology using Microsoft SQL Server database to conduct temporal analysis of Facebook data. We designed a multi-dimensional data model for Facebook data using interactions as numeric/fact measures. The interactions measure data is further processed across several dimensions: temporal (daily, weekly, monthly, and yearly), actions (post, comment, and like), actors (admin and non-admin) and artefacts (posts and comments). Since the type of interactions that can be performed by various actors on a post artefact include comment and like, using a multidimensional approach is required. Further, web links were extracted from the Facebook corpus and consisted of both the explicitly shared links in the 'Link" element of the JSON objects returned by the Facebook Graph API as well as the implicitly shared links in posts and comments by using regular expression. The links were then qualitatively categorized as discussed in the analysis and discussion section forthcoming.

4. Analysis and Discussion

This section is organized into three parts. First, we provide a case description of Sundhed.dk. Second, we present and discuss qualitative findings about the information dissemination strategy and information communication of Sundhed.dk. Third and last, we report and discuss quantitative findings from the big social data analytics of the Facebook wall of Sundhed.dk to assess content performance in terms of likes, comments, and shares etc.

4.1 Case Description: Sundhed.dk

Sundhed.dk is a joint health portal for the public Danish Healthcare Services. It was established in 2003 by Local Governments Denmark, Danish Regions and the Danish Ministry of Health, who are the three main contributing partners to Sundhed.dk. Danish Regions is the main stakeholder, as it holds the majority of the responsibility and costs of the Danish health care system. The responsibilities of Sundhed.dk in the Danish health sector is to provide access to health information for citizens and health professionals alike. Sundhed.dk does not produce health information, but relies on the specialized Danish governmental health organizations to deliver its content. The portal consists of a restricted part, where citizens can access their personal health records and health professionals can access citizens' health records, and an open part, where everyone can access general health information such as a patient handbook with information and recommendations on all major health issues. You could for example access your personal files on the restricted part of Sundhed.dk to find out the test results from a trip to the hospital or you

could access the openly available health information from Danish governmental health organizations such as the Ministry of Health, Danish Regions, Local Government Denmark, The Danish Health Authority, and the Danish Medicines Agency. According to Sundhed.dk, their role as Denmark's health portal, is to provide easy access to health information from partner organizations for Danish citizens and their health professionals. Sundhed.dk state that they not only measure their success through the number of visitors on the portal, but also on the effect of the patients being better prepared in the way they meet the health authorities, the citizens knowing how to approach the health authorities and the time being freed for health professionals to focus on other tasks. (Sundhed.dk).

4.2 Qualitative Content Analysis

4.2.1 Semi-Structured Interview: Social Media Strategies for Health Information Communication

In 2011, Sundhed.dk had their first discussions on the relevance of creating their own Facebook page and appointed a cross disciplinary group to make recommendations on the issue. According to the social media editor, there were especially two arguments, which carried weight in their recommendation for Sundhed.dk to adopt social media. One argument is that Sundhed.dk, as the authoritative Danish portal on health information, needed to be present on social media, as other influential health actors such as special interest organizations and pharmaceuticals grew increasingly active there. The other argument was the belief amongst the staff of Sundhed.dk that a high degree of social media engagement would help Sundhed.dk rank high on Google's search engines, which was already an established goal of the portal. In 2013, the recommendation of the cross disciplinary group was accepted by the Sundhed.dk directors, who allocated the necessary staff to create the social media editorial board. The editorial board initially consisted of four people; a social media editor, a web architect (and search engine optimization specialist), a content writer, and a student support. None of these were health professionals. As Sundhed.dk primarily worked with text-based health information, they felt more at home on Facebook than on other social media platforms such as Twitter and Instagram. They did try to establish themselves on Google+, because of its relevance for their search engine ranking, but were not successful. They did also consider Snapchat as it has a special appeal to young demographic, which is notoriously difficult to captivate for health organizations, but these considerations were abandoned due to the secretive and image-biased way of the platform.

