Using Social Media to Decrease Healthcare Utilization for Pediatric Asthma: a Pilot Randomized Control Trial

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Protocol Title:	Using Social Media to Decrease Healthcare Utilization for Pediatric Asthma: a Pilot Randomized Control Trial
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Population:	200 Children 3-17 years old hospitalized at Children's Memorial Hermann for asthma
Number of Sites:	Single site Children's Memorial Hermann
Study Duration:	Two years
Subject Duration:	One year

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Abstract:

Background: Pediatric asthma is a leading reason for healthcare utilization. Successful strategies for decreasing utilization have focused on increasing asthma education. However, traditional teaching methods are often fragmented and time-limited sessions on the day of discharge or office visits. Social media may provide a forum for more consistent and sustained education. **Design**: We propose a pilot randomized control trial of social media enhanced education (**SME**) versus usual asthma education to decrease treatment days within one year of enrollment. We will randomize 200 patients to 1) usual asthma education supplemented with SME: education provided throughout the year with at least once-a-week posts on Facebook, Twitter, Instagram, and Snapchat. 2) Usual asthma education: education provided in the clinic, emergency room, and hospital without modification. **Hypothesis**: We hypothesize that SME will reduce treatment days in a medical setting, missed school days, and health system costs. We believe that treatment effect will be stronger in patients with higher social media engagement, and also in those that both patient and caregivers join the intervention compared to either only the patient or the caregiver. **Analysis:** Bayesian analyses will be used to assess the probability of benefit and cost reduction with the intervention. We aim to show that social media can be used as a resource inexpensive modality to provide frequent and consistent asthma education to patients and their families, ultimately leading to decreased healthcare utilization.

Background:

Asthma is the most common chronic condition among children, a leading reason for pediatric hospitalization in the United States, and a leading cause of potentially preventable pediatric admissions.[1] Hospital readmissions and emergency room utilization is common among children with asthma, and is responsible for a large economic burden on the healthcare system with $1.5 billion in hospital charges annually in the US[2] and approximately $6 billion in estimated direct healthcare costs.[3]

Many strategies for decreasing asthma-related emergency department (ED) visits and hospital admissions have been investigated.[4] The most successful interventions have involved increasing asthma education and teaching of self-management techniques to patients and their families.[5] Traditional teaching is often limited by fragmented or rushed sessions on the day of discharge from the hospital or ED, or during time-limited follow up visits at the clinic. Other strategies such as comprehensive home visits, specialized asthma clinics, or community-based initiatives, although effective, are costly and resource intensive.[6-8]

Given the limited time for patient-provider interaction, there's a need to develop more efficient ways for healthcare providers to interact with patients and parents outside medical settings. Social media is a forum that could provide more frequent contact with patients and families, and allow for continuing education. It is estimated that more than 70% of the U.S population uses some form of social media.[9] For teenagers, this usage jumps to over 90%. About 95% of teenagers have access to a smart phone and 45% of teenagers report being online on a near constant basis.[10] Reaching this age group may be of particular importance, as it has been shown that adolescents have decreased compliance, increased improper usage with asthma treatments, and comprise of a large proportion of hospital readmissions and emergency room utilization.[11-13]

Social media is a promising tool to provide education. Previous studies have used social media in a wide range of topics to provide education to both patients and clinicians. Positive effects have been seen in adults in promotion of breastfeeding, diabetes management, dementia management, and reproductive health education in adolescents[14-17]. Studies have also supported the use of social media as improving learning, engagement, and motivation in learners.[18]

We propose to conduct a Bayesian pilot randomized trial to assess the overall probability and magnitude of benefit of supplementing usual asthma education with a social media intervention as a resource inexpensive modality to provide consistent asthma education to patients and their families in reducing the total days of care in a medical setting (primary outcome), other adverse outcomes, and health system costs.

We plan on utilizing four of the most common social media platforms to deliver asthma education.

1. **Facebook**
   Facebook is the world's largest social media platform and has over 196 million daily active users in the United States and Canada as of the third quarter of 2020.[19] In terms of age distribution, 51% of those 13-17 years, and 70-80% of adults use the platform.[20] Users can post text, polls, photos, and videos that can be shared directly to "friends" or within a group. Facebook has been used in previous studies as a media for education, and has been used successfully in trials as a tool in providing continuous dementia education, promotion of exclusive breastfeeding, and diabetes self-management. [14-16]

2. **Twitter**
   Twitter is a social media platform that has over 68.7 million users in the United States.[21] In terms of age distribution, 32% of teenagers, and 22% of adults use the platform.[9,20] Users can "tweet" a

message of 280 characters, link photos/videos, and conduct polls. Studies have supported the use of Twitter in improving learning, engagement, and motivation.[18]

3. **Instagram**

Instagram is primarily a photo based social media platform and has over 140 million users in the United States.[22] In terms of age distribution, 72% of teenagers, and 37% of adults use the platform. Users post photos or videos that are shared to their followers who can then "like" or comment on the posts.

