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Artificial Intelligence in Female Cancers Screening, Diagnosis and Treatment

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ABSTRACT :
Diagnosing diseases is crucial to planning the right treatment and ensuring the well-being of patients. Human error hinders accurate diagnosis because interpreting medical information is a complex and cognitively challenging task. The application of artificial intelligence (AI) can improve diagnostic accuracy and efficiency. While the current literature explored different approaches to diagnose different diseases, there is no overview of the areas in which AI has been applied, including their effectiveness in identifying new digitized health services, in the current. research .By conducting a critical review, we present the landscape of artificial intelligence into diagnostics and provide an overview for future research. This article expands the scientific world by proposing a research agenda. Practitioners understand the extent to which AIimproves diagnosis and how it benefits healthcare. However, before the successful application of artificial intelligence in the diagnosis of diseases, several problems must be solved.

Keywords : Artificial intelligence ,Types of cancer ,Screening and Diagnosis ,Deep learning ,Machine learning ,Deep Neural Network

I. INTRODUCTION :

The application of artificial intelligence (AI) offers advantages in disease diagnosis. The healthcare system is a dynamic and changing environment and professionals constantly face new challenges with changing responsibilities and frequent interruptions .This variability regularly causes disease diagnosis to become a secondary problem for health professionals. In addition, clinical interpretation of medical information is a cognitively challenging task . This applies not only to experienced specialists, but also to operators with different or little knowledge, such as young medical assistants. Doctors' free time is usually limited and diseases can evolve and patient dynamics change over time, making diagnosis a very complex process .However, an accurate diagnostic process is essential to ensure timely treatment and thereby achieve safe and effective patient care..

The term AI does not have a single definition , but is considered "the ability of a machine to perform the cognitive functions that we associate with the human mind, such as perception, reasoning, learning, interaction". with the environment, solve problems, make decisions, and even show creativity" . Artificial intelligence is usually related to human behavior and covers many research areas such as natural language processing or robotics..

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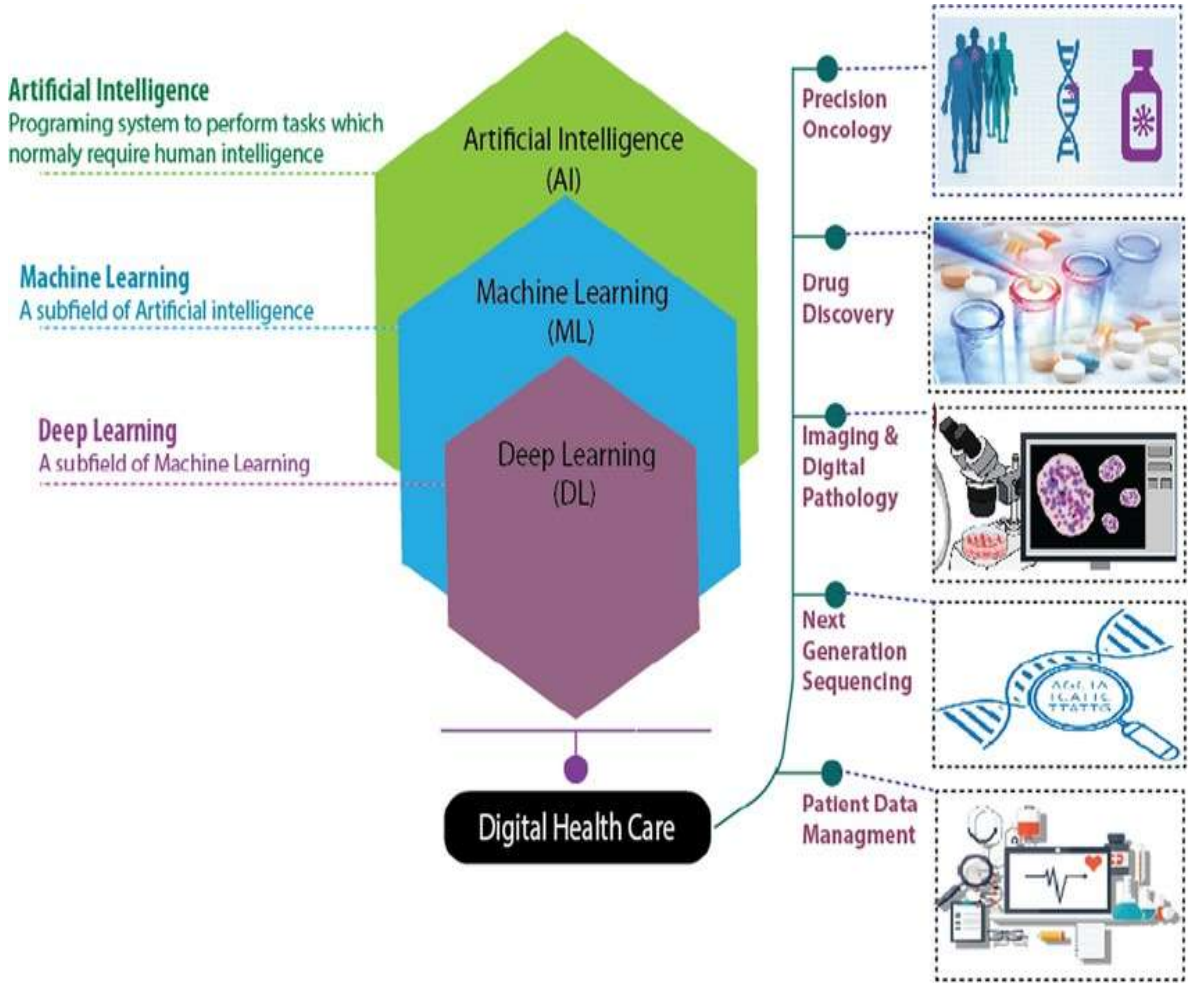

