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Project Title: Social Media as a tool for Antimicrobial Stewardship

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Social Media as a Tool for Teaching Antimicrobial Stewardship

Antibiotic stewardship is increasingly recognized as an important tool for improving the antimicrobial use, optimizing treatment for or prevention of infection, preventing bacterial resistance, decreasing antibiotic-related toxicity and reducing the cost of care.[1] As a class of drugs, antimicrobials are very diverse and complex with an entire specialty devoted to diagnosing infections and managing antibiotic therapy. However, antibiotics are also commonly prescribed by almost all clinicians despite minimal education sometimes leading to resistance, overuse, and avoidable errors. Guidelines to treat common infections including community acquired pneumonia[2] and hospital acquired pneumonia[3] exist, but despite their availability and the best intentions by physicians, are not consistently utilized by health care providers.[4] Widespread utilization of standardized order sets has been shown to increase adherence to guidelines and additionally have a mortality and cost benefit in the treatment patients with both community acquired pneumonia (CAP)[5] and hospital-acquired pneumonia (HAP)[6].

Education of house staff in particular is complicated by frequent turnover and work hours restrictions that limit time for clinical experiences and traditional didactic sessions[7,8] and the use of innovative strategies for healthcare provider education regarding antibiotic use are needed to supplement teaching beyond the lecture hall and the medical wards. In the hands of physicians and at the bedside, technology has the potential to bridge the gap in educational opportunities. Social Media, including Facebook (Menlo Park, CA) and Twitter (San Francisco, CA) has proven to be very successful in consumer education and advertising[9] and, with the help of reputable experts, could be utilized to provide needed medical education as well.[10] The potential for rapid spread of ideas (both good and bad) is obvious from the phenomenon of "viral" videos on YouTube.[11] Crowd sourcing, or the use of the public in community data collection, paired with contests to engage participants have been successfully used in public health campaigns like the MyHeartMap project in Philadelphia which used public input to identify and map all of the automated external defibrillators (AEDs) in Philadelphia[12].

At the University of Chicago Medicine, Internal Medicine (IM) house staff use Apple iPads (Cupertino, CA) in their daily work and are part of the key demographic for social media advertisers. **We aim to test the hypothesis that social media platforms, Facebook and Twitter can be used to efficiently disseminate educational information to Internal Medicine house staff leading to increased adherence to established practice guidelines in an academic medical center.** Because people who work together tend to share information and practices, both participants and their colleagues are expected to improve practice. **If successful, the use of such methods could solve some of the biggest roadblocks to education and communication in the healthcare setting and would certainly contribute new knowledge to the fields of medical education and antimicrobial stewardship.** By using the Antimicrobial Stewardship Program's (ASP) Facebook, Twitter, and intranet web pages as novel communication tools, we will increase use of stewardship-sponsored order sets and pathways, achieve improved adherence to guidelines for selected conditions, and increase overall knowledge base about antimicrobials. In order to accomplish this goal, we plan to engage the trainees on Twitter and Facebook by hosting daily medical trivia contests rewarding both participation as well as timely

correct answers (see design below). Between contests, additional educational material (clinical pearls, links to guidelines, etc) will be pushed out to participants. The contests and messages will also serve as a novel medical education platform focusing on appropriate antibiotic use, antibiotic safety, and use of educational tools (including pathways and order sets) currently underutilized at our hospital.

Aim #1: To quantify Internal Medicine house staff engagement in antimicrobial stewardship-related social media activities. "Engagement" will be measured in number of followers or friends in the selected demographic (UCM Internal Medicine house staff), click through rates, re-tweets/posts, and contest participation rates. Daily trivia contests consisting mainly of medical knowledge questions will be posted using Twitter and Facebook. The first correct response will win a nominal prize (small value coffee card) and all responses will be entered into a weekly raffle for a larger prize.

Aim #2: To measure change in antibiotic-specific knowledge derived from Facebook and Twitter messaging. All new and existing friends (Facebook) and followers (Twitter) will be asked to take a pre-test designed to measure specific concepts and facts about antimicrobials. Over the course of the project, all topics on the test will be covered either in posts, links to reference material (internal and external), or trivia questions. After 6 months time, friends and followers will be asked to re-take the test and difference in pre and post-test scores will be calculated. Subgroups based on level of participation will also be evaluated.

