A SURVEY OF PSA SCREENING SERIES OF WIDE AWAKE IN PROSTATE CANCER USING BIG DATA ANALYTICS

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ABSTRACT

Big data driven approaches towards personalized health-care and this big data analytics in health sector provides stakeholders with new insights that have the potential to advance personalized care improve patient outcomes and avoid unnecessary costs. Big data methods require advanced techniques and technologies to enable their capture, storage, distribution, management, and analysis. Early detection of prostate cancer (PCa) with prostate-specific antigen (PSA) has led to a stage migration with increased detection of early stage, potentially curable disease. A recent analysis of results from the Prostate Cancer Prevention Trial (PCPT) has provided insight into the positive predictive value of PSA in the so-called "normal" range. This paper will help to analyze the PSA screening for identifying Prostate Cancer and maintaining data in Big Data concepts.

Keywords: Big Data Analytics, Public awareness, Prostate cancer screening.

I. INTRODUCTION

This paper introduces the field of big data in health care. The corporate sector leads in this arena, for which big data analytic techniques have helped identify consumer trends that guide product development and marketing.

Analytic techniques include natural language processing, machine learning, and data mining, which are all inherently different from currently used statistical methods for health services research. Machine learning is a branch of artificial intelligence concerned with the construction and study of systems that can learn from data. Machine learning focuses on prediction, based on known properties learned from sets of training data.

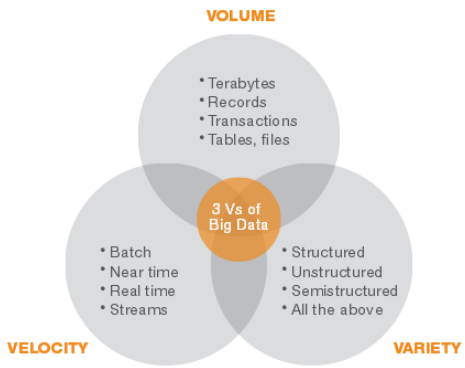
Big Data

Big data is about the growing challenge that organizations face as they deal with large and fast-growing sources of data or information that also present a complex range of analysis and use problems. Big data typically refers to the following types of data:

• Traditional enterprise data – includes customer information from CRM systems, transactional ERP data, web store transactions, and general ledger data.

• Machine-generated /sensor data – includes Call Detail Records ("CDR"), weblogs, smart meters, manufacturing sensors, equipment logs (often referred to as digital exhaust), and trading systems data.

• Social data – includes customer feedback streams, micro-blogging sites like Twitter, social media platforms like Facebook



• **Volume** is the amount of data generated by organizations or individuals. Enterprises in all industries are looking for ways to handle

the ever-increasing data volume that's being created every day.

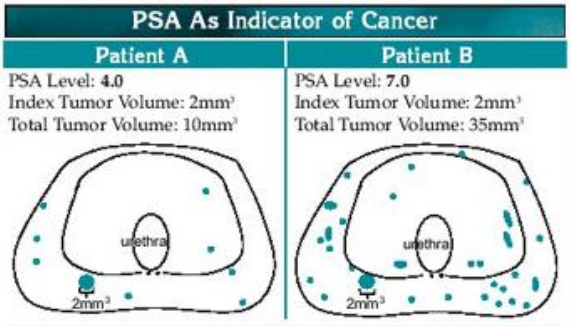
• **Velocity** is the frequency and speed at which data is generated, captured and shared. Consumers as well as businesses now generate more data and in much shorter cycles, from hours, minutes, seconds down to milliseconds.

• **Variety** is the proliferation of new data types including those from social, machine and mobile sources.

PSA Screening Series

Screening is looking for cancer before a person has any symptoms. This can help find cancer at an early stage. When abnormal tissue or cancer is found early, it may be easier to treat. By the time symptoms appear, cancer may have begun to spread.

Scientists are trying to better understand which people are more likely to get certain types of cancer. They also study the things we do and the things around us to see if they cause cancer. Screening tests may be repeated on a regular basis. If a screening test result is abnormal, you may need to have more tests done to find out if you have cancer. These are called diagnostic tests[1].