The social media editorial board was initially concerned with the possible impact that their social media presence might have on other core Sundhed.dk services such as the website and the phone support, so they defined separate criteria for what is good content on for example their website and on their Facebook page. They have a set of written strategic guidelines for communicating on social media, which emphasizes the portals desire to be: (a) Dialogue-centered, (b) Personal, (c) Unbiased, and (d) Forthcoming and helpful. Their strategy serves the dual purpose of supporting search engine optimization and providing an offering, which differs from existing Sundhed.dk services. The idea is to facilitate dialogues, which are relevant to their users - and to do so without neither controlling nor owning the conversation. The social media editorial board has therefore adopted a liberal view on external posts and very diverse information to be attributed to their wall. The social media editorial board does monitor the postings and their social media guidelines offer the possibility to delete inappropriate postings or comments, but it has not yet been practiced. The social media editorial board also maintain a close connection with their partner organizations through fellow editors, whom they also approach in connection with feedback, questions and likewise. Even though the partners of Sundhed.dk produce the health information displayed on the portal it is very rare that a partner organization will approach Sundhed.dk with a request for what to post.

The social media editorial board are using Facebook insight for social media management tool. They are also using Fanpage Karma with some success. They have decided not to adopt specific KPIs to evaluate their performance, as they find it hard to capture their success criteria through them. They still maintain a high search engine ranking as a primary success criterion, but as they don't know Google's algorithms behind the search ranking, they find it difficult to adopt measurements to capture it. Instead they are working with activity- and diversity-based aims such as posting 1-3 times a week, response time and reach to pre-defined demographic groups. They want to aim at a broad demographic group and do therefore not only link to their own content. The social media editor feels convinced that the Facebook page has proven itself valuable in less tangible ways such as the value of the

community and the dialogue with patients and citizens, but has yet to develop the indicators to define and capture this value. They are currently fulfilling their goals to their own satisfaction and are considering adopting more engagement-oriented goals. According to Fanpage Karma, they did have 1.4 million views last year.

4.2.2 Netnographic Observations: Facebook Page Culture

The intention of this netnographic study is to understand the culture of sharing information on the Facebook page of Sundhed.dk. We have based our netnography on Hine[13], who argues that the internet *"[…] as a mixture of varyingly interlinked cultural sites and cultural connections, could form a model for a new way of orienting an ethnography to the field."* [13]. Our netnography takes point of departure in the historic data from Sundhed.dk's engagements on their Facebook page during the period of 2013 – 2015. We decided to focus on the part of the dataset, which contained the Facebook posts with shared information in the form of link, photo, video, etc. After cleaning the dataset, we found 327 posts, which were posted by Sundhed.dk and visitors to their page. Informed by the notion that one *"[…] can usefully think of the ethnography of mediated interaction as mobile rather than multisided"* [13], we decide to lay-out both a temporal and spatial dimension of our analysis of the data.

In order to understand what information is shared on the Facebook page, we read through the 327 posts, their comments and the information linked with the post. We coded the posts and divided them into 15 categories in accordance with the type of information, which was shared through the post. We furthermore coded the posts in accordance with their communication type and the type of social influence it exercised. The most common category of information type contained shared information of "general informative" character and accounted for 185 posts, whilst other categories were "personal identification", "health campaign", "page competition" and "health science communication". In their posts, Sundhed.dk are mainly addressing ways for citizens and patients to interact with health information and the Sundhed.dk portal. They also provide personal accounts of how citizens and patients interact with various health services, specific medical conditions and with managing general health aspects in their lives such as sports. Judging by the level of user engagement, the most successful posts are of specific informative nature such as a national overview over dentist's prices and of the coverage of the EU's public health insurance, personal accounts of citizens' and patients' experiences such as donating blood or living with a specific condition and competitions, where users can vote for Denmark's most active patient or the happiest team sports team. We notice that Sundhed.dk does neither seem to address how citizens and patients can learn to interact with health information for example through applying it to everyday situations nor how citizens, patients and health professionals interact with each other for example through patient inclusion in medical trials, which might also have been relevant in accordance with Sundhed.dk's objective

