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CERVICAL CANCER PROGNOSIS SYSTEM

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Abstract

The cervix is the lower part of the uterus, where a baby grows during pregnancy. Cervical cancer is caused by a virus called HPV, which spreads through sexual contact. Cervical cancer may not cause any symptoms at first. Later, they may have pelvic pain or bleeding from the vagina. Treatment will depend upon the stages of cancer. Stages can be identified depends upon the size and area of the cancer spread. Our system can be making us to understand the stages of the cancer easily. Stages can be easily classified by our mathematical calculation from early detection to metastasis. Treatment may include surgery, radiation therapy, chemotherapy, or a combination. The choice of treatment depends on the size of the tumor, whether the cancer has spread and whether we would like to become pregnant someday.The survival of the patient also depends upon the stage of the cancer.

Keyword: Cervix, HPV, metastasis

1. INTRODUCTION

Cancer is the result of the uncontrolled division and growth of abnormal cells. Most of the cells in our body have a set lifespan and when they die, new cells are produced to replace them.

Abnormal cells can have two problems:

- they do not die
- they continue dividing

The cervix is the lower part of the uterus, the place where a baby grows during pregnancy[1]. Cervical cancer is caused by a virus called HPV, which spreads through sexual contact. Cervical cancer is a disease in which malignant (cancer) cells form in the tissues of the cervix. Human papillomavirus (HPV) infection is the major risk factor for cervical cancer. Signs and symptoms of cervical cancer include vaginal bleeding and pelvic pain. Tests that examine the cervix are used to detect (find) and diagnose cervical cancer.

In our system, we can easily detect the stage of the cancer from the diagnosis process of the cancer. It's make the non medical people can easily understand the stage of the cancer in the patient. Since the common people may know about the cancer and its recovery stage. Our system make this task very easy to the common people to understand about the cancer just by keeping their diagnosis report such as scan etc..

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2. RELATED WORK

Certain factors affect prognosis (chance of recovery) and treatment options. The prognosis (chance of recovery) depends on the following[2]:

- The stage of the cancer (the size of the tumor and whether it affects part of the cervix or the whole cervix, or has spread to the lymph nodes or other places in the body).
- The type of cervical cancer.
- The patient's age and general health.

Treatment of cervical cancer during pregnancy depends on the stage of the cancer and the stage of the pregnancy. For cervical cancer found early or for cancer found during the last trimester of pregnancy, treatment may be delayed until after the baby is born.

STAGES OF CERVICAL CANCER

After cervical cancer has been diagnosed, tests are done to find out if cancer cells have spread within the cervix or to other parts of the body. There are three ways that cancer spreads in the body[3]. Cancer may spread from where it began to other parts of the body.

- The following stages are used for cervical cancer:
  - Carcinoma in Situ (Stage 0)
  - Stage I
  - Stage II
  - Stage III
  - Stage IV

After cervical cancer has been diagnosed, tests are done to find out if cancer cells have spread within the cervix or to other parts of the body. The process used to find out if cancer has spread within the cervix or to other parts of the body is called staging. The information gathered from the staging process determines the stage of the disease. It is important to know the stage in order to plan treatment.

THREE WAYS OF CANCER SPREADING

When cancer spreads to another part of the body, it is called metastasis. Cancer cells break away from where they began (the primary tumor) and travel through the lymph system or blood.
Cancer can spread through tissue, the lymph system, and the blood:

- Tissue. The cancer spreads from where it began by growing into nearby areas.
- Lymph system. The cancer spreads from where it began by getting into the lymph system. The cancer travels through the lymph vessels to other parts of the body.
- Blood. The cancer spreads from where it began by getting into the blood. The cancer travels through the blood vessels to other parts of the body.

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The metastatic tumor is the same type of cancer as the primary tumor. For example, if cervical cancer spreads to the liver, the cancer cells in the liver are actually cervical cancer cells. The disease is metastatic cervical cancer, not liver cancer.