Prostate-specific antigen, or PSA, is a protein produced by cells of the prostate gland. The PSA test measures the level of PSA in a man's blood. For this test, a blood sample is sent to a laboratory for analysis. The results are usually reported as nanograms of PSA per milliliter (ng/mL) of blood.

The blood level of PSA is often elevated in men with prostate cancer, and the PSA test was originally approved by the FDA in 1986 to monitor the progression of prostate cancer in men who had already been diagnosed with the disease. In 1994, the FDA approved the use of the PSA test in conjunction with a digital rectal exam (DRE) to test asymptomatic men for prostate cancer. Men who report prostate symptoms often undergo PSA testing (along with a DRE) to help doctors determine the nature of the problem[2].

In addition to prostate cancer, a number of benign (not cancerous) conditions can cause a man's PSA level to rise. The most frequent benign prostate conditions that cause an elevation in PSA level are prostatitis (inflammation of the prostate) and benign prostatic hyperplasia (BPH) (enlargement of the prostate). There is no evidence that prostatitis or BPH leads to prostate cancer, but it is possible for a man to have one or both of these conditions and to develop prostate cancer as well[3].

AUA Guidelines for PSA Screening

Normal Range of PSA Levels for Men in Each Age Group.

Age Range (Yr)	PSA Normal Range (mg/ml)
40-49	0-2.5
50-59	2.6-3.5
60-69	3.6-4.5
70-79	4.6-6.5

The study consisted of a self-administered questionnaire testing 7 key areas of PCa knowledge and PSA screening:

1. Awareness of PCa
2. Presenting symptoms
3. Risk factors
4. Awareness of screening with PSA
5. Performance of screening with PSA

6. Sources of information on PCa and PSA screening
7. Willingness to undergo PSA test if recommended

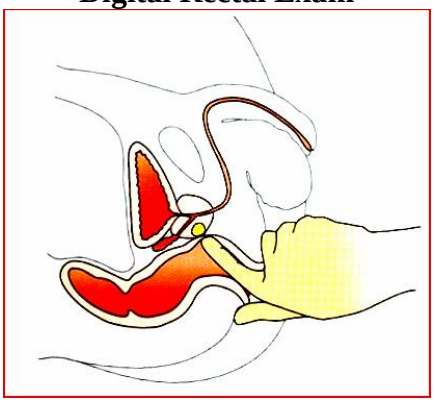
Recommended for prostate cancer screening by many doctors and professional organizations encouraged yearly PSA screening for men beginning at age of 50.

Medicare provides coverage for an annual PSA test for all Medicare-eligible men age 50 and older. Many private insurers cover PSA screening as well[4].

About the elevation of PSA level

If a man who has no symptoms of prostate cancer chooses to undergo prostate cancer screening and is found to have an elevated PSA level, the doctor may recommend another PSA test to confirm the original finding[5]. If the PSA level is still high, the doctor may recommend that the man continue with PSA tests and DREs at regular intervals to watch for any changes over time.

Digital Rectal Exam



If a man's PSA level continues to rise or if a suspicious lump is detected during a DRE, the doctor may recommend additional tests to determine the nature of the problem. A urine test may be recommended to check for a urinary tract infection. The doctor may also recommend imaging tests, such as a transrectal ultrasound, x-rays, or cystoscopy.

If prostate cancer is suspected, the doctor will recommend a prostate biopsy. During this procedure, multiple samples of prostate tissue are collected by inserting hollow needles into the prostate and then withdrawing them[6].

A pathologist then examines the collected tissue under a microscope. The doctor may use ultrasound to view the prostate during the biopsy, but ultrasound cannot be used alone to diagnose prostate cancer.

The PSA test may give false-positive or false-negative results

A false-positive test result occurs when a man's PSA level is elevated but no cancer is actually present. A false-positive test result may create anxiety for a man and his family and lead to additional medical procedures, such as a prostate biopsy, that can be harmful. Possible side effects of biopsies include serious infections, pain, and bleeding[7].

A false-negative test result occurs when a man's PSA level is low even though he actually has prostate cancer. False-negative test results may give a man, his family, and his doctor false assurance that he does not have cancer, when he may in fact have a cancer that requires treatment.