4.2.3 Big Social Data Analytics: Facebook Page Performance

The launching post of Sundhed.dk on Facebook was a brief statement about the overall purpose of their Facebook page, which is to provide a space for everyone interested in health and illness conditions and for discussing current subjects, news on health, share opinions, discuss, etc., on June 3rd 2013. In the following 7 months Sundhed.dk and their users where mainly interacting about the digitalization of the health care sector (as part of the public sector in Denmark) and its implications for citizens and patients in Denmark. Sundhed.dk successfully engaged - and interacted with users on Facebook about how to access and retrieve information from Sundhed.dk, their questions and through competitions. In 2014, Sundhed.dk on the same time widens and deepens their interactions with users. They continued to serve their followers with instructions on how to use Sundhed.dk and they launched a very engaging competition on crowning Denmark's most active patient. They shared more factual information for example on pollen and winter depression and made it more timely in order for people to prepare for it and to give them time to react on it. Table 1 below presents the overview of the Facebook dataset. Figure 3 shows the distribution of Sundhed.dk's Facebook data with figure 4 showing overall post performance. Figure 5 and 6 show the post performance for admin (Sundhed.dk) and non-admin (users).

Table 1: Overview of the Sundhed.dk's Facebook Dataset collected using SODATO

Content Attribute	Value	Actor Attribute	Value
Timeperiod	Start: 2012-01-31 21:00 End: 2015-12-29 15:16	Total Actors	20295
Total Page Likes	37731	Total Unique Actors	17150
Posts	496	Unique Posters	113
Comments	4913	Unique Commenters	3832
Comment Replies	416	Unique Comment Reply Actors	168
Likes on Posts	23021	Unique Wall Post Likers	13116
Likes on Comments	5781	Unique Comment Likers	2930
Likes on Comment Replies	207	Unique Comment Reply Likers	136

