ADVANCED COGNITIVE COMPUTING APPLIED TO PERSONALIZED DELIVERY OF EVIDENCE-BASED TOBACCO CESSATION PROGRAMS

Charles A. Moore, MS, MMI
Northwestern University
charlesamoore@me.com

Abstract—An extraordinary amount of structured and unstructured data exists globally related to tobacco cessation quit assistance programs and clinical research. Advances in cognitive computing offer new opportunities to aggregate and analyze this data, while raising awareness and personalizing tobacco cessation programs for consumers/patients. Themes discussed in this paper include lifestyle behavior change, population health, big data, and advanced cognitive computing.

This paper explores the concept of applying advanced cognitive computing to personalized tobacco cessation programs for consumers/patients, to include within the context of integration into primary medical care. Additionally, cognitive computing has the potential to more accuracy identify tobacco related costs, to the user, health care system and society, while providing new perspective in the development of targeted financial and other incentives for consumers/patients successfully cease use of tobacco.

Advanced cognitive computing offers new opportunities to capture extraordinary amounts of data, both structured and unstructured, a pool of data referred to as a "corpus", which is analyzed, cognitively, then available for query in the form of question/answer, as well as ongoing assessment of data correlation. New forms of delivery of personalization of information to care providers, consumers/patients is then enabled via advanced smart apps, phones, watches, fitness bands and other emerging biometric devices. Advanced cognitive computing will improve upon and expand current tobacco cessation algorithms. At the same time, there is a higher probability better connectivity to personalized care will result.

While there is not a central repository of tobacco use and cessation program data, countless data sources exist, to include in the U.S.A. the Centers for Disease Control (CDC), State Quit Line/Assist Programs, the American Heart, Lung and Cancer Associations, as well as historical and active academic and clinical research. Beyond the U.S.A., there are many data sources, for example www.isdscotland.org, offering a country-wide database of health statistics, to include tobacco use statistics, for all of Scotland. These data sets, from across the globe, can now form a data cluster from which an advanced cognitive computing data corpus for identification of correlation patterns will be analyzed.

Advanced cognitive computing differs from traditional computing in that systems learn over time, as the domain is better understood, both language and terminology, as well as processes. Cognitive systems can process natural language and unstructured data, not unlike humans. Whereas expert systems of the past required a human to hard code rules, cognitive systems take this a step further by learning beyond the hard coding, in essence learning along with the human, and serving as a decision support system for the human.

To date, the most recognizable name in cognitive computing is IBM Watson. Watson not only won the television game show Jeopardy, but has since "attended" medical school, and Watson has been focused on cancer oncology treatment protocols at institutions to include Memorial Sloan Kettering.

I. INTRODUCTION

This paper focuses on several key aspects of tobacco costs and cessation programs, and the perceived impact of the application of advanced cognitive computing, with a primary objective to match consumers/patient with a personalized smoking cessation program, as well as monetary and other quit incentives. The resulting QuitKit will include virtual and physical elements, based on personalized needs. Consumer/patient access/delivery will be available via
Rather than offering a singular version of smoking cessation program, QuitKit differs in the solution leverage the billions spent on under-utilized evidence-based smoking cessation programs, many of which are free to tobacco users. How? Answer: Advanced cognitive computing, example IBM Watson, is combined with application protocol interfaces (APIs) to house an actionable "corpus" of all global smoking cessation information available via the web, to include clinical research study.

QuitKit provides consumers/patients virtual and physical deliverables, while coordinating evidence-based care in conjunction with physician health care. Generally speaking 1) the majority of tobacco users indicate a desire to quit, 2) most have failed on one or more attempts, 3) consumers/patients are 30% more likely to experience quit success with physician coordination, 4) and financial, as well as other incentives, increase success probability.

Given a cognitive computing solution platform is secure, combined with consumer/patient-facing smart app technology, to include integrated biometric identification, financial and other incentives can be optimized and distributed via QuitKit. Further, QuitKit personalizes a smoking cessation program to the consumer/patient, driven by cognitive computing which is continually assessing multiple factors in matching the optimal program and evidence-based treatment to the tobacco user. The smart app concept is accessible directly to the patient/consumer, as well as in a clinical setting as a decision support tool for physicians, nurse practitioners, physicians assistants and other allied health professionals to guide patients to the optimal evidence-based tobacco cessation program.

II. TOBACCO/SMOKING COSTS

The global health and monetary smoking of smoking and tobacco product use are staggering, yet, for the most part 100% preventable. The health risks of tobacco use are well-documented, and will include both innovations, such as "smokeless" or "E" cigarettes, sometimes referred to as "vaping," as well as the trend of legalized marijuana smoking (where less clinical research exists). While the some of the best data is available in the U.S., in order to quantify many aspects of tobacco use, smoking and tobacco use are global issues, and thus represent a global solution opportunity.

