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The deep DNA machine learning model to classify the tumor genome of patients with tumor sequencing

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Abstract--In general, the various medical systems currently available provide insights into changes in the tumor genome of patients with tumor sequencing. Most of the tumor DNA sequencing can also be referred to as genetic specification or genetic testing. The sequence results help clinical decision-making to develop a personalized cancer treatment plan based on the molecular characteristics of the tumor rather than a one-size-fits-all treatment approach. The tumor sequencing also plays a major role in cancer research. In this paper, an improved method based on machine learning was proposed to analyze the sequencing and tumor sequencing patterns of the human gene. This proposed method analyzes the circulatory problems of patients with different tumor types for analysis in the public domain. It also constantly monitors large data sets of cancer or tumor genetic sequences to calculate tumor size and location. This allows the doctor

to get an accurate report on the type of tumor and the problems it can cause to the patient. The Analysis of these datasets of cancer tumor gene sequences reveals that the genetic makeup of each patient is different and that no two cancers are the same.

Keywords---medical systems, tumor genome, tumor sequencing, DNA, genetic testing, clinical decision-making, machine learning

1. Introduction

The human body is made up of cells. Cells in the body have periods of growth such as birth and death. When it fails, disease occurs. Cancer has been taking human lives for many years. Cancer is not an epidemic [1]. Cancer treatment doctors say that early stage disease can be completely cured. In the changing chemical world, new diseases are emerging [2]. At the same time, there is no escape from it without awareness, basic clarity and self-defense. A healthy cell completes the delicate task of body movement, then dies and the next cell grows [3-4]. This is the normal function of cells. Otherwise, new cells form out of control in overgrowth and eventually become tumors [5]. Cells that divide and grow uncontrollably become lumps or masses. One is a benign tumor and the other is a malignant tumor. Not all tumors that appear in the body need to be considered cancer. However, benign tumors are more likely to become malignant [6]. There are hundreds of cancers. They are classified according to where they appear in the body parts. Cancer cells release hormones that harm the digestive, circulatory and nervous systems and can alter body functions [7-8]. Cancer cells maintain their niche in two ways. First, these cells multiply and spread like an octopus, destroying healthy tissue in the blood and lymphatic channels with their deadly arms [9]. This is called Invasion and next, these monster cells divide multiple times, grow and form new blood vessels of their own to obtain nutrients for growth and become autonomous [10-11]. This is called angiogenesis. Malignant cells that have fixed themselves to this stage will at some point stick to any medicine pills like glue. Running back and forth like a game of hide and seek [12]. At the same time, it destroys beneficial cells. It turns out that the cells that were originally in the lungs have escaped and affected the brain as well. These are called 'secondaries'. This condition is called Metastasis. Medicine says that destroying cancer cells is a difficult task in this situation [13-14].

According to the American Cancer Society, cancer is the second leading cause of human death worldwide. Looking at the various studies, it is generally not possible to say for sure that this is the cause. But, they have found a few [15]. First is heredity. That is the traditional way. (Genes – The DNA type) If you have this disease from your mother or father in your family, it is very important to get tested without neglecting it [16]. This disease is spread by many chemical factors (carcinogens) such as tobacco, roofing asbestos, arsenic metal, radiation (Gamma and X Rays), excessive solar radiation, smoke emitted from vehicles [17]. For example, when we eat chicken that is fried in liters of oil in large oil pans, soaked in packets of masalas and fried to a red and fragrant color, we don't think about whether it is fresh oil rather than what kind of oil it is. Why does cancer come if you boil it again? It is a chemical change [18]. Free oxygen radicals are formed at

excessive boiling point. They absorb the beneficial electrons in our body and create disease. It is also the cause of various chronic diseases [19-20]. Antioxidants have the power to reduce its severity. That is why they are told to eat nutritious natural vegetables and fruits [21].