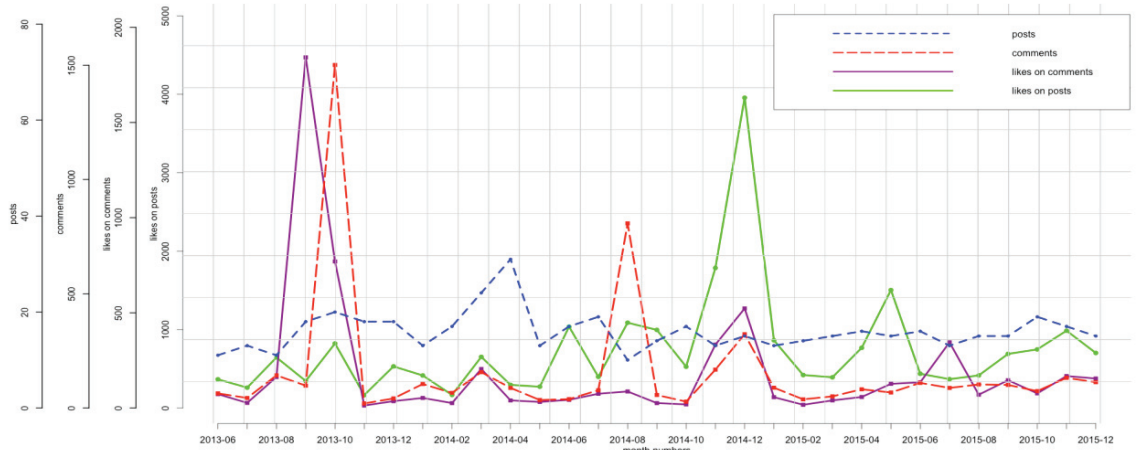
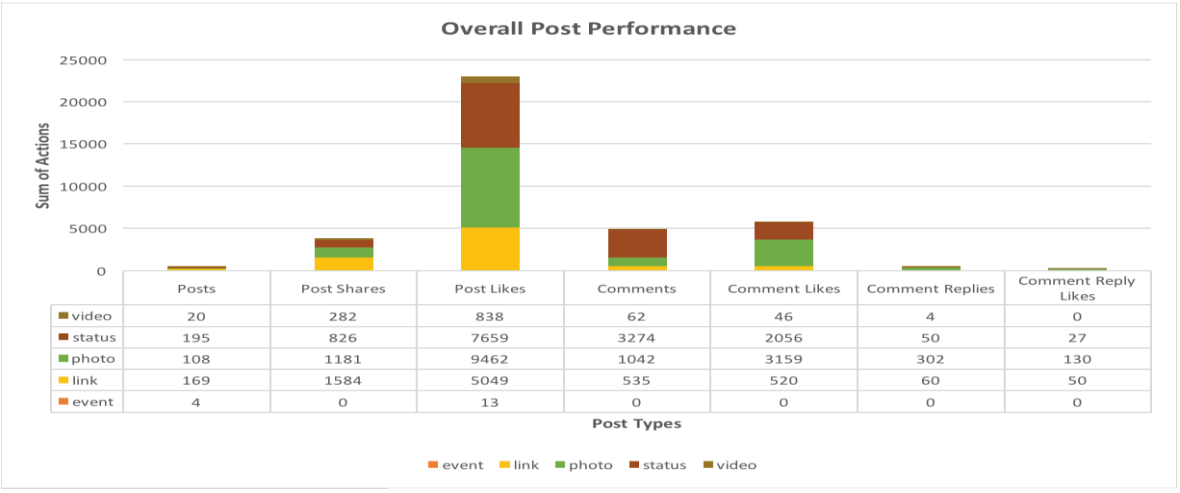
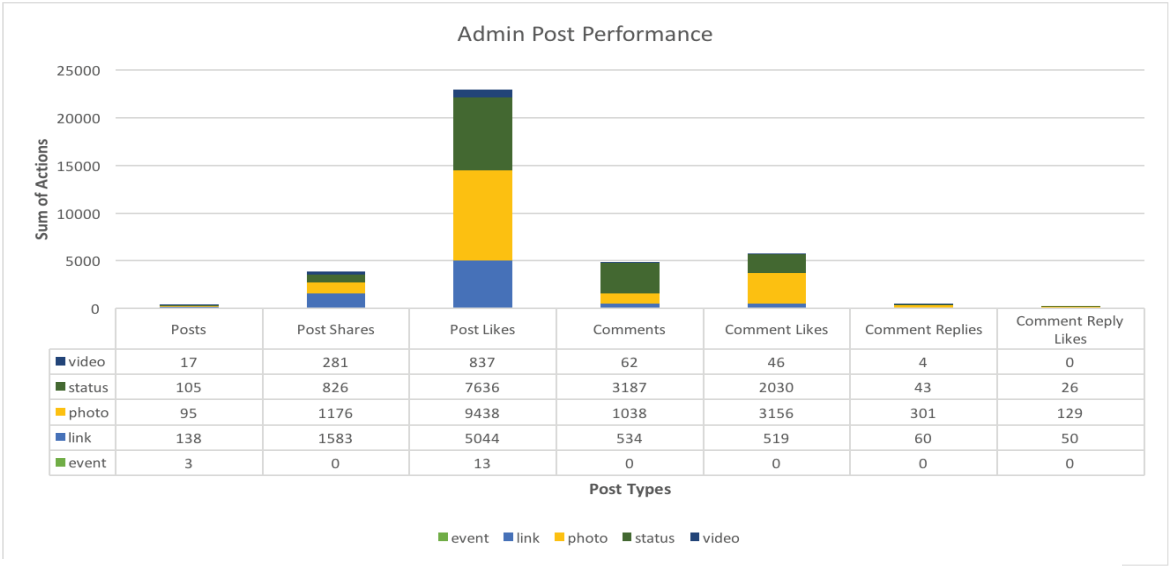