Aim #3: To increase use of stewardship-sponsored order sets. Order sets for community acquired pneumonia and pneumonia in the ICU patient were previously created but are not used consistently (less than 13 times in the last 6 months for both order sets combined). As part of this project, these tools will be encouraged using Facebook and Twitter. Use of the order sets will be tracked. Additionally, the extent of social dissemination will be estimated by measuring use of the order sets by house staff not participating in the social media platforms.

Assessment of Need for the Intervention

This initiative meets the goal of the RFP as it is a quality improvement project focused on optimizing the care of hospitalized patients receiving treatment for proven/suspected bacterial infections. At UCM, as in all other academic medical centers, relatively inexperienced house staff are on the frontlines, making complicated decisions regarding antibiotic usage that potentially affect patient outcomes on a daily basis. Antimicrobial therapy, in particular, has been shown to be most effective when the correct drug is initiated as early as possible,[13,14,15] often before teaching rounds with a more experienced attending physician. Furthermore, even seasoned general medicine attendings can use a "cookbook" approach to antibiotics because of the sheer number of antibiotics available and the rapid changes in epidemiology and institutional ecology. Hence, point of care education for the house staff in meaningful and timely "bites" of information could help arm them with the knowledge they need to make good decisions. **This project aims to improve the antibiotic prescribing practices of our primary prescribers by both improving their antibiotic knowledge as well as increasing the use of**

standardized order sets, with the anticipated results being increased adherence to established national guidelines and improved outcomes specifically for hospitalized patients with pneumonia.

House staff at academic medical centers face the challenge of increasingly restrictive work hours requirements. While patients likely benefit from having a rested clinician, cramming medical education into a shorter time frame comes with its own risks. **An analysis of intern work hours at UCM confirmed that interns are spending less time in the hospital since ACGME implemented a more stringent work hours policy in 2010. Interns spent 76 hours/week in the hospital prior to restrictions and 58 hours/week after the 2010 restrictions (data per ACGME tracking tools).[16] While patient care loads were also modestly restricted, interns now carry only one fewer patient than prior to the 2010 restrictions, thus leaving a disproportionate deficit in educational time.** Furthermore, some rotations mandate non-traditional hours (overnight shifts) leaving trainees completely absent from daytime educational activities and teaching rounds. It remains a challenge to educate the future generation of physicians and this project aims to create a novel method for reaching these trainees at the point of care. While we focus on pneumonia guidelines and antimicrobial use now, success in this endeavor can be applied to any medical education gap.

Studies have shown that patients who received inappropriate initial antimicrobial coverage have greater in-hospital mortality rates than did patients who were appropriately covered.[13,14,15] Guidelines and order sets can help guide appropriate antibiotic use regardless of the healthcare provider's level of experience when caring for complex patients. When the impact of the use of an adult pneumonia standardized order set to aid in clinical care has been previously studied, not only was core measure compliance increased, but mortality and costs benefits were shown as well.[6] **At UCM, order sets for community acquired pneumonia and pneumonia in the hospitalized/ICU patient (based on ATS/IDSA guidelines)[2,3] were used only 13 times in the last 6 months. With over 22K admissions each year, this clearly represents underutilization.** Elements of the national guidelines that are included as CMS measures are reported as 100% at UCM, but this is hardly the whole story. The CMS indicators[17] do not address antibiotic use after the first 24 hours, de-escalation, duration, or interpretation of diagnostics all of which are critical to good patient care and responsible antimicrobial use. We have had success optimizing initiation of antibiotics through formulary restriction and prospective audit and feedback and are currently exploring ways to improve the use of the antibiotics being prescribed (appropriate diagnostics, dose, duration, de-escalation, documentation of appropriate indication). With support from this grant, our ASP will have the resources to monitor these parameters and show the efficacy of this form of education.

Social Media Platforms

The use of social media explicitly to provide medical education and quality improvement has not been described previously. However, social media has been successfully used to educate consumers (advertising)[9] which suggests that this platform can be used for more formal education as well.[10] Social media refers to "web-based and mobile-based technologies which

are used to turn communication into interactive dialogue among organizations, communities and individuals,"[18] as well as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0*, that allow the creation and exchange of user-generated content."[19] Two popular social media platforms, Facebook and Twitter, will be used in this study. The UCM ASP Facebook and Twitter feeds were initiated in April 2012 as a pilot project to gauge the ease of disseminating information and attracting followers.