3. PROPOSED SYSTEM

In the proposed work, we have created the system which is used to easily identify the stages of the cancer automatically from the width and size of the tumor [3]

The following stages are used for cervical cancer:

Carcinoma in Situ (Stage 0)

In carcinoma in situ (stage 0), abnormal cells are found in the innermost lining of the cervix. These abnormal cells may become cancer and spread into nearby normal tissue. Usually the abnormal tissue growth is measured in the size of millimeters.

Stage I

In stage I, cancer is found in the cervix only.

Stage I is divided into stages IA and IB, based on the amount of cancer that is found. The stage IA and IB diagrammatic representation is shown in Figure 1: Stage IA and IB Cervical Cancer [3]

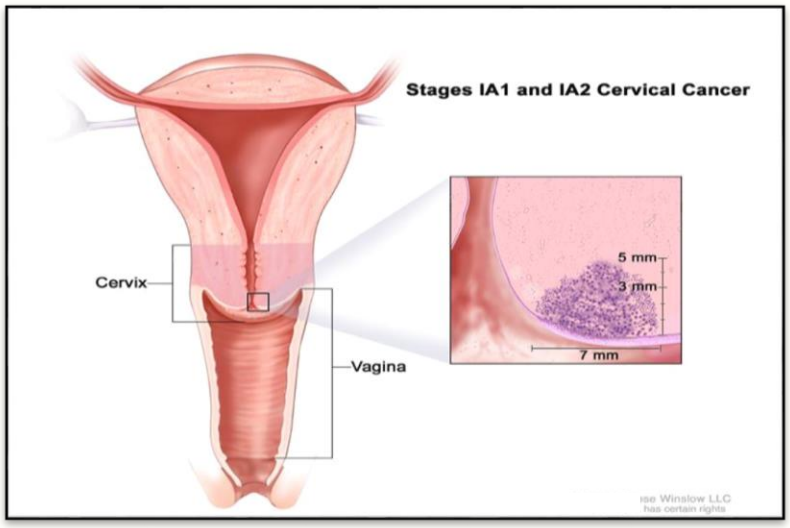

Figure 1 : Stage IA and IB Cervical Cancer

Stage IA

- Stage IA1 and IA2 cervical cancer. A very small amount of cancer that can only be seen with a microscope is found in the tissues of the cervix. In stage IA1, the cancer is not more than 3 millimeters deep and not more than 7 millimeters wide. In stage IA2, the cancer is more than 3 but not more than 5 millimeters deep, and not more than 7 millimeters wide. A very small amount of cancer that can only be seen with a microscope is found in the tissues of the cervix.

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We have converted the cervical area and cancer affected area in the geometric form in the below Figure 2: Stage IA1 and IA2

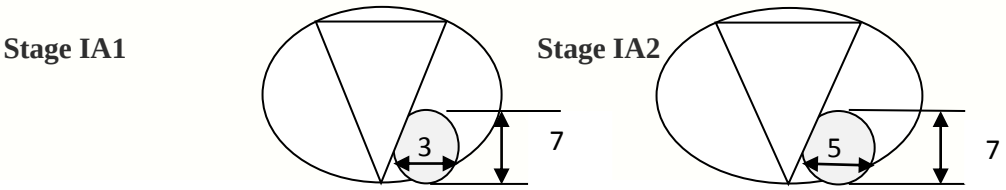

Figure 2: Stage IA1 and IA2

The cancer stage has been identified as IA1 which is represented as 1 by calculating the size of the tumor where the width is represented as y and the depth of the tumor is represented as x in equation(1). When the cancer stage is IA2, it is represented as 0. Here the cancer area is shown in the shaded region in Figure 2

$$P(x,y) = \begin{cases} 1 & \text{if } 0<x<3,\ 0<y<7 \\ 0 & \text{if } 3<x<5,\ 0<y<7 \end{cases} \quad (1)$$

Stage IB1 and IB2 cervical cancer

In the stage IB1 and IB2, the cancer is spread in the width wise in the cervical area. The stage IB2 is the advanced stage of IB1 is shown diagrammatically in Figure3