Medical studies suggest that cancer is caused by viral infection. Chief among them are HPV (Human papilloma virus) (causes cervical cancer in women), hepatitis B and C, which causes liver cancer [22-13]. Epstein-Barr virus is the cause of various cancers in children. Any viral infection weakens the body's immune system. This increases the chances of developing cancer [24]. The top four cancers are breast cancer, cervical cancer, oral cancer, and colorectal cancer. People who are addicted to tobacco, smoking, drinking alcohol, drugs like Panbarak and betel nut have chances of failure [25-26]. Just betel nut may have medicinal properties. But those who consume it with tobacco will be affected. It is said that India has the highest unemployment rate. You fill the house with cigarette smoke, which you call anxiety [27-28]. The children who sit on your lap and inhale nicotine are more likely to get lung cancer. When it comes to cancer, prevention is the smart thing to do [29]. Health education is the first line of prevention. Photographs, movies, advertisements can create some awareness. Women are more affected by breast cancer [30]. Globally, 43 percent of women in one lakh population are affected by this disease. Gone are the days when cancer hospitals and patients were everywhere, now cancer has spread everywhere like a common fever. The consequences are beyond comprehension. There is no clarity about the disease in the villages.

2. Literature Review

Most of the time, it is the changes in today's lifestyle that sufferers complain about. All the foods we eat are genetically modified. From chemical additives, multi-colored harmful plastic containers in the name of modular kitchen, food prepared in the oven, Teflon coating on non-stick dosa to drinking milk, there is a risk of cancer in everything [2]. Beauty face paints, hair dyes, powders, sunscreen lotions... In other words, even clothes made of synthetic fibers that are mixed with chemicals are dangerous. It is the unsuspecting people who get caught up in the machinations of the corporate industry that sells products that cause disease and makes pills that prevent it [3]. There is an unspoken scientific approach to food as prescribed by our forefathers. For those of us who eat undercooked food, bag it up and store it in the freezer, the influx of new diseases is no surprise [5]. In earlier times, old grandmothers advised that the child should be breastfed for one year. Stopping breastfeeding for a day or two is now said to cause breast cancer. Early puberty or delayed puberty by eating meats injected with growth promoting hormones, prolonging the age of menarche, taking continuous hormones to maintain youth, eating processed fatty foods, lack of physical activity, obesity, the list goes on and on [8].

Women do not always care about their health like family and work. Self-examination should be done for any lumps in the breast or for any lumps in the armpit. If there is pain in the breast, bloody discharge, pain in the nipple, irritation, reddening of the skin, scaly peeling, inward turning, changes in the mole or wart, it is better not to ignore it and get proper examination and

treatment [9]. Breast cancer is rarely detected early. That's why women over 30 years of age should have frequent medical check-ups even if they don't have these symptoms. Breast cancer can be detected by methods like mammography and scan. The cervical cancer has created fear in the minds of women to an extent that cannot be expected. HPV virus type considered the most important cause [10]. Doctors say that cervical cancer can be partially prevented if a woman gets this vaccine after reaching puberty with her consent. This vaccine is given in almost 80 countries. It is not implemented in India due to high cost [12]. Warts that appear inside and outside of the genital area should be taken care of. Cytology (Visual screening), POP Smear, CT (CT - Computed tomography), MRI (MRI - Magnetic resonance imaging), pet scan (PET - Positron emission tomography) etc. can detect the disease. Women with impotence, unintended weight loss, prostatitis, ovarian cysts (Pcod), irregular menses, profuse shedding should seek medical treatment early [13].

Endometriosis can cause the endometrium to grow inside the uterus due to irregular hormones, which can turn into endometrial cancer. Excessive hormonal drugs administered for infertility are also causes of the disease [14]. After the cancer is attacked, the disease is cured by three-pronged treatment methods such as chemotherapy (Chemotherapy) which injects drugs into the blood vessels, radiation (Radiation) and internal radiation (Brachy therapy) and surgeries (Tumor board treatment) [16]. Various awareness meetings are held at national and state level to detect and prevent the disease. The researchers also emphasize the idea that village health nurses can be trained in primary health centers in villages to detect early disease impact due to the high prevalence of the disease [17].