4. **Snapchat**

Snapchat is a mobile app for Android and iOS devices that is primarily a photo based social media platform. It has over 80 million users in the United States. In terms of age distribution, 69% of teenagers, and 24% of adults use the platform. Among teenagers, it is the social media platform that they use most often.[9,10] While most "snaps" are made available to the receiver for only a short time before it becomes inaccessible, Snapchat has a "snapcode" feature that functions similarly to QR reader. This can be used to open an internet link through the Snapchat application. A previous study has used this feature to promote reproductive health education in hospitalized adolescents.[17]

Social media is now a part of daily life for the majority of Americans and particularly for adolescents. Given that social media is already a forum utilized by our patients and families, using it seems like a promising resource inexpensive modality to provide consistent asthma education.
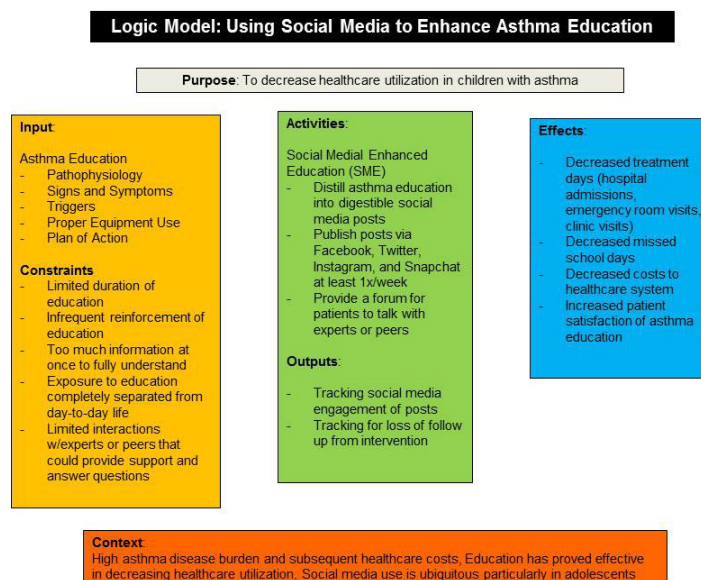
Specific Aims:

1. To randomize 200 eligible children with asthma to social media enhanced education or to usual care to evaluate whether SME will:
   a. Reduce total number of treatment days defined as summation of days of subsequent hospital admission, emergency room visits, and clinic visits
   b. Reduce missed school days
   c. Reduce total costs from a health system perspective
   d. Have increased effect with increased social media engagement
   e. Have increased effect in participants with both caregiver and patient (combined) with social media accounts, compared to participants where only the patient or only the caregiver uses social media (single)
   f. Have increased patient satisfaction in the asthma education received
2. To obtain the experience and data needed to refine SME to be able to expand this platform for other chronic medical conditions with high healthcare utilization including pediatric diabetes, epilepsy, and sickle cell disease

Hypotheses: Social media enhanced education will result in

1. Reduction in treatment days in a medical setting from enrollment to one year from enrollment (primary hypothesis)
2. Reduction in missed school days
3. Reduction in total health system costs
4. Increased treatment effect in those patients with high social media engagement compared to low social media engagement
5. Increased treatment effect in those with combined (patient + caregiver) social media accounts compared to single participants
6. Increase in patient satisfaction of amount and frequency of asthma education.