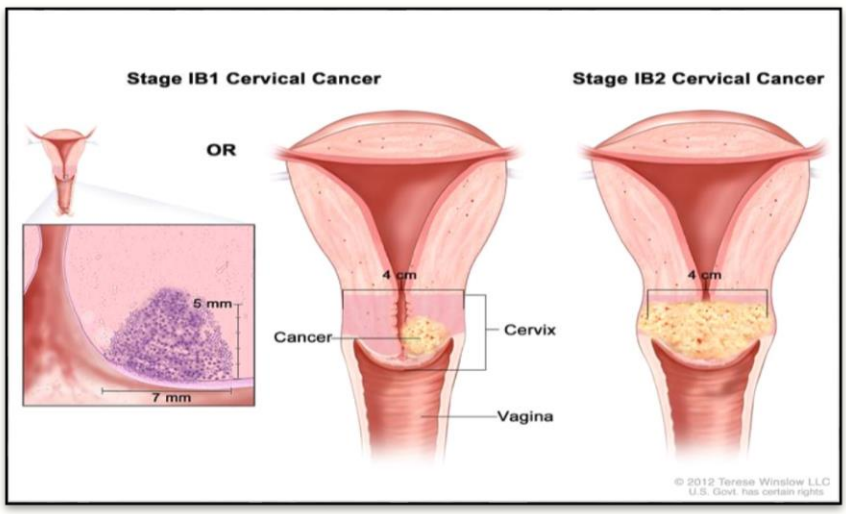

Figure3: Stage IB1 and IB2 cervical cancer

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In stage IB1, the cancer can more than 5 mm deep and the width can more than 7 mm wide or the cancer can be 4 cm or smaller. In stage IB2, the cancer is larger than 4 cm[3]. Here the depth of the cancer is represented as x and the width is represented as y where the value 1 represents the stage IB1 and the value 0 represents the stage IB2 in (2).

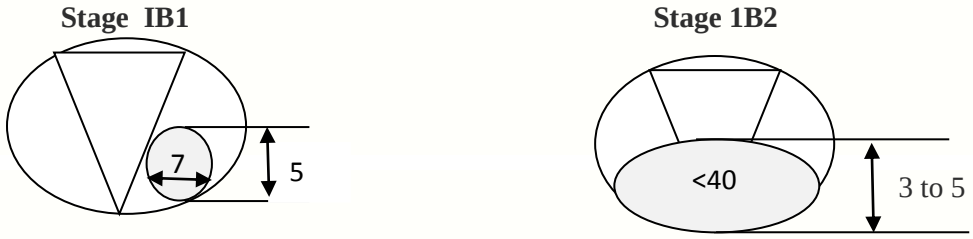

Figure 4: StageIB1 and StageIB2

$$F(x,y) = \begin{cases} 1 & \text{if } 0<x\leq 5,\ 7<y<40 \\ 0 & \text{if } 3<x<5,\ y\geq 40 \end{cases} \qquad (2)$$

Stage II cervical cancer.

In stage II the cervical cancer is spread to the vagina and the uterus region. Cancer has spread beyond the cervix to the lower third of the vagina. In stages IIA1 and IIA2, cancer has spread beyond the cervix to the vagina. In stage IIA1, the tumor can be seen in 4 centimeters or smaller. In stage IIA2, the tumor can be seen larger than 4 centimeters. In stage IIB, cancer has spread beyond the cervix to the tissues around the uterus.

Our system considers that cervix as null point or 0. The limits of the vagina (v) is set as $-\infty$, but our diagnosis report always gives the value in the positive and hence we consider $-\infty$ as ∞ for our calculation purpose, and the limit of the uterus(u) and above area as $+\infty$. Here the stages are represented directly as 2A1, 2A2 and 2B. Here also the depth of the cancer is represented as x and the width is represented as y. The value u is the cancer at uterus and the value v is the cancer at vagina.

$$F(x,y)= \begin{cases} 2A1 & \text{if } 2<x<4,\ 0<y<40,\ v=1,u=0 \\ 2A2 & \text{if } 4<x<\infty,\ 40<y<\infty,\ v=1,u=0 \\ 2A1 & \text{if } 4<x<\infty,\ 0<y<\infty,\ v=0,u=1 \end{cases} \qquad (3)$$