Fig. 3: Temporal Distribution of Facebook Data for Sundhed.dk



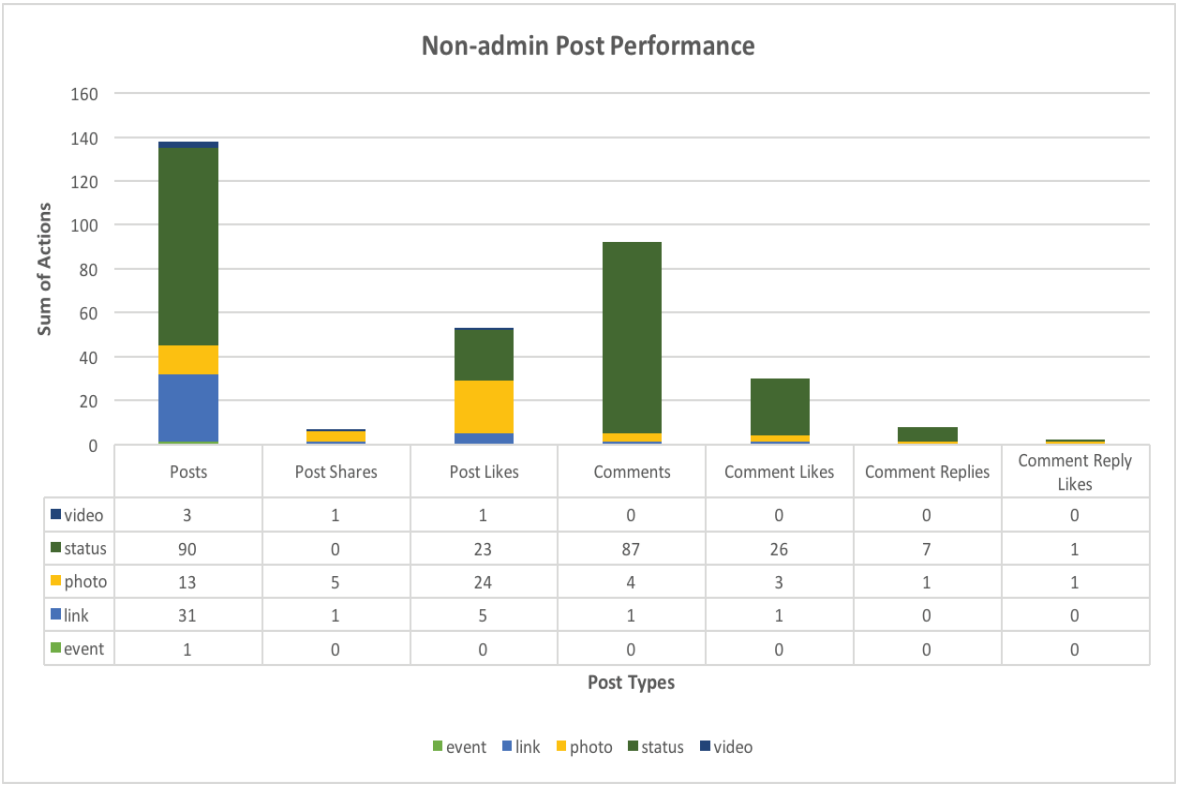
	Posts	Post Shares	Post Likes	Comments	Comment Likes	Comment Replies	Comment Reply Likes
video	20	282	838	62	46	4	0
status	195	826	7659	3274	2056	50	27
photo	108	1181	9462	1042	3159	302	130
link	169	1584	5049	535	520	60	50
event	4	0	13	0	0	0	0

Fig. 4: Overall Post Performance



	Posts	Post Shares	Post Likes	Comments	Comment Likes	Comment Replies	Comment Reply Likes
video	17	281	837	62	46	4	0
status	105	826	7636	3187	2030	43	26
photo	95	1176	9438	1038	3156	301	129
link	138	1583	5044	534	519	60	50
event	3	0	13	0	0	0	0