Why is social media an important platform for teaching busy house-staff? 66% and 16% of on-line adults in the United States use Facebook and Twitter. 83% of Facebook users are 18-29 and 27% of Twitter users are between the ages of 18-29; the majority of use is on mobile devices.[20] The use of social media is growing, especially among the age group that comprises the vast majority of medical trainees (medical school and residency). **A study published in 2007 by our UCM colleagues Farnan et al., found that 72% of UCM residents and fellows have at least some familiarity with social media;[21] in a more recent survey, the same group reports that now almost 100% of UCM medical trainees have a social media presence through the use of Facebook, Twitter or blogs (data not published). The UCM is an innovator in the use of mobile technology (UCM iPad Initiative) at the bedside and have successfully incorporated iPads into the workflow of every IM resident subsequently increasing the efficiency in delivering patient care.[22]** Many training programs, following UCM's lead, are incorporating iPads and other mobile devices into residents' work, allowing current trainees to be connected both throughout the workday as well as during "nontraditional" hours. We believe social media has the capacity to reach medical trainees to disseminate and reinforce important information regarding antibiotic use criteria and other educational/patient safety tools, including the use of order sets and pathways in a uniquely timely, far-reaching fashion and at the point of care.

Facebook is a social networking service launched in 2004 that now boasts over 1 billion active users.[12] An individual can register for the service and finds "friends" using an algorithm that searches for other users with similar history (same college, medical school, same place of work, etc) or demographics. Users post information in the form of short statements, longer blogs, pictures, movies, or by "liking" content on another's page; links to other sources of online information can also be posted in the newsfeed, embedded in the post. Posts can, in turn, be made accessible to the users' Facebook friends in their own newsfeeds. The newsfeed is a continuously updating lists of all posts made by connected friends and organizations. It is commonplace for businesses and organizations to maintain Facebook pages as a way to detail information about their organization. All pages are searchable through the search engine at the top of the application/website. The UCM ASP is the only antimicrobial stewardship group on Facebook and can be found at the web address: www.facebook.com/UCMASP. We have maintained a Facebook page since April of 2012 and currently have 234 friends (see Fig1).

*Web 2.0 - Describes the new era of the dynamic and interactive use of the internet, where software developers and individuals create content and applications that are continuously updated and modified by all users in a collaborative way. [19]

Fig 1. Screenshot of UCM ASP facebook page and posts outlines changes in guideline recommendations and news articles.

Twitter is a social networking service launched in 2006 with over 500 million active users[24]. This service allows users to post (tweet) short messages of up to 140 characters, and links can be embedded in messages that users can connect through directly to posted content. Every time a user posts a tweet, it is sent out to the all of their followers. Users can also "follow" others including celebrities and organizations. If a user sees a tweet that interests them, they can "retweet" it to their own followers. Hash tags, or the use of a "#" in front of a word, can allow the post and all other posts with an identical hash tag to be searchable. For example, when asking our followers for the appropriate duration of for treatment for CAP, we would use a