3. Proposed Model

It's important to take an active role in discussing the health of your prostate. Prostate cancer is the second most common cancer in men after skin cancer. More recent studies show that 1 in 9 men will be diagnosed with prostate cancer in their lifetime. That being said, prostate cancer is generally a slow-growing cancer and is highly curable, especially when caught early. One of the most influential factors in prostate cancer can be found in mutations in your genes. Genetic mutations can be inherited or acquired later in life due to changes in your genetic material. Hereditary causes of prostate cancer are often linked to changes in the genetic code of your DNA. Acquired causes are the result of genetic changes, such as when cancers transform a normal prostate cell into a tumor cell and/or tumor suppressor genes are turned off during the process of cell replication shown in fig 1.

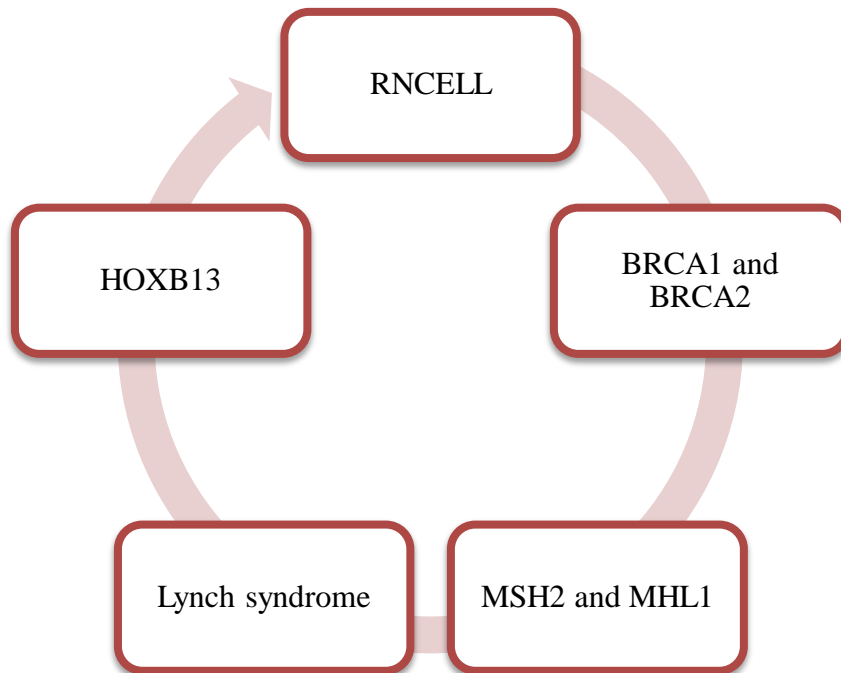


Fig 1: Tumor suppressor genes

- RNCELL (formerly HPC1): Abnormal cells that cause them to live longer than they should.
- BRCA1 and BRCA2: Consequences of cell DNA mistake-repair errors and cell loss if mistakes cannot be corrected. Often linked to certain cancers that run in families.
- MSH2 and MHL1: Fail to repair mismatches in DNA before a cell is ready to divide.
- Lynch syndrome: Hereditary nonpolyposis colon cancer (HNPCC) occurs in people with the gene and increases the risk of colon, prostate, and certain other cancers.
- HOXB13: mutations in the development of the prostate gland leading to early-stage prostate cancer. These cases are very rare.

Research findings have found some correlation between certain characteristics and diagnosed cases, but not enough to warrant a prediction. Many people with multiple risk factors will never develop prostate cancer. Likewise, people with no known risk factors will develop cancer. Your best approach is to stay on top of your health, establish a prostate care plan with your doctor, and be aware of any changes in your health that may be contributing to prostate cancer. The findings of different factors are shown in the following fig 2.