Scientists are investigating ways to improve the PSA test to give doctors the ability to better distinguish cancerous from benign conditions and slow-growing cancers from fast-growing, potentially lethal cancers. Some of the methods being studied include:

1. Free versus total PSA. The amount of PSA in the blood that is "free" (not bound to other proteins) divided by the total amount of PSA (free plus bound). Some evidence suggests that a lower proportion of free PSA may be associated with more aggressive cancer.
2. PSA density of the transition zone. The blood level of PSA divided by the volume of the transition zone of the prostate. The transition zone is the

interior part of the prostate that surrounds the urethra.

3. Age-specific PSA reference ranges. Because a man's PSA level tends to increase with age, it has been suggested that the use of age-specific PSA reference ranges may increase the accuracy of PSA tests.
4. PSA velocity and PSA doubling time. PSA velocity is the rate of change in a man's PSA level over time, expressed as ng/mL per year. PSA doubling time is the period of time over which a man's PSA level doubles. Some evidence suggests that the rate of increase in a man's PSA level may be helpful in predicting whether he has prostate cancer.
5. Pro-PSA. Pro-PSA refers to several different inactive precursors of PSA. There is some evidence that pro-PSA is more strongly associated with prostate cancer than with BPH.

Probability of Developing Significant Cancer

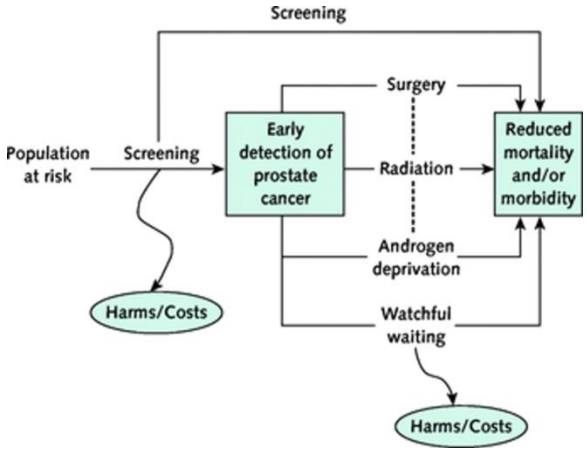
0-39 Yr	40-59Yr	60-69 Yr	>=70 Yr	0-?
1/10149	1/38	1/14	1/7	1/6

II. PSA TEST MEASURES AND METHODS

Free PSA Screening

PSA screening is available for free one afternoon a month at University of Washington Medical Center. The PSA test is a blood test that measures a protein released in the blood by the prostate gland. Both normal and malignant (cancerous) prostate cells secrete the protein.

While there is no perfect screening test for prostate cancer, PSA is the best indicator available. That said, abnormal PSA results alone are not sufficient to diagnose prostate cancer. Elevated PSA levels are most often caused by noncancerous conditions of the prostate, such as benign prostatic hyperplasia (BPH), and some men who have prostate cancer do not have elevated PSA.



The PSA test measures total PSA. The higher a man's total PSA level, the more likely he is to have prostate cancer. Most doctors consider a total PSA level of 4.0 ng/mL or lower to be normal in men age 60 or older and 2.5 ng/mL or lower to be normal in men younger than 60. Total PSA is used not only to screen for prostate cancer but also to monitor patients who've had prostate cancer to check for recurrence. Therefore, if a man had a PSA level above 4.0 ng/mL, doctors would often recommend a prostate biopsy to determine whether prostate cancer was present.

Screening and Biopsy

A prostate cancer screening may reveal results that prompt a doctor to recommend a biopsy. There are many other supplementary tests and considerations that can help a man who is undergoing screening decide if a biopsy is necessary, including:

1. Lower vs. higher free PSA test
2. PSA velocity (rate of rise over time)
3. PSA density (PSA per volume of prostate)
4. Family history
5. Ethnicity
6. Prior biopsy findings
7. Digital rectal exam results

8. Different forms of PSA (i.e. bPSA, pro-PSA)

In general, a lower free PSA (percentage) indicates a higher risk of finding cancer at biopsy, as does a higher PSA velocity and PSA density. The PLCO investigators found that men who underwent annual prostate cancer screening had a higher incidence of prostate cancer than men in the control group but the same rate of deaths from the disease.