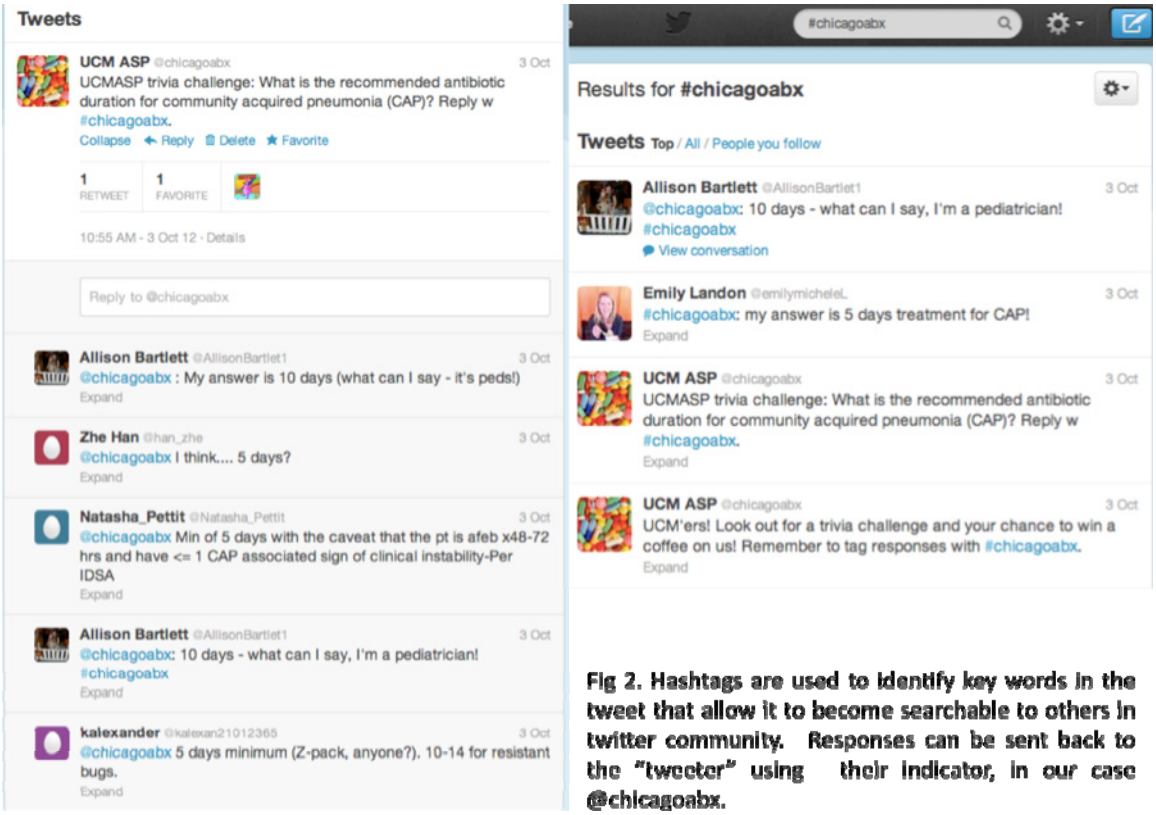

Fig 2. Hashtags are used to identify key words in the tweet that allow it to become searchable to others in twitter community. Responses can be sent back to the "tweeter" using their indicator, in our case @chicagoabx.

hash tag in front of #chicagoabx. Therefore, when you search for #chicagoabx, you will see all the posts with that hash tag (Fig 2). Similarly, if you were looking for all posts about antibiotics, you would search #antibiotics. Followers can also address responses by directly replying to the post, automatically including the UCM ASP's indicator @chicagoabx. In these ways, we are able to see responses to our posts or comments on our tweets (see Fig 3). It also lets our followers easily find everything people are saying about antibiotics at UCM.

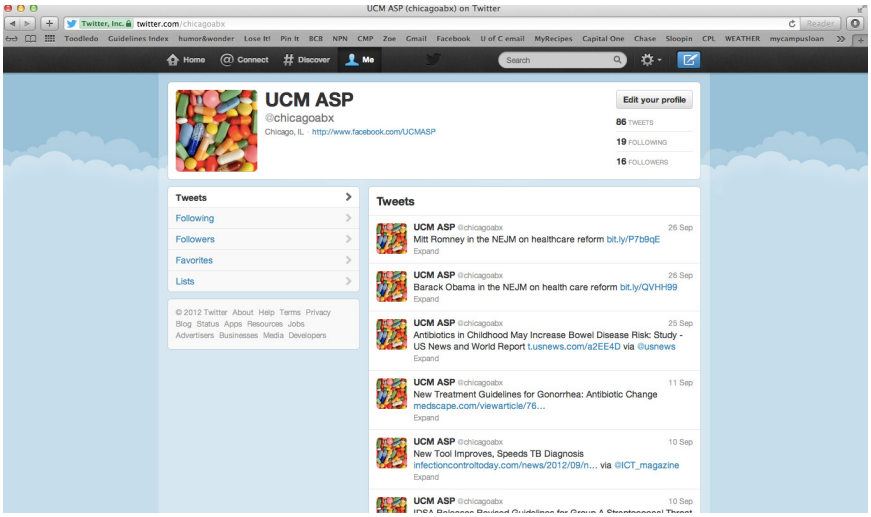

Fig 3. Screenshot of UCM ASP twitter profile page with examples of tweets including embedded links to guidelines, journal articles, and news articles

Intervention Design and Methods

Aim #1: To quantify Internal Medicine house staff engagement in antimicrobial stewardship-related social media activities. The first step in the success of this project is to engage the IM house staff using social media platforms. ASP presence on Facebook and Twitter will be actively marketed to IM house staff by the members of the ASP during conferences, meetings, and in interactions with the house staff when making recommendations about antimicrobials use. Consent from participating house staff will be elicited as we hope to study their knowledge and order set use by comparing those who are part of our Facebook/Twitter audience and those who are not as well as looking at pre and post-intervention data.