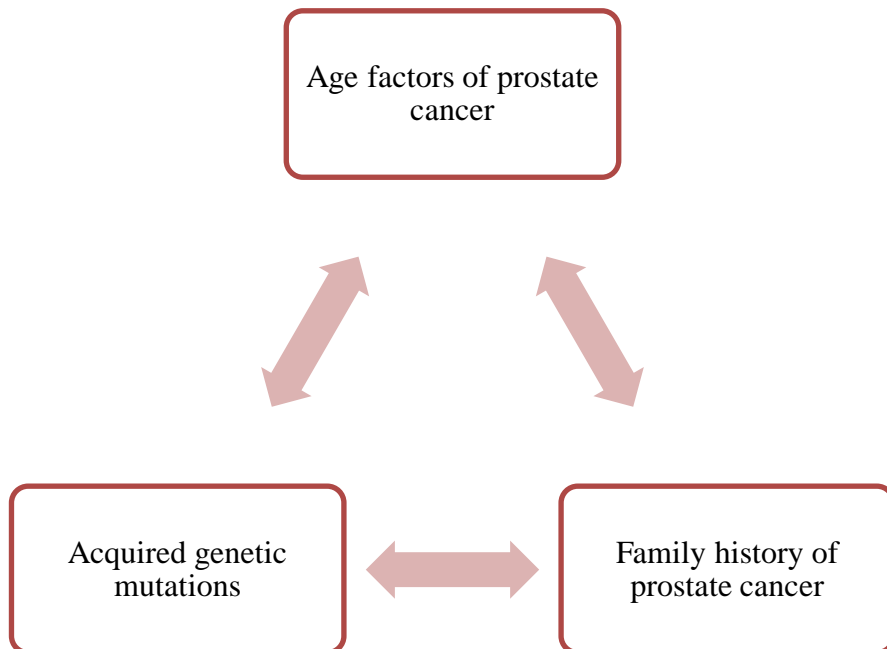


Fig 2: Findings of different factors

- Age factors of prostate cancer: Rare in people under 40. The risk rises rapidly after age 50, affecting 65 in 10 men aged 6 and over. Recommendations may vary based on your age, health, other health issues, and personal preferences. Based on your risk factors, your doctor may recommend one or two preliminary prostate cancer screening tests.
- Family history of prostate cancer: People with inherited genetic factors should be extra careful. A father with a history of prostate cancer doubles your risk. Those with a family history or genetic mutation linked to prostate cancer. More specifically, if you have more than one first-degree relative (father, brother or son) diagnosed at a young age (under 65).
- Acquired genetic mutations: It's caused by situations where something goes wrong during the process of gene replication.

It is still relatively unknown what conditions cause any errors during the process of gene replication. However, factors associated with prostate cancer include body chemistry and hormones. Specifically, high levels of testosterone and other male hormones that promote cell growth have been linked to prostate cancer. The faster prostate cells grow and divide, the more likely mutations are to occur. The different stages of prostate cancer cells are shown in fig 3