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099
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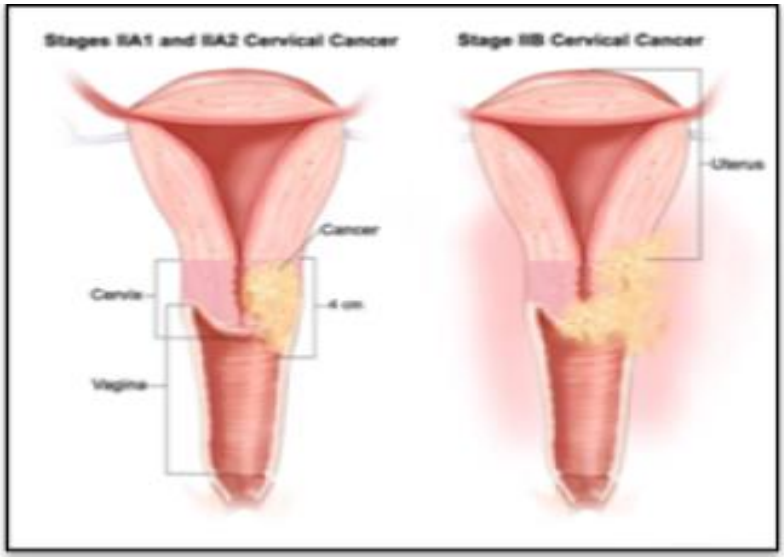

, **Figure 4: Stage IIA1, Stage IIA2 and Stage IIB Cervical Cancer**

In stage II, cancer has spread beyond the uterus but not onto the pelvic wall (the tissues that line the part of the body between the hips) or to the lower third of the vagina is shown in the Figure 4.

STAGE III

In stage III, cancer has spread to the lower third of the vagina, and/or onto the pelvic wall, and/or has caused kidney problems. Stage III is divided into stages IIIA and IIIB, based on how far the cancer has spread.

STAGE IIIA

- Stage IIIA cervical cancer. Cancer has spread only to the lower third of the vagina is shown in the Figure5.

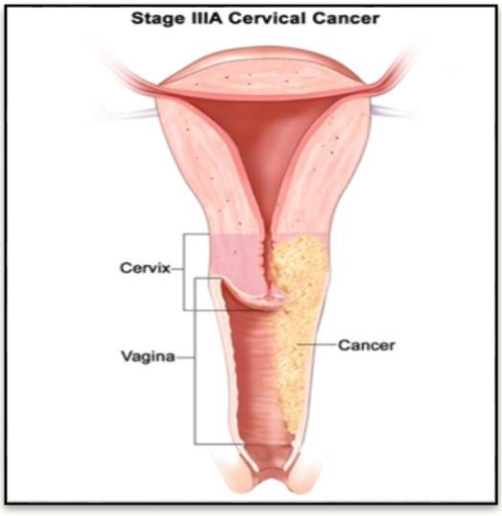

Figure 5: Stage IIIA Cervical Cancer

International Journal of Global Engineering (IJGE) E- ISSN: 2456-3099
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$$P(x,y)=\begin{cases}\text{IIIA} & \text{if } 4<x<\infty,\ 40<y<\infty,\ v=1,\ u=0\end{cases} \quad (4)$$

Here also the depth of the cancer is represented as x and the width is represented as y[5]. The values v and u represents whether the cancer spreads into the vagina and uterus respectively in (4)

Stage IIIB

Cancer has spread to the pelvic wall; and/or the tumor has become large enough to block the ureters (the tubes that connect the kidneys to the bladder) in Figure 6. The drawing shows the ureter on the right blocked by the cancer. This blockage can cause the kidney to enlarge or stop working.