UTHealth
The University of Texas
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Study Design and Methods:

Logic Model: Using Social Media to Enhance Asthma Education

Purpose: To decrease healthcare utilization in children with asthma

Input:

Asthma Education
- Pathophysiology
- Signs and Symptoms
- Triggers
- Proper Equipment Use
- Plan of Action

Constraints
- Limited duration of education
- Infrequent reinforcement of education
- Too much information at once to fully understand
- Exposure to education completely separated from day-to-day life
- Limited interactions w/experts or peers that could provide support and answer questions

Activities:

Social Medial Enhanced Education (SME)
- Distill asthma education into digestible social media posts
- Publish posts via Facebook, Twitter, Instagram, and Snapchat at least 1x/week
- Provide a forum for patients to talk with experts or peers

Outputs:
- Tracking social media engagement of posts
- Tracking for loss of follow up from intervention

Effects:
- Decreased treatment days (hospital admissions, emergency room visits, clinic visits)
- Decreased missed school days
- Decreased costs to healthcare system
- Increased patient satisfaction of asthma education

Context:
High asthma disease burden and subsequent healthcare costs, Education has proved effective in decreasing healthcare utilization, Social media use is ubiquitous particularly in adolescents

Population: We will recruit children age 3-17 years old hospitalized to Children's Memorial Hermann admitted for asthma exacerbation. To be eligible, the patient and/or primary caregiver must have internet access on cellular phones or at home and use a social media account (Facebook, Twitter, Instagram, and/or Snapchat). Exclusion criteria include children with other chronic conditions besides asthma that may necessitate frequent health care utilization. i.e. children with complex chronic conditions, sickle cell, seizures, diabetes. Children less than 3 years are excluded as a formal diagnosis of asthma prior to this age is difficult, and we aim to homogenize the population and exclude similar diagnoses such as bronchiolitis or wheezing of infancy.

Randomization, Consent, Allocation, Blinding: The PI (RPC) will be primarily responsible for enrollment and randomization. We will submit our study to the UTHealth Institutional Review Board as a quality improvement (QI) trial to verify the benefits of an intervention to increase access to asthma education beyond what would otherwise be provided in usual care. As allowed under federal regulations for QI studies judged unlikely to increase patient risk,[23-25] we will request waiver of consent from the IRB, but we plan to still seek verbal permission to be able to contact patients monthly to assess their healthcare utilization.

Block randomization with variable block sizes and stratification by age will occur. Stratification for age will occur, (3-11 years or 12-17 years) to allow for equal allocation of teenagers to each arm. Allocation ratio of 1:1 will be used. Patients will be randomized during their hospitalization. While patients and caregivers cannot be blinded, the statistician and healthcare economist will be.

Interventions:

<u>Usual Asthma Education</u>: (which will not be modified by the study protocol) For patients who are admitted to Children's Memorial Hermann for asthma exacerbation, asthma education is provided to patients and families on the day of discharge by the nurse and respiratory therapist. Respiratory therapists spend approximately 20-30 minutes educating on the following topics: Triggers, Signs & Symptoms, Medication Use, Medication Delivery, Peak Flow, Zones and how to respond to each, and Cleaning equipment. Nursing staff are responsible for printing out education sheets to give to patients and showing an education video that is ~20 minutes long. An asthma action plan (paperwork with a plan of action ie. how many puffs of albuterol to take, when to come to the emergency room, etc.) are given to families on discharge. Patients that are discharged from the emergency room are given the same educational materials by the nurses and/or respiratory therapists except for the asthma video. Patients receive a variable amount of asthma education when going to usual clinic visits. The education provided is dependent on the provider, and usually limited in length to the time of the visit (~10-20 minutes).

<u>Social Media Enhanced Education</u>: Along with usual asthma education received in the hospital, ED, or office visits, patients and families randomized to the SME arm will receive asthma education via various social media platforms – Facebook, Twitter, Instagram, and/or Snapchat. Topics of education will include those typically covered in usual asthma education. These include background on asthma and pathophysiology, asthma severity classification, asthma triggers, different medications and indications for when to take them, how to use an inhaler technique, and symptom monitoring. Online resources from the American Lung Association and the National Asthma Education and Prevention Program will also be posted. Social media educational posts will be based off the framework of the Health Belief Model. This model for behavior change consists of six components: 1) Perceived susceptibility, 2) Perceived severity, 3) Perceived benefits, 4) Perceived barriers, 5) Cue to action, and 6) Self-efficacy. The research team consists of two pulmonary specialists (RM, KS) and pediatric hospitalists (RPC, KS). This medical team will craft pre-planned educational posts and the PI (RPC) will disseminate the posts at a minimum frequency of one post/platform per week. Other unplanned posts (retweets of asthma organizations, interactive polls, reminders of medication compliance etc.) will be posted at the discretion of the PI.

Facebook

For the participants who use Facebook, the research team will utilize multiple features of the platform to engage users.