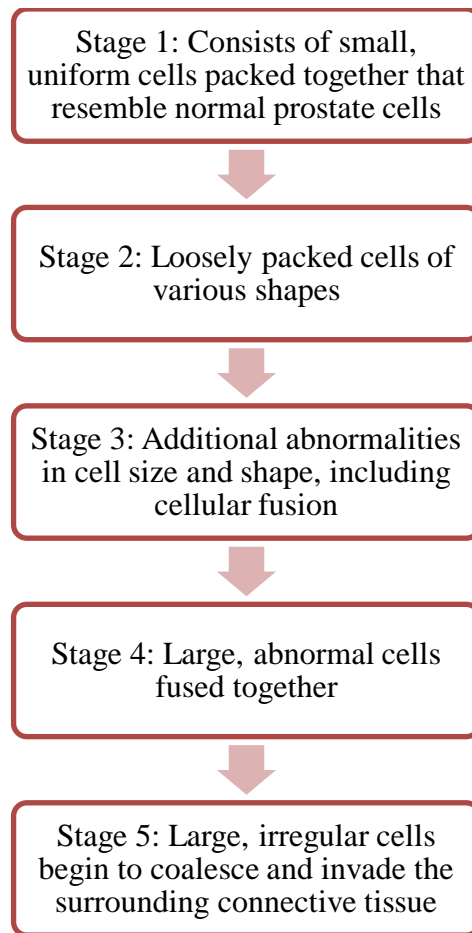


Fig 3: The different stages of prostate cancer

- Stage 1: Consists of small, uniform cells packed together that resemble normal prostate cells
- Stage 2: Loosely packed cells of various shapes
- Stage 3: Additional abnormalities in cell size and shape, including cellular fusion
- Stage 4: Large, abnormal cells fused together
- Stage 5: Large, irregular cells begin to coalesce and invade the surrounding connective tissue

Active surveillance is a non-treatment option that involves regular monitoring of prostate cancer. Frequent tests (twenty or quarterly) are needed to monitor for any changes with PSA blood tests, digital rectal exams (DRE) and ultrasounds. Biopsies may be done to assess the aggressiveness of the cancer and its risk of growing and spreading. Studies have found that after 15 years of active surveillance, less than 1% of men have developed a metastatic disease. Additionally, more than 30% of men have prostate cancer. If your cancer has not spread outside the prostate, surgery to remove your prostate gland is a common option for curing prostate cancer. There are a few different options including open

radical prostatectomy and laparoscopic radical prostatectomy. TURP is a non-curative approach in men with advanced prostate cancer to help relieve symptoms.

The latter operations are relatively similar. After surgery, a thin, flexible tube called a catheter is placed in your penis to help drain your bladder for 1 to 2 weeks. Typical recovery time involves a hospital stay of several months and activity limitations for several months. During a radical retropubic prostatectomy, an incision is made under the abdomen to remove the entire prostate gland, some tissue, and/or seminal vesicles. If there is a reasonable chance that the cancer has spread outside the prostate, your surgeon may perform a lymph node biopsy before proceeding with surgery, as it is unlikely to be cured by surgery alone, and the prostate may be removed for other serious side effects. In a radical perineal prostatectomy surgery, your surgeon will make an incision between the anus and scrotum to access the prostate. Although this surgery is shorter, it may cause less pain and have an easier recovery, leading to an erection.

4. Results and Discussion

The proposed deep DNA machine learning model (DDMLM) was compared with the existing classification of cancers using DNA (CCDNA), Deep transfer learning (DTL), Machine learning in DNA microarray analysis (MLDNA) and a deep embedded refined clustering approach (DERCA)

4.1. Handling of Digital Rectal Examination

During a digital rectal exam, your doctor will ask you to bend over or lie in the fetal position on the exam table. He or she will insert a gloved, lubricated finger into your rectum to check for abnormalities. If he or she feels a lump, hard or tender spot, or if your prostate is enlarged, further testing may be recommended. This exam only takes a couple of minutes, but can be uncomfortable, especially if you have hemorrhoids shown in table 1.

Table 1: Handling of Digital Rectal Examination

No of datasets	CCDNA	DTL	MLDNA	DERCA	DDMLM
1000	78.57	65.11	63.58	76.71	94.25
2000	78.90	66.61	64.17	78.58	95.26
3000	80.24	67.72	65.15	79.41	95.42
4000	80.91	69.09	65.87	80.93	96.15
5000	81.74	70.40	66.66	82.28	96.73
6000	82.58	71.70	67.44	83.63	97.32
7000	83.41	73.01	68.23	84.98	97.90

4.2. Handling of Prostate-specific antigen blood test

PSA is a protein produced by the prostate that is found mostly in semen and in very small amounts in the bloodstream. Although not mutually exclusive, PSA levels are elevated when there is a problem with the prostate. Elevated levels can act as a smoke alarm for you and your doctor to investigate additional tests.