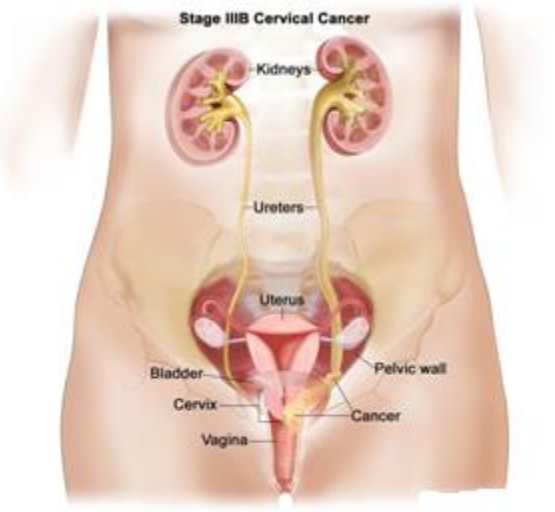

Figure 6: StageIIIB Cervical Cancer

$$P(x,y)=\begin{cases}\text{IIIB} & \text{if } 4<x<\infty,\ 40<y<\infty,\ p=1,\ ur=1\end{cases} \quad (5)$$

Here also the depth of the cancer is represented as x and the width is represented as y[6]. In this stage the cancer is spread into the pelvic bone, the value is p and the ureter is represented as ur in (5).

Stage IV

In stage IV, cancer has spread beyond the pelvis, or can be seen in the lining of the bladder and/or rectum, or has spread to other parts of the body. Stage IV is divided into stages IVA and IVB, based on where the cancer has spread. The Stage IV is the advanced stage in which the cervical cancer is spread over the other parts of the body or the other organs. In this stage, apart from the width and depth of the tumor, mostly the other affected organ is called.

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STAGE IVA

- Stage IVA cervical cancer. Cancer has spread to nearby organs, such as the bladder or rectum. Cancer has spread to nearby organs, such as the bladder or rectum is shown in Figure.

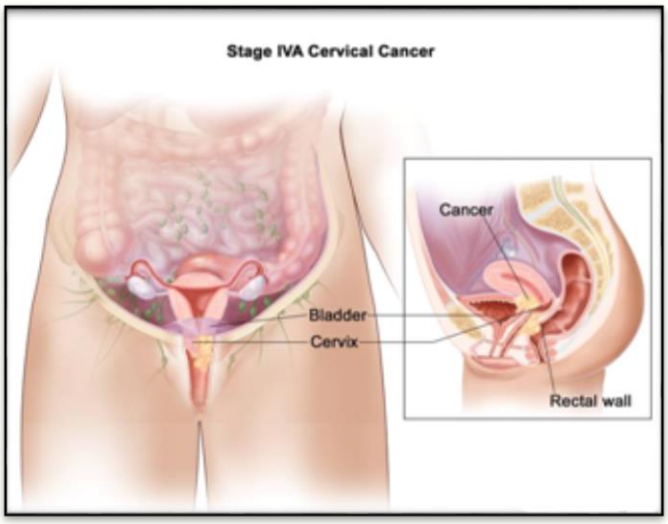

Figure 7: Stage IVA Cervical Cancer

$$F(x,y)=\begin{cases} \text{IVA} & \text{if } 4<x<\infty,\ 40<y<\infty,\ ub=1,\ r=1 \end{cases} \quad (6)$$

Here the width and depth is same as that of Stage IIIB but the urinary bladder and rectum is blocked or affected, which is represented as ub=1 and r=1 in (6)[5].

STAGE IVB

The cancer has spread to other parts of the body, such as the lymph nodes, lung, liver, intestine, or bone. Cancer has spread to other parts of the body, such as the liver, lungs, bones, or distant lymph nodes. In this stage most of the organs of the body is affected by the cancer, the cancer has been spread via lymph, blood and tissues. So most of the body gets affected and make the patient moving towards the death. The survival rate of this stage is very low than that of the other stages

Since most of the organs get affected, our report may consists of all the affected organs in the body. We are in need to consider all the affected parts in our equation. Hence we considered all thee organs of the body as the parameters of the equation. The equation is represented in (7),

$$F(x,y) = \begin{cases} \text{IVB} & \text{if } 4<x<\infty,\ 40<y<\infty,\ l=1,\ ub=1, gb=1, li==1, b=1, ly=1 \end{cases} \quad (7)$$