1. The team will "friend" them. This will allow participants to be provided information on their "news feed" as well as have access to "stories" – a photo or text post displayed separate to their "news feed."
2. Participants will be able to directly message or post questions or comments on the group page. This will provide an informal avenue of communication with the team as well as other members of the group. Previous studies have shown that this "peer group" aspect of social media to be an effective form of support.

Twitter

The research team will engage participants of Twitter in several ways.

1. The research team will post "tweets" of asthma education, uploads of photos and videos, and conduct of polls.
2. Relevant twitter posts that provide education or important information from various asthma organizations will be retweeted ie. @CDCasthma, @AllergyAsthmaHQ, @NAECB_Official, @accpchest.
3. Participants will have an informal avenue of communication to the team by tweeting questions or comments to the team.

Instagram

The research team will post photos and short videos to be shared with participants. Participants can comment on the posts to discuss or ask questions to the team.

Snapchat

The research team will post pictures and videos similar to the Instagram platform. The team will also create snapcodes that link participants to our cloud based asthma education website run via google drive. This will allow for text based education along with the typical photo based content of this platform.

Outcomes:

Primary Outcome: Total number of treatment days in a medical setting (hospital, ED, clinic) within one year of enrollment. Treatment days are defined as the summation of days in the hospital, ED, or in the clinic. We chose one year because of the chronicity of asthma, as well as its seasonal variation.

Secondary Outcomes: Total number of hospitalizations, total number of readmissions, total number of emergency room visits, and the total number of clinic visits, patient satisfaction and understanding of asthma education, number of missed days of school, and total estimated health system costs, hospital costs, and clinic costs.

Healthcare utilization will be primarily assessed by parental report. The PI will contact families every month and ask if their child had been admitted, visited the emergency room, had a clinic appointment for asthma, or missed any days of school within that month. We will also verify utilization of any of the 14 Memorial Hermann hospitals (MHHS) and the UT Health clinics from their respective electronic medical records and claims data. While we are aware of the risk of recall bias, we believe a contact every month is frequent enough to minimize the bias. We will also obtain multiple ways of contact (phone call, text, email, social media) in order to reduce loss to follow up.

Level of engagement will be tabulated by the following: Facebook engagement will be tracked through "likes," comments, unfriending, completion of learning units, completion of polls. Twitter engagement will be tracked through "retweets," comments, completion of polls, and unfollowings. Instagram engagement will be tracked by "likes," comments, and unfollowings. Snapchat engagement will be tracked by number of snapcode links viewed, and any unfollowings.

Hospital and clinic costs will be assessed from the health system perspective. For each ED visit and hospitalization in the MHHS, total hospital-specific costs will be obtained from the cost-accounting system for these hospitals. Costs for physician services provided at CMHH will be estimated using UTHealth claims data and Relative Value Units (RVUs) from the Medicare Fee Schedule. The costs at other hospitals outside MHHS will be estimated based on the mean costs of these encounters at MHHS. Costs for clinic visits at UT Health will be estimated using UTHealth claims data and using the standard RVU-based method. The costs for office visits occurring outside our center will be estimated based on the mean costs observed at UTHealth. For the social media intervention group, we will also add the costs of the personnel time spent curating and managing the educational material to be used in the social media platforms. The total time spent with the social media intervention will be prospectively collected by the PI (who will be primarily responsible for managing the social media intervention and will also include time from the pulmonologist [RM] and hospitalist [KS] whenever their input is required) and will then be multiplied by the unit time costs based on the personnel salary, fringes, and overhead costs. All costs will be inflated to the year of analysis based on the Consumer Price Index for medical services.

Data Analysis Plan:

Effect size, recruitment, power & statistical analysis

Based on retrospective data of patients hospitalized at CMHH as well as estimated national data,[27,28] we estimate a 25% hospital readmission rate and 35% emergency visit rate within one year of discharge for those receiving usual asthma education. We also assume a 35% unplanned clinic visit rate within one year of discharge. Each admission accounts for 2.4 treatment days, and each clinic and ER visit accounts for 1 treatment day. In a population of 100 patients, we then expect the total number of treatment days to be 114 days or 1.14 days per child-year. With an expected 25% effect size (based on the 20%-30% effect size reported in the Cochrane reviews on the impact of asthma education on healthcare utilization among pediatric patients,[4] recruitment of 200 patients will give 0.80 power to show reduction in total number of unplanned treatment days with probability of benefit >60%.

Power analysis assumed data arise from negative binomial distribution with standard deviation 1.5 times mean total treatment days. In 1000 simulations, relative risks were estimated from negative binomial model with prior relative risks centered at 0 with credible interval 0.3-3.0 and posterior probabilities were derived from normal approximation of model coefficients.