A second large trial, the European Randomized Study of Screening for Prostate Cancer (ERSPC), compared prostate cancer deaths in men randomly assigned to PSA-based screening or no screening. As in the PLCO, men in ERSPC who were screened for prostate cancer had a higher incidence of the disease than control men. In contrast to the PLCO, however, men who were screened had a lower rate of death from prostate cancer.

III. SOME OTHER SCREENING MEASUREMENTS

If the total PSA test results are high or abnormal, your doctor may use other screening tests, including special types of PSA tests or a PCA3 test, to help determine if you need a biopsy, which is the only way to definitively diagnose prostate cancer.

Free-PSA Level

The free-PSA test checks for the amount of PSA in the blood that is not bound to other proteins. This is a subset of the total PSA. The test is usually ordered only if the total PSA is elevated. It can help your doctor determine whether you need further diagnostic tests. The free-PSA level is divided by the total PSA to get the percent of free PSA

Prostate Health Index (PHI)

It uses two of the PSA subset values to create a cancer risk ratio that may help your doctors determine whether they should perform a biopsy. Studies of the accuracy of this test are ongoing.

Urinary PCA3 Test

This is a urine test for proteins that are specific to prostate cancer. Unlike PSA, PCA3 is only produced by prostate cancer cells, and the level is not affected by prostate size. This test can be used in addition to total and free PSA tests to help determine whether a biopsy is needed. It is not used as a stand-alone test, and it is used more commonly in men who've had a negative biopsy to determine whether another biopsy may be warranted.

PSA Screening Risks & Benefits

Preventive Services Task Force (USPSTF) recommended against routine PSA screening for prostate cancer because two studies did not show it substantially lowered death rates and because screening can result in harm from biopsies, from treatment of patients who may not be at risk of dying from prostate cancer, and from treatment-related side effects.[1]

At Seattle Cancer Care Alliance (SCCA), we believe there are several good reasons to continue PSA screening.

1. It helps detect early-stage disease. PSA screening has yielded a dramatic transformation in how prostate cancer patients present; more present with early-stage and potentially curable disease.
2. Screening and treatment can be done selectively, based on a man's individual situation. PSA screening is a beneficial test that has likely saved many lives, but it also uncovers many cases of prostate cancer that do not need to be

treated. The main harm in screening is not the PSA test itself but the possibility that the results may lead to overtreatment of low-risk cancers in older men. Men who are younger and appear to be healthy are most likely to benefit from screening that leads to early detection and treatment.

3. There are limitations to the USPSTF recommendation. The task force's conclusion was based on studies that had limited follow-up and a lower death rate than expected in the absence of screening, which almost certainly understated the lives saved over the long term and produced an overly negative assessment of the screening benefit.
4. Screening works. Most importantly, there is no doubt that prostate cancer deaths have decreased by about 40 percent since the advent of PSA screening, as shown in a National Cancer Institute investigation.[2]

When to Start—and Stop—Screening

When to start screening is generally based on individual risk, with age 40 being a reasonable time to start screening for those at highest. For otherwise healthy men at high risk starting at age 40-45 is reasonable.

Guidelines differ for men at average risk. Some recommend an initial PSA and DRE at age 40, and others recommend starting at age 50. When to stop screening is also controversial. Some groups propose 75 as a reasonable cut-off age. Other groups suggest this is an individual decision based on life expectancy and overall current health.

IV. RESULTS

A total of 652 men completed the questionnaire. The mean age of the respondents was 45.1 years (range 20–69). Most of the men (38.8%) were in the age group 40–49 years. The overall knowledge score based on the 7-part questionnaire was 4.11 (58.7%).

V. CONCLUSION

Despite a high awareness of PCa among public servants in Anambra State, Nigeria, a very small proportion of these men had undergone PSA screening. To achieve a stage migration in PCa detection in Nigeria, early detection using PSA screening should be actively driven by health personnel using the media.

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