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VOL 1 ISSUE 2 (2016) PAGES 7 TO 17
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In the above equation we have represented many parameters such as l,ub,gb,li, b, ly for lungs, urinary bladder, gal bladder, liver, bone and lymph, in which the cancer is affected. The diagrammatic representation of Stage IVB is shown in the following Figure 8

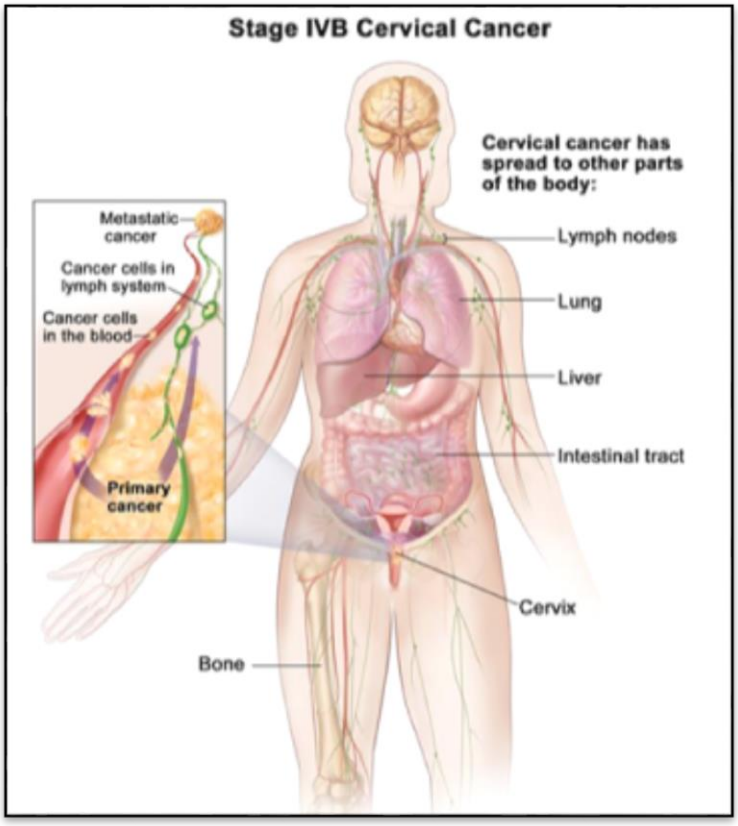

Figure 8: Stage IVB Cervical Cancer

4. RESULTS

The results has been produced by applying the parameters in the above equations, which we got from the diagnosis report and produced the survival rate of the cervical cancer. The survival rate is taken from the National Cancer Database which is shown below

Survival rates for cervical cancer

They are based on data collected by the National Cancer Database. These are the most recent statistics available for survival by the current staging system[4].

- The 5-year survival rate for people with stage 0 cervical cancer is about 93%.
- For stage IA cervical cancer, the 5-year survival rate is about 93% For stage IB cancer, the 5-year survival rate is about 80%.
- For stage IIA cervical cancer, the 5-year survival rate is about 63%. For stage IIB cancer, the 5-year survival rate is about 58%.

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- The 5-year survival rate for stage IIIA cervical cancer is about 35%. For stage IIIB cancer, the 5-year survival rate is about 32%
- Stage IVA cervical cancer has a 5-year survival rate of about 16%, and stage IVB cancer has a 5-year survival rate of about 15%. Still, there are often treatment options available for women with these stages of cancer.

CONCLUSION AND FUTURE ENHANCEMENT

In our system, we can easily identify the stages of the cancer by giving the parameters, which we got from the diagnosis report. From which we can easily determine the patient status from the stage of the cancer. In our paper we have taken the verbal diagnosis report for determining the stage of the cervical cancer. In future we can enhance this work with image processing by taken the diagnosis image as input and find the stages of the cancer for the prognosis process. By this proposed system, the common people can easily understand the prognosis of the cancer.

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