"Since 1980, large reductions in the estimated prevalence of daily smoking were observed at the global level for both men and women, but because of population growth, the number of smokers increased significantly. As tobacco remains a threat to the health of the world’s population, intensified efforts to control its use are needed." (Source: Smoking Prevalence and Cigarette Consumption in 187 Countries, 1980-2012) "Even though the global smoking rate has declined since 1980 by about 25% for men and 42% for women, the total number of smokers has grown from 721 million to 967 million. The total number of cigarettes consumed annually has risen from 4.96 trillion to 6.25 trillion." (Source: Smoking prevalence remains high worldwide, LA Times)

Smoking not only effects the user, also a host of associated humans, to include those involved in the harvesting of tobacco leaves, and those subjected to second-hand smoke. In the U.S.A. alone, 400,000+ people die of tobacco-related health conditions, 40,000+ of those lives attributed to second-hand smoke (Source: Mayo Clinic). Smoking costs the average smoker at least $1.1 million over a lifetime, according to a WalletHub state-by-state analysis of the financial cost of the habit. Alaska had the highest total cost per smoker at a little more than $2 million, followed by Connecticut at almost $2 million and New York at $1.9 million. Not only is there a significant cost to smokers of their unhealthy behavior, the Journal of Nurse Practitioners estimates EACH PACK of cigarettes in the U.S. alone can be associated with approximately $13.50 of related health care and other costs to society.

III. ADVANCED COGNITIVE COMPUTING MEETS SMART APP

This paper provides background regarding a to-be-developed smoking cessation app, and a supporting web-based solution, suitable to be prescribed in a
clinical setting, yet generally available to the public. The app will be the initial solution in a suite of apps focusing on behavior change, disease prevention and treatment. The primary purpose of the app is to optimize treatment protocol, while offering best-suited options and resources to smokers exhibiting readiness-to-change. Rather than representing a single smoking cessation program and/or medication, the app will leverage cognitive computing to match all known global smoking cessation programs and treatments to the patient and/or consumer, based on algorithmic factors, to include clinical research findings. QuitKit will seek to educate and assist tobacco users in known smoking cessation treatment practices, to include how human "receptors" respond to nicotine, and how that addiction can be broken.

The objective is not only to personalize and tailor a smoking cessation program to the patient/consumer, but to make them aware of specific programs and local resources that are available to support their effort. For example, all known smoking cessation support groups will be included in the cloud-based data warehouse. Once a patient/consumer location is known, they can be made aware of virtual and physical resources in their local area (with GPS-based directions to physical locations, for those with smart phones). Personalization will occur after the patient/consumer answers 5 simple questions.

From a big data perspective, QuitKit will allow an unprecedented means of cataloging all global smoking cessation programs, resulting in a data corpus linked to an advanced cognitive computing platform. The result is an ongoing "learning" by the cognitive computer of ongoing effectiveness, associated back to real-time patient experience and success. Not only will this allow for more effective and targeted treatment, to potentially include genetic testing (and matching to the most effective cessation program), but the monetary value of the patient data may be a significant factor in the revenue model.

IV. CHARACTERISTICS OF ADVANCED COGNITIVE COMPUTING SYSTEMS

• Navigate the complexities of human language and understanding
• Ingest and process vast amounts of structured and unstructured (big) data
• Generate and evaluate countless possibilities
• Weigh and evaluate responses that are based only on relevant evidence
• Provide situation-specific advice, insights, and guidance
• Improve knowledge and learn with each iteration and interaction
• Enable decision making at the point of impact
• Scale in proportion to the task
(Source: IBM)

V. TOBACCO CESSATION PROGRAM OPTIMIZATION

TOBACCO USERS LACK CONNECTIVITY AND PERSONALIZATION TO GLOBAL SMOKING CESSATION RESOURCES/PROGRAMS. CONSUMERS/PATIENTS UNDER-UTILIZE AND LACK KNOWLEDGE REGARDING SMOKING CESSATION PROGRAMS...BILLIONS ARE SPENT TO SUPPORT PROGRAMS THAT ARE NOT OPTIMIZED. A key is connecting tobacco users' to the optimal cessation program. A premise of this is advanced cognitive computing will match a tobacco user and, where applicable with care provider assistance, to an optimal cessation program by assessing all global tobacco cessation programs, population health data, clinical research, evidence-based treatment, and the individual consumer's characteristics, possibly to include personalized genomic data.

VI. EDUCATION/RECEPTORS

TOBACCO USERS LACK EDUCATION AND ACCESS TO EVIDENCE-BASED SMOKING CESSATION SOLUTIONS TO ADDRESS NICOTINE ADDICTION AND UNDERSTANDING OF HUMAN BRAIN RECEPTOR FUNCTION. The majority of smokers indicate a desire to quit, and have experienced one or more failed attempts. Often times, quit attempt failure is associated with a lack of
understanding of nicotine addiction, to include how tobacco usage and nicotine addiction effect the brain's "receptors". On the positive side, understanding how receptors work, will increase the odds of quit success. Reduction of nicotine dependence and receptor impact occurs over time, and a personalized smoking cessation program will increase the odds, tools and resources to aid the lifestyle behavior change journey.