Daily trivia contests will be held to encourage participation and regular use of the social media platforms. The questions will consist of medical trivia (focused on infectious diseases and antimicrobial use) and participants will be encouraged to respond with the correct answer using the hash tag #chicagoabx or by replying with @chicagoabx on Twitter or as a comment on Facebook. Recognizing that IM house staff can be working at any time of the day or night, these questions will be tweeted/posted randomly throughout the day/night. Depending on the day, the first correct answer or a randomly chosen correct answer from the early respondents will be rewarded with a $5 coffee or gas card. In order to elicit continued participation even after a daily prize has been awarded, all respondents will be entered into a monthly drawing (once for each day) for a larger prize ($100 Amazon gift card).

By rewarding attention to our posts and tweets, we can take advantage of this platform to disseminate additional information and resources regarding appropriate antibiotic use or the use of guidelines and order sets available for use through our electronic medical record. All posts to Twitter (tweets) are automatically posted to Facebook simultaneously so that either platform can be used by IM house staff.

Aim #2: To increase use of stewardship-sponsored pathways and order sets and evaluate their effectiveness in treating CAP or pneumonia in a hospitalized/ICU patient. In exploring why our pneumonia order sets and pathways (available upon request) are underutilized, one common response from residents is that they do not know that the order sets and pathways exist and are unsure how to access them. Finding the appropriate order set without knowing it's specific title requires browsing through a long list of options that are not easily searchable in the electronic medical record. Through the use of social media platforms, we will familiarize the IM house staff with these tools and how to access them on a regular basis. Additionally, we plan to post notifications using these social media outlets with links to internal and national guidelines and pathways. Trivia questions from Aim 1 will encourage review of the guidelines as well.

Aim #3: To measure change in antibiotic-specific knowledge and its application to patient care derived from Facebook and Twitter messaging. All IM house staff will asked to take a online pre-test (Appendix) designed to measure specific concepts and facts about antimicrobials. This pre-test will also serve as consent for the study if they choose to participate. Over the course of the intervention period, all topics on the test will be covered either in posts, links to reference material (internal and external), or trivia questions. After 6 months time, all IM house staff, including friends and followers will be asked to re-take the test and difference in pre and post-test scores will be calculated.

Data Collection & Statistical Analysis

Aim 1: Data collection for this aim is automatically recorded through Facebook and Twitter. The number of Twitter followers and/or Facebook friends of the ASP will be recorded. We use a software program called Bitly (New York, NY) to post to Twitter and Facebook and will allow us to calculate the number of "click-throughs" (number of users who click on links embedded in tweets and posts) and the number of re-tweets (when a user forwards the tweet to their own twitter followers, thus expanding the original tweets audience) as a measure of active engagement. Facebook includes a tracking feature as well that allows us track page clicks (how many users visit), click through rates, and "likes" of posts. These tools let us measure how often and how meaningfully people interact with (and, therefore, pay attention to) the information we post/tweet. The number and quality of responses to the daily trivia questions can also be measured. Taken together, these provide a much clearer picture of the learners' engagement with the material than the traditionally used lecture attendance roster and/or brief feedback form. Validation of the Bitly and Facebook's tracking features will be periodically performed by ASP staff by hand counting responses, friends, followers, etc. and comparing to

the service-generated values. Descriptive statistics will be used to describe users and monthly numbers will be aggregated for demonstration.

We expect that our numbers of Facebook and Twitter followers will increase dramatically as the residents are made more aware of our social media presence and are enticed with the opportunity to the incentives for participating in the trivia contests. Currently we have 234 followers on Facebook and we expect this to increase by 25%. Currently we have 16 followers on Twitter and we expect this to increase by at least 200%. We understand that not everyone who is on Twitter and Facebook posts or responds frequently, which is why evaluating a change in the use of order sets (Aim 2) and antibiotic-specific knowledge (Aim 3) will also be important to measure the engagement of those who consent for participation in the study as well as IM house staff who are outside the study but still operating within the social network.

Limitations and Alternative Strategies: It is possible that a smaller proportion of IM house staff physicians use social media compared to the population at large. However, with prompting and rewards, we are confident we can overcome this barrier. It is also possible that our marketing of social media could encourage overuse of such platforms for non-work activities during the workday. Firstly, unlimited social media opportunities are currently available to all IM house staff and, even in case of restriction on hospital-based computers, will still be available on their mobile devices. Secondly, we anticipate that following the ASP will take no more than 10 minutes of use each day (very likely much, much less). Because of the MobileIron® device management software used by the hospital, use of social media websites can be tracked. If concerns arise, this can be used as an auditing tool as well as a deterrent from non-work use of social media. It is our philosophy that the internet will continue to be both a source of information and education as well as a distraction for all healthcare providers. Development of personal responsibility and professionalism are favored methods for encouraging appropriate use of the internet at work. Nonetheless, the tracking tools provided by IT will provide additional accountability.