CANCER:

In cancer research, each cancer sample presents the researcher with an altered genome containing a unique and unpredictable number of point mutations, indels, translocations, fusions, and other abnormalities. Because many of these changes may never have been detected before and may not be found in coding regions of the genome, whole genome sequencing is increasingly considered the only rigorous approach to find all variants in the cancer genome. Among all these changes, there are some that promote the progression of the disease. Based on the premise that changes in gene expression levels influence disease progression, RNA-Seq is increasingly used as a useful technique to determine whether these genetic changes influence disease progression. Genetic changes can affect all cellular processes, including chromatin structure, DNA methylation, RNA splice variants, RNA editing and microRNA (miRNA), to name a few. True progress in cancer research will be achieved through the measurement and integrated analysis of all these interdependent processes.

A key feature of next-generation sequencing technologies is the parallel generation of billions of independent sequence reads, each from a single DNA molecule. The resulting data correspond to an approximate random sample of DNA molecules, which in turn represent the genomes of individual cells in a tumor sample

FEMALE CANCER :

Lung, breast, ovarian and pancreatic cancer research has innovatively explored AI and ML to provide an evidence-based approach to the field. Although some studies have investigated the use of AI in breast screening based on ethical and social issues related to adoption 18 and radiology 19 , there are signs of new findings, such as DL, supporting the finding of lymph node metastases in breast cancer. 20 Similarly, by applying CAD e ML models to colon screening, endoscopic images

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and videos were processed in record time and enabled real-time detection of polyps with excellent and high accuracy.21,22 Other ML learning methods were also used for detection. lack of difference correction (d MMR) in colorectal screening. 23 In liver cancer, artificial intelligence methods using CS-SVM in liver cancer rehabilitation groups found that the methods can clearly predict the time and place of cancer recurrence. 24 The application of AI and ML in cancer prognosis, diagnosis and rehabilitation is increasingly discussed among researchers, but the overview of the scope, progress and achievements can be a reference for future research and applications of innovative technologies.

Healthcare is undergoing a transformation thanks to artificial intelligence (AI), especially in the areas of female cancer screening, diagnosis, and treatment, such as ovarian, cervical, and breast cancer. This article examines how AI is changing various fields and provides hope for more precise diagnosis, earlier detection, and individualized treatment regimens.1. Prompt Identification and Evaluation AI algorithms have been created for the analysis of medical imaging, including MRIs, ultrasounds, and mammograms. These algorithms are able to identify anomalies that could point to the existence of cancer. For example, AI is remarkably accurate at identifying little calcifications in mammograms, which may be an early indication of breast cancer. According to studies, artificial intelligence (AI) can occasionally identify breast cancer more accurately than human radiologists, especially in thick breast tissues where malignancies can be more difficult to detect.AI tools for risk assessment.

1.BREAST CANCER :

The National Breast Cancer Foundation states that early detection, if it occurs when the cancer is still localized, entails the discovery of breast lumps, masses, and densities. After five years, the overall survival rate is 99% if early identification is accomplished.

55,581 of the 58,344 women aged 40–74 who had routine mammography screenings between April 1, 2021, and June 9, 2022, were included in the study. Based on an initial positive read, 269 (0·5%) women were diagnosed with screen-detected breast cancer; double reading by one radiologist plus AI was not inferior to double reading by two radiologists for cancer detection (261 [0·5%] vs 250 [0·4%] detected cases; relative proportion 1·04 [95% CI 1·00–1·09]). Additionally, double reading by two radiologists was not inferior to single reading by AI (246 [0·4%] vs. 250 [0·4%] identified cases; relative proportion 0·98 [0·93–1·04]) or triple reading by two radiologists plus AI (269 [0·5%] vs. 250 [0·4%] detected cases; relative proportion 1·08 [1·04–1·11]). The group made use of a dataset comprising pictures from 25,000 mammograms taken on 6,369 women who underwent breast cancer screening. Out of these women, 351 had interval invasive breast cancer and 1,600 developed screening-detected breast cancer.

SCREENING:

Currently, the best method for detecting breast cancer early, when it is more likely to be smaller and contained in the breast, is routine screening, most usually done with a mammography machine. Furthermore, patients may experience better results and require less intensive treatment programs when breast cancer is detected in its early stages.

Mammography has been the gold standard for screening for breast cancer for a long time because it is very good at finding anomalies in breast tissue that may be cancerous even before patients notice lumps or other symptoms. However, mammography isn't flawless. Some women have thick breasts or have other risk factors (gene mutations, family history) that require further imaging (MRI or ultrasound). Women are occasionally summoned back for what turns .

Drs. Constance Lehman and Regina Barzilay, BCRF investigators, created and evaluated the MIRAI deep learning model, which is based on mammography. They achieved this by integrating risk factor information into the tool's analysis, analyzing several mammography pictures over time, and making use of a sizable group of varied patient data. The group showed that, in comparison to conventional risk models, MIRAI might produce tailored, fair, and economical gains in breast cancer risk prediction. Crucially, MIRAI yields reliable results from different mammography devices and locales.

DIAGNOSIS :

Screening detects a cancer, