

Citiscreeen-A Combination of Precision Medicine and Artificial Intelligence in Cancer Screening

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Introduction

Precision medicine is a novel trend for treatment and prevention that emphasizes individual variability in genes, family history, and lifestyle for each person. This approach allows doctors to accurately predict which treatment and prevention strategies will work for an individual. It is in contrast to the one-size-fits-all approach used now where treatment and prevention are designed for the average person, not taking into account the differences between individuals. Although the term “precision medicine” is new, the concept has been known for years. For example, a person requiring blood transfusion is not given blood from a random donor; instead, the donor’s blood type is matched to the recipient. Precision medicine is different from boutique medicine. The latter is designed for wealthy consumers who are not interested to wait in line, have access to a health care provider during office hours only, use generic drugs, etc. Boutique or concierge medicine are for customers who do not rely on insurance only and look for alternative ways to maintain their health and wellness. It includes same day appointments, 24-hour access to healthcare providers, extended office and home visits, and conducting of tests and procedures despite lack of insurance approval. It is a VIP treatment. Cost is also an issue with precision medicine. Technologies such as sequencing large amounts of DNA are expensive to carry out. Medications developed to target a person’s genetic or molecular makeup are expensive as well. However, the benefits of such an approach are obvious. Precision medicine combines the benefits of regular medicine with the ones of an individual needs of a particular patient. Recently, a number of companies involved in early detection of cancer among other diseases (EZRA, IMedis, etc.) are using artificial intelligence but limit its armamentarium to imaging modalities only. CitiScreen put together a fragmented screening system by creating screening algorithms. These individual screening algorithms combine ultrasound, MRI, CT imaging, genetic and tumor markers, as well as other technologies [1]. Below, please find common components of the CitiScreen program to be used in screening algorithms:

CitiScreen steps of cancer screening

- Screening for risk factors in healthy individuals
- Genetic tests for specific cancers (blood or saliva test)
- Screening for the presence of cancer precursors
- Blood screening for tumor markers
- Smears (dental, urinary, vaginal, etc.)

Screening results are used as building blocks for individual screening algorithms which comes with practical recommendations eq. frequency of colonoscopy, need for MRI screening, etc. CitiScreen algorithms are constantly updated based on changing circumstances (age, new cases in the family, changes in living habits, etc.) and new advancements in the science of cancer screening. CitiScreen research group is constantly searching and assessing new scientific data [2-4]. The Bureaucratic government- sponsored preventative program is very ineffective and cumbersome. It is being updated every 5 years which does not allow for adjustment to the new developments in medicine. CitiScreen clients receive yearly screening recommendations on the frequency and type of screening modalities. They are free to choose any medical center, imaging facility, laboratory or doctor’s office anywhere in the world and report results back to CitiScreen.

Finances play an important role in shaping government sponsored screening programs because clients expect insurances to cover its cost. Recent studies have demonstrated that a lack of insurance coverage accounts for lower cancer screening rates [5]. The percentage of adults who underwent screening for breast cancer was 67.8% among uninsured verses 77.5% of patients with insurance. Similar rates for colorectal screening was 41.9% verses 48.5%. The economic burden of cancer care in the United States remained heavy for patients, who incurred more than \$21 billion in costs in 2019, according to part two of the Annual Report to the Nation of the Status of Cancer [5]. Financial hardship among

cancer patients, including problems paying medical bills, and delays in care due to cost, is increasingly common in The United States and elsewhere [6]. Adults aged 65 years and older with Medicare coverage incurred the highest out-of-pocket costs during the first 12 months after their cancer diagnosis (\$2,200 for medical services and \$243 for prescription drugs) [6]. Therefore, monetary considerations play a significant role in developing screening protocols in an effort to control costs. Citiscreen is a private screening program for motivated individuals with less emphasis on cost although many procedures are covered by insurances. On the other hand, investing in cancer screening and prevention has the potential to decrease the high cost of cancer care. Cancer-associated net annual costs, (hospitalizations and office visits) are \$304.3 (95% CI, \$257.9-\$350.9) for adults aged 18 to 64 years and \$279.1 (95% CI, \$215.1-\$343.3) for those aged 65 years and over. (7) Facing cancer, patients are ready to supplement deficiencies in insurance coverage. Thus, an analysis by a cancer site showed the highest out-of-pocket costs for cancers with a high prevalence: breast (3.14 billion), prostate (\$2.26 billion), colorectal (\$1.46 billion), and lung (\$1.35 billion) [3]. Unlike government run programs, Citiscreen puts emphasis on improving detection rates rather than cost. Increased detection rate of malignancies in early stages will decrease the cost of care by eliminating the need for adjuvant therapy (radiation, chemotherapy etc.). In other words, spending funds on prevention saves much more on treatment. Cancer accounted for 600,000 deaths in the United States in 2017, making it the second leading cause of death. The most cancer-related deaths are due to cancers of the lung (men, 21%; women, 24%), colon/rectum (men and women, 9% each), breast (women, 15%) and prostate (10%). Cancer led to 4 million potential years of life lost in 2017 in the United States. Years of life lost are defined as the sum of the total years of life lost before age 75 and potential years of life lost per individual death in 2017 for 45 categories of cancer [6-7]. Cancer-related death resulted in 4,280,128 potential years of life lost before age 75 years in the U.S. in 2017 [7]. Cancers with

the highest potential years of life lost are lung (20.8%), colorectal (9.6%), breast (9.4%), pancreatic (6.6%), and liver or intrahepatic bile duct (5.4%). They correlate with overall cancer mortality rates, with the exception of prostate cancer, accounting for 5.1% of deaths and 2% of potential years of life lost [5-7].

Preliminary Results of Citiscreen

Citiscreen has been implemented into clinical practice on a limited basis since 2019 and included 192 cases. It is known that clinical value of any screening program is time and labor consuming. At the time of this report, the following malignancies were detected: 1- borderline ovarian cancer, 1- stage one ovarian cancer, 2 early-stage melanomas, one early-stage endometrial carcinoma and 2 late-stage cancers (colon and pancreas). The diagnosis of early-stage cancers is encouraging while, the diagnosis of late-stage diseases in first-time patients is understandable since the screening was performed on patients with preexisting cancer. With increasing use of the Citiscreen program, we expect to detect malignancies and/or its precursors on treatable stages.

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