Aim 2: To evaluate Aim 2, the use of the order sets and hits on the ASP website pathway pages will be tracked. The number of times an order set is used can be tracked by our electronic medical record (EMR) and we will collect utilization data before, during and after the six-month intervention period. Additionally, using retrospective electronic medical records and prospective data collection, we will gather patient-level data comparing hospitalized patients with pneumonia treated with and without (control group) the use of the order set to determine if antibiotic prescribing practices were improved (antibiotic choice, dose, de-escalation, duration paired with the appropriate indication and diagnostics) when treated by trainees that subscribe to our social media platforms. Chi square and/or Fisher's exact Test (for categorical variables) and the student t test and/or Mann-Whitney U test (for continuous variables) will be used (as appropriate) in the univariate analysis. If possible, regression analysis will be utilized to further delineate the association between the levels of engagement in social media with successful process measures in patient care. Most educational initiatives struggle to establish ties between the intervention and actual clinical practice but the use of advanced technological platforms will allow us to make comparisons that otherwise would not be possible. It will be

important to continue to collect data on order set use and adherence to guidelines for a time period (3 months) after the intervention to understand extinction of the learned behaviors.

We expect to see overall order set use increase to be used in at least 50% of patients being treated for pneumonia. Taking this into account, we estimate that the order sets will allow providers to more closely adhere to the guidelines and these measures will be improved by at least 20% in patients treated with the use of the available order set.

Limitations and Alternative Strategies: It is possible that use of our social media presence will not result in increased order set use among the IM house staff. An interim analysis showing no improvement in utilization of order sets would suggest that more barriers to use are present beyond what we have previously identified and would prompt focus groups and structured interviews to identify them and establish the feasibility of removing them. In such an extreme circumstance, improving accessibility of the order sets could be followed by a washout period (where tweets and posts did not focus on order set use) to establish a new baseline utilization followed by a more limited intervention period for this aim only. All other aspects of the aims could continue, including those for management of pneumonia. Specifically, we would be able to make comparisons between residents that consented for our initiative and those that did not to see if there was any difference in their approaches to patient care. Additionally, we would plan to compare the care of patients presenting with pneumonia in the previous year during the same 6 month time period to see if there was any change derived from the intervention as a whole.

Aim 3*:* For Aim 3, differences in pre and post-test scores will be calculated in total and for individual questions. Subgroups based on level of social media engagement will also be evaluated. All of the IM house staff will be asked to complete the pre and the post-tests within the same time period. A group of IM house staff not participating in social media and those that never participate in the trivia questions or click-throughs will be used as a control to quantify the temporal trend in acquisition of knowledge outside of our intervention. We expect that the residents who engage in the intervention will have at least a 20% improvement in scores after the educational initiative (i.e. participation in social media).

Limitations and Alternative Strategies: It is possible that performance on the pre-test will be so excellent that post-test scores cannot improve by 20%. The investigators have created medical knowledge tests for educational interventions previously and are experienced in avoiding this outcome. The process of creating the test will include piloting questions with volunteer first year medical subspecialty fellows. Additionally, there may be inadequate control provided by the non-participant group either because everyone participates in the initiative, there is more social dissemination than anticipated, or significant group crossover occurs (people join the initiative late or leave early or people not consented still follow us on Facebook and Twitter regardless). Because we will monitor level of engagement, we can establish a functional control group defined by their actual use and participation in the social media.

Determining audience engagement and outcome dissemination

As previously noted, this project is uniquely capable of quantifying engagement through electronic tracking of click-throughs, re-tweets, interactive responses, etc. This study is limited in that it cannot quantify the number of total number of people that view the posts but do not comment or respond (termed "lurking" by social media scientists). The other measures (order set use, guideline adherence, test performance) are designed to fill this gap.