Many factors can increase and decrease your PSA level. In fact, some studies show that 75% of men do not have cancer. The two most common causes are prostate cancer (benign prostatic hyperplasia, a non-cancerous enlargement of the prostate) and prostatitis (infection or inflammation of the prostate gland) shown in table 2.

Table 2: Handling of Prostate-specific antigen blood test

No of datasets	CCDNA	DTL	MLDNA	DERCA	DDMLM
1000	81.38	68.10	66.36	80.32	96.38
2000	82.43	69.11	67.50	81.24	95.95
3000	83.14	70.04	68.61	82.57	97.15
4000	84.44	71.04	69.31	83.44	97.30
5000	85.32	72.01	70.44	84.57	97.69
6000	86.31	72.99	71.43	85.63	98.08
7000	87.30	73.96	72.43	86.70	98.48

4.3. Handling of Transtectal Ultrasound

During a usually painless, 15-minute outpatient procedure, a small probe is passed through your rectum and an ultrasound machine sends sound waves to create an image of your prostate gland. This image will help your urologist tell the difference between non-cancerous and cancerous changes in your prostate and the size of the area of concern. This visual guide is also used to biopsy the site in TRUS-guided biopsy. An enema may be needed the night before, and you may have some blood in your urine afterwards shown in table 3.

Table 3: Handling of Transtectal Ultrasound

No of datasets	CCDNA	DTL	MLDNA	DERCA	DDMLM
1000	76.27	62.81	66.98	79.45	93.34
2000	76.60	64.31	67.57	81.32	94.38
3000	77.94	65.42	68.55	82.15	94.51
4000	78.61	66.79	69.27	83.67	95.25
5000	79.44	68.10	70.06	85.02	95.83
6000	80.28	69.40	70.84	86.37	96.42
7000	81.11	70.71	71.63	87.72	97.00

4.4. Handling of Prostate cancer biopsy

This outpatient procedure requires a small needle to numb the site. Large specimens may require anesthesia. In a TRUS-guided biopsy, your urologist will quickly insert a thin, hollow needle through the rectum and through the prostate to collect core tissue samples from different parts of the prostate. Most urologists will take about 12 core samples to increase the chances of catching any abnormal cells shown in table 4.

Table 4: Handling of Prostate cancer biopsy

No of datasets	CCDNA	DTL	MLDNA	DERCA	DDMLM
1000	79.08	65.80	69.76	83.06	95.47
2000	80.13	66.81	70.90	83.98	95.04
3000	80.84	67.74	72.01	85.31	96.28
4000	82.14	68.74	72.71	86.18	96.39
5000	83.02	69.71	73.84	87.31	96.80
6000	84.01	70.69	74.83	88.37	97.20
7000	85.00	71.66	75.83	89.44	97.60

A biopsy sample can also be obtained through a trans-perineal biopsy, in which a needle is placed through the perineum or skin between the scrotum and the anus. A pathologist will examine the samples under a microscope to grade the cancer cell patterns in your tissue and determine your Gleason score, a scale from 2 to 10 that rates the invasiveness of your cancer to your prostate cells.

5. Conclusion

A cancer diagnosis is life expectancy. Fortunately, very few prostate cancers require emergency treatment. Most men have time to find the best activities for them. The best thing you can do is educate yourself about available treatments, find a doctor you're comfortable with, and make smart lifestyle choices to improve your ability to fight cancer and stay positive. The proposed deep DNA machine learning model (DDMLM) was compared with the existing classification of cancers using DNA (CCDNA), Deep transfer learning (DTL), Machine learning in DNA microarray analysis (MLDNA) and a deep embedded refined clustering approach (DERCA). The advances in proposed machine learning model predicts the treatments like proton therapy are helping to offer prostate cancer patients stronger cure rates, reduced side effects and improved outcomes, such as a reduced risk of impotence and incontinence. In fact, recent studies show that the statistics are only getting better as treatments continue to improve.

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