Fig. 5: Post Performance for Admin (Sundhed.dk)



	Posts	Post Shares	Post Likes	Comments	Comment Likes	Comment Replies	Comment Reply Likes
video	3	1	1	0	0	0	0
status	90	0	23	87	26	7	1
photo	13	5	24	4	3	1	1
link	31	1	5	1	1	0	0
event	1	0	0	0	0	0	0

Fig. 6: Post Performance for Non-Admin (Facebook Users)

Figures 7 shows the word cloud generated from keyword analysis of the text contained in posts, comments, and replies to comments by Sundhed.dk.

Fig. 7: Word cloud of Sundhed.dk's Posts, Comments & Replies to Comments

In 2015 the engaging posts became even more factual and informative, but also with more varied social engagement forms such as participation, involvement and engagement. Sundhed.dk developed a better feeling for their audience and were able to deliver more posts with considerable user engagement. Analysis of the links shows that they mainly linked back to themselves with a few exceptions of other health organizations such as "Oplysning om Organdonation". The majority of links are hosted by Sundhed.dk and Facebook. The two largest types of artefact are by far links and photos. There are about 20 videos, where 14 are contributed by Sundhed.dk. They have also advertised one event, the 10th year anniversary of Sundhed.dk, in 2013. Not surprisingly, users are engaging most in competitions, where they can elect for example Denmark's most active patient or Denmark's happiest sports team. The informative post is broadly very well liked and shared, but not always very well commented upon. The highest engaging informative posts includes posts on how to use Sundhed.dk, how to be covered with travel health insurance and facts about health and sickness (through the patient handbook). Campaigns gets likes, but are rarely interacted with through share or comments, which might indicate a higher degree of indifference amongst users. There are not many patient stories, where a patient for example tell about how to live and cope with a condition, but they are generally well engaged with. These stories could also include health aspect such as biking to work or be a winter swimmer (popular and barbaric activity in the Nordics, when it's cold). Science themed posts are also relative few in numbers and could vary from popular science themes such as "do eyes freeze" to development of new examination forms in for example gut screening.

We found 8 different forms of social influence [14] on the Sundhed.dk Facebook page: debate, encouragement, fact sharing, involvement, participation, user friendliness, and visibility. Generally, encouragement, involvement, visibility and fact-based post are highly engaging amongst users. The stories are for example on how private individuals are coping with health and sickness situations, Sundhed.dk's page competitions, informative and factual posts about everything from how to find the best dentist prices, the fluctuation of pollen numbers and explanations on why we get grey hair. The trend is mainly that Sundhed.dk is complying with the perception of "positive computing" as the tone is relatively light, friendly and personal[15].

4.2.4 Summary of Findings

- Sundhed.dk's social media strategy is well-aligned their organizational strategy, which is to amongst other to have many visitors on the web portal.
- Sundhed.dk is not explicitly working to explore and exploit the capacities of social media.
- Sundhed.dk is struggling to move beyond the generic social media metrics to define (and set standards for) what is good SSHI. That is, they need domain-specific metrics in new public health to measure the effectiveness of their social media strategy, tactics and operations.
- Sundhed.dk has undergone a temporal development from discussing "digitalization" to focusing more on "facts" and "content" (which we believe has created better content)
- Sundhed.dk has undergone a spatial development towards a focus on information and fact, but might have neglected the "personal" application aspect in the process.
- The strategic integration and tactical application of the IMB model by Sundhed.dk and other public health organizations in their social media strategies could improve SSHI efficacy, effectiveness and satisfaction.

5. Future Work

Current work in our laboratory is applying machine learning techniques such as k-means clustering and supervised classification with domain-specific models from public health to identify seasonal trends and interactional patterns in the dataset of more than 150 Facebook walls of public health organisations, NGOs, pharma companies, patient groups, disease-specific organisations etc.

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