As Facebook and Twitter are in the public domain, we will utilize them to share our methods and outcomes; anyone can participate but only the participation of our trainees will be measured. Only trainees will be eligible to win prizes in our trivia contests. However, if successful, this project certainly can be expanded with more support. We plan to present abstracts at national conferences, Infectious Diseases Society for America (IDSA) and the American College of Physicians (ACP) Internal Medicine conference and publish manuscripts detailing the results of this project in infectious diseases and medical education journals.

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Detailed Workplan and Deliverables Schedule

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
Attract followers and consent subjects	**X**	**X**	**X**															
Administer pre-test			**X**															
Social media Intervention				**X**	**X**	**X**	**X**	**X**	**X**									
Interim analysis							**X**											
Administer post-test										**X**								
3 month post intervention phase										**X**	**X**	**X**						
Retrospective data collection				**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**						
Data cleanup											**X**	**X**	**X**					
Biostatistical Analysis													**X**	**X**	**X**			
Abstract presentation																**X**		
Manuscript preparation and submission																**X**	**X**	**X**

We expect the entire project to take 1.5 years: 3 months to attract followers/consent subjects and collect baseline data, 6-month intervention time period/prospective data collection, 6-months for post–test administration, retrospective chart review, data cleanup, biostatistical analysis, and 3 months for manuscript preparation and submission. We will plan to present an abstract at the SHEA 2014 or IDSA 2014 prior to/or in conjunction with manuscript submission. Since the award period is 2 years, this time frame allows for flexibility in the face of unforeseen challenges.

Appendix: Sample questions from knowledge base survey (to be administered via online survey software). Full survey is available upon request and is subject to modification based on pilot data although overlying themes will remain consistent.

1. When admitting a patient with community-acquired pneumonia, do you utilize the EPIC order set?
a. Always b. Sometimes c. Rarely d. Never e. Did not know it existed

2. When treating an inpatient for hospital-acquired pneumonia, how often do you utilize the EPIC order set?
a. Always b. Sometimes c. Rarely d. Never e. Did not know it existed

3. MJ is a 54 year old female with a PMH of asthma, hypertension, and coronary artery disease who is admitted to the medical ICU with respiratory failure. She is subsequently intubated and after 4 days of mechanical ventilation, a tracheal aspirate is obtained which grows *Pseudomonas aeruginosa*. Which one of the following agents has *in vitro* activity against this bacterium?

a. Ampicillin/sulbactam
b. **Cefepime**
c. Moxifloxacin
d. Tigecycline
e. Ertapenem

3. Which is not one of the 5 D's of Antimicrobial Stewardship?

a. Right **Drug**
b. Appropriate **Dose**
c. For the right **Diagnosis**
d. Appropriate **De-escalation**
e. Correct **Duration**
f. Utilization of Decision support programs

4. For a hospitalized inpatient, how often should antibiotics be reviewed to **verify the appropriate dose, duration and indication** to ensure the highest quality of patient care?

a. On a daily basis
b. On a weekly basis
c. On an hourly basis
d. At admission and discharge
e. When prompted by the Antimicrobial Stewardship Team

5. In which of the following situations could a positive blood culture for *S. aureus* be considered a contaminant?

a. A + blood culture for *S. aureus* that was drawn from a central line
b. A + blood culture for *S. aureus* drawn from a peripheral stick in a patient with an AV fistula
c. A + blood culture for *S. aureus* from a peripheral stick in a patient with septic arthritis
d. A + blood culture for *S. aureus* in a patient undergoing chemotherapy with mucositis
e. A + blood culture for *S. aureus* is almost never a contaminant

6. An 18yo female presents to the urgent care clinic with vaginal discharge. She reports a new sexual partner in the last 6 weeks. Cervical culture is negative for *Chlamydia trachomatis* but positive for

Neisseria gonorrhea. Which of the below statements is FALSE regarding the treatment of cervicitis secondary to *N. gonorrhea?*

a. If PCN allergic and prescribed Azithromycin 2g po x 1 alone, patient will need to follow up in one week for test of cure
b. Ceftriaxone 250mg IM + azithromycin 1g po x 1 is first line therapy for treatment of *N. gonorrhoea*
c. The CDC no longer recommends oral cefixime at any dose for the first line treatment of gonococcal infections
d. Ceftriaxone alone is appropriate first line therapy for the treatment of N. gonorrhoea
e. All of the above are true

7. A 63 year old female is admitted to the medical ICU with respiratory failure and septic shock. Blood, urine, and respiratory cultures are taken and the patient is started empirically on cefepime, tobramycin, and vancomycin. The respiratory culture grows *Pseudomonas aeruginosa* (pan-sensitive) and 2/2 blood cultures grow *Enterococcus faecalis* (ampicillin sensitive and vancomycin resistant). The patient's clinical status has improved significantly and is hemodynamically stable. The current intern in the medical ICU asks you if there is a single antimicrobial that will cover the bacteria isolated from her blood and respiratory tract. She has NKDA. What is your response?
    a. Cefepime alone
    b. Piperacillin/tazobactam
    c. Ciprofloxacin
    d. No single agent would be expected to cover both bacteria. They should continue cefepime, discontinue vancomycin, and start daptomycin.