VII. CLINICAL EVIDENCE-BASED CARE

TRADITIONAL MEDICAL CARE MANAGEMENT WILL INCREASE THE ODDS OF SUCCESS. Smokers who receive advice to quit from their doctor are 30% more likely to quit than those who do not receive advice. Yet, for example, patient referral rates to U.S. State Free Quit Lines are less than optimal, as are post-program participation patient chart/electronic health record documentation electronic post-back to the consumer's/patient's care provider. A key element to this point is the impact of a medical referral (preferable electronic) to the appropriate program. Post referral, consumer/patient cessation program information can be electronically sent back a care provider by health record exchange protocols to include HL7 messaging.

VIII. IMPROVED COST ESTIMATION

BETTER ESTIMATES OF TOBACCO COSTS WILL ADD TUNING OF INCENTIVES. Health care and other costs related to tobacco use differ greatly, however, only is in the billions to hundreds-of-billions of estimated costs, beyond the cost of the tobacco products themselves. For example, a pack of cigarettes now costs more than $5, however, estimates of the subsequent health care and other costs of a pack of cigarettes range from $10 - $20 per pack, AGAIN, beyond the cost of the pack itself. Some corporate wellness programs estimate smokers cost on average an additional $3,000+ per employee per year in added health care and lost productivity costs. Cognitive computing will help provide more accurate cost estimates, as well as recommend optimal application of dollars spent.

IX. IMPROVED ACCESS TO CLINICAL RESEARCH STUDIES

CONSUMERS/PATIENTS MAY BE ELIGIBLE FOR CLINICAL RESEARCH STUDIES, YET ARE UNAWARE OF THE OPPORTUNITY, AND BENEFITS, OF PARTICIPATION. Consumers/patients may be eligible for clinical research studies, yet are unaware of the opportunity. Data from studies can be assessed in new ways via advanced cognitive computing.

X. FINANCIAL/Others INCENTIVES

Financial and other incentives have shown success in tobacco cessation programs. A GE employee program awarded those who quit approximately $700, which a separate study paid physician offices approximately $5,000 for smoking cessation referrals to State QuitLines. An advanced cognitive computing platform will allow for the proper optimization, assessment and identification of incentive awards. This will include advanced biometric patient identification.

XI. FUNDING MODEL

With respect to a revenue model, smoking cessation is a multi-billion industry, with a significant portion of the capital being contributed by the makers of tobacco products themselves, either related to law suit settlements, regulatory requirements, or attempts to improve public image. QuitKit may explore the path of becoming a clinical prescription app, with health insurance/other reimbursement. An example of this is Welldoc: www.bluestardiabetes.com. In addition, the creation of a foundation providing access to QuitKit is a viable alternative, as are clinical research partnerships and agreements with entities such as a CVS, which is the one of the first consumer health stores to stop selling tobacco products.
XII. CONCLUSION

QuitKit will leverage the latest innovations in back-end big data and cognitive computing, possibly to include the unprecedented capability of solutions such include IBM Watson. The public perception and credibility associated with IBM Watson will add in the credibility of QuitKit, powered by Watson, both to consumers and clinicians. The consumer-facing technology to include the web, smart-phones and smart watches and/or fitness bands will provide news means of integrating tobacco cessation into daily life.

However, it is important to keep in mind smoking commonly addicts and effects the poorest members of society. In such cases, QuitKit will have to be adapted to include local human outreach, to include health fairs, as well as exploration of a simple device or physical kit that can be provided to those smokers indicating a readiness to change.

XIII. FUTURE WORK

To continue work on this project, the next step will be to participate in the first ever IBM Watson Hackathon to be held in Brooklyn, New York, U.S.A. May 4-5, 2015.

REFERENCE

U.S. TOBACCO STATISTICS
http://www.cdc.gov/tobacco/data_statistics/fact_sheets/fact_facts/
SCOTLAND NATIONAL DATA
www.isdscotland.org
THE TRUE COST OF SMOKING
http://www.cancer.org/research/infographicgallery/tobacco-related-healthcare-costs
TOBACCO RELATED MONETARY COSTS IN THE U.S.A.
CLINICAL REVIEW OF NICOTINE ADDICTION
http://www.ncbi.nlm.nih.gov/books/NBK53018/
QUALITY REVIEW OF QUITLINE REFERRAL SYSTEMS
CASE STUDY: GE SMOKING CESSATION FINANCIAL INCENTIVE PROGRAM
IBM WELLNESS CHECKPOINT
ASSESSING THE TOBACCO USE LANDSCAPE
2013
MAYO CLINIC NICOTINE DEPENDENCE
http://www.mayo clinic.org/diseases-conditions/nicotine-dependence/bas is/treatment/con-20014452
COMMUNITY HEALTH CENTER CESSATION GUIDE
IBM WATSON
State of Maryland Smoker Data Set
QuitNowTXT
https://catalog.data.gov/dataset/quitnowtxt-text-messaging-library
CDC DATA
https://chronicdata.cdc.gov/Survey-Data/Graph-of-Cigarette-Use-Among-Adults-Behavior-Risk-/syfb-fzcd?