We believe this to be a conservative estimate since we assume that each patient with readmission, clinic visit, and ER visit would only have done so once within the year. Previous studies suggest that there is a population of frequent healthcare utilizers, and that one visit often is the precursor for multiple subsequent visits in this population.[29-31] We also believe the 25% effect size is reasonable, as systematic reviews and previous studies have shown that asthma education can increase compliance with medications by at least 20%[32], decrease hospital admissions by 20%, decrease ER utilization by 25%, and decrease clinic visits by more than 30%.[4] We also believe the sample size is feasible. CMHH alone admits ~250 – 300 patients for asthma each year.

We propose the use of Bayesian analysis to provide direct estimates of the probability of benefit (reduction in treatment days and health system cost reduction) as well as the magnitude of benefit or harm. In this pilot study, some treatment effects that would be considered important for patients, families, and clinicians may not be statistically significant by traditional frequentist analysis. While we have planned feasible patient recruitment in this pilot study to demonstrate a high probability of benefit with moderate effect size, we have avoided arbitrary probability thresholds ($p < 0.05$) used in frequentist analysis to define trial success. Moreover, given the low-risk, low-cost nature of this intervention, substantial cost reduction could be achieved with small decreases in health care utilization. As the first pilot study testing efficacy of SME in the pediatric asthma population, our planned Bayesian analysis will allow study conclusions to depend on the probability of benefit based on actual observed effect size balanced with potential harms/costs from the intervention and will inform future implementation and expansion of the intervention to additional patient populations.

All statistical and economic analyses will be conducted under the intent-to-treat analyses principle using generalized linear models with appropriate link function based on data distribution (ie, negative binomial or Poisson with log link). All Bayesian models will use neutral, vaguely informative prior such as those with relative risk centered at 1 with credible interval range from 0.3-3.0 encompassing the largest likely effect size for major outcomes in RCTs. Cost differences between the two arms will be assessed using generalized linear models with log-link and gamma distribution. To account for patients who may not be hospitalized or incur hospital-related costs during the study period, zero-inflated models will be considered. All models will be adjusted for stratifying variables (asthma control, recruitment site, and age) and account for patient clustering as necessary. Optimal model fit for each outcome will be determined from model diagnostics and comparison of likelihood-based statistics. All analyses will be conducted in R.

Data Storage and Handling: We will use Research Electronic Data Capture (REDCap) to randomize patients and collect predefined study data needed to address each of our hypotheses. REDCap is a secure, web-based application designed to support data capture for research studies, providing: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources

Study Procedures: Participants will be approached for enrolment during their index hospitalization. Consent will be obtained. Study duration will last one year from enrolment. Participants will be contacted once a month (12 contacts total) to assess healthcare utilization within that past month. The PI on enrollment will ask for several different methods of contact and ask which the participants prefer ie. calling - what times of day/day of week, emailing, texting, directly messaging on social media etc. The PI will contact each participant by their mode of preference once a month. During the follow up contacts, participants will also be asked a short questionnaire (approximately 10 minutes).

Information to be gathered will be missed school days, total number of hospitalizations, emergency room visits, and clinic visits. We will also gather costs of these visits. Engagement data will be obtained from the various social media platforms.

Interpretation and Potential Importance of Findings:

If we are able to demonstrate successful effects of social media enhanced asthma education in decreasing unplanned healthcare utilization, we believe the impact to be substantial. First, there is a large disease burden. Asthma is the most common chronic disease in childhood that affects 5.5 million children in the United States. Second, the intervention is easily implementable since social media use is so ubiquitous. Third, the outcome of a cost dominant intervention has implications for tremendous savings on costs to the healthcare system. Compounding this, we think the results of the study would be easily generalizable – 1. To the adult population, encompassing another 19.2 million patients with asthma in the US (339 million worldwide), and 2. To other chronic pediatric medical conditions that have frequent unplanned healthcare utilization such as pediatric diabetes, sickle cell, and epilepsy.

Plans for Dissemination of Results:

Once the project is completed, we plan on dissemination of results through submissions to national conferences (Pediatric Academic Societies, American Academy Pediatrics, and Pediatric Hospital Medicine) as well as manuscript publication in a peer-reviewed journal (JAMA Pediatrics, Pediatrics, Hospital Pediatrics).

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ATTACHMENTS

1. Script of follow up visits