8. MP is an 82 year old female who is transferred to the medical ICU from an OSH with overwhelming septic shock. The medical resident reports on rounds that 2 sets of blood cultures were drawn prior to transfer, which both grew *Klebsiella pneumoniae*. The antimicrobial susceptibility results are not available from the microbiology laboratory but MP's medical records from the OSH state that the *K. pneumoniae* was ESBL (+). Repeat blood cultures at UCMC have already been drawn and are pending. Based on this information alone, what would be an appropriate initial agent to cover the *K. pneumoniae* from the OSH?
    a. Piperacillin/tazobactam
    b. Amikacin
    c. Imipenem/cilastatin
    d. Aztreonam

9. KT is a 42F h/o type-1 diabetes mellitus who presents with fevers and shortness of breath x 2 days. On physical exam she is febrile, a finger stick indicates her sugar is 540, and she is 89% on room air. You hear crackles in the right lung base on exam and CXR is consistent with a RLL infiltrate. She is admitted for treatment of community acquired pneumonia and reports a history of a childhood drug rash to penicillin in her initial evaluation.

Which of the following antibiotic regimens is appropriate first line therapy in this patient?

a. Ceftiaxone and azithromycin
b. Piperacillin/tazobactam and vancomycin
c. Ciprofloxacin alone
d. Aztreonam and vancomycin
e. None of the above are appropriate first line therapy

10. What is the preferred method for hand hygiene during routine patient care?
    a. Hand washing with plain soap and water after touching a patient
    b. Hand washing with antimicrobial soap and water before entering each patient's room
    c. Hand rubbing with an alcohol-based, waterless product or soap and water if hands are visibly soiled or the patient has *Clostridium difficile* diarrhea.
    d. Either hand washing or hand rubbing when hands are visibly soiled.
    e. Surgical scrub

11. A 50 y/o M with HIV and a recent CD4 count of 190 is admitted with suspected pneumocystis pneumonia. He recently started therapy with atripla. In the UCM pharmacy, how should this be ordered?
    a. Only 2 drugs to order: Tenofovir & emtricitabine because tenofovir is a combination drug
    b. Three drugs are needed: tenofovir, emtricitabine, and ritonavir for boosting effect
    c. We don't have those drugs. The regimen should be changed for an equivalent one that is on formulary like AZT, 3TC, and efavirenz
    d. Three drugs: tenofovir, emtricitabine (or FTC), and efavirenz

12. What is the appropriate duration of therapy for community acquired pneumonia?
    a. 5 days
    b. 7 days
    c. 10 days
    d. 14 days

13. A 35 y/o F was recently admitted for pyelonephritis without bacteremia. Urine culture grew E coli susceptible resistant to ampicillin, bactrim, and ciprofloxacin. It was susceptible to cefazolin, ceftriaxone, nitrofurantoin, cefepime, and meropenem. She has been doing well on ceftriaxone and you are preparing for discharge. What is the best option for her continued therapy?
    a. Continue the IV ceftriaxone for a total of 14 days
    b. Transition her to PO keflex at a dose of 1g q8
    c. Transition her to oral nitrofurantoin
    d. Switch to IV cefepime for ease of dosing at home

14. A nursing home patient is admitted to the ICU with HCAP and shock. There is no information about her in the medical record system and she has been intubated but looks frail and chronically ill. Which of the following antimicrobial regimens is most appropriate in this setting?
    a. Vancomycin, Cefepime and at least one dose of tobramycin while figuring out the situation
    b. Linezolid, Cefepime, and at least one dose of tobramycin because *Staphylococcus aureus* pneumonia should be treated with linezolid instead of vancomycin.
    c. Vancomycin, cefepime, at least one dose of tobramycin, and azithromycin to cover for atypicals
    d. Vancomycin and Cefepime alone because tobramycin will give her renal failure and she is already at high risk of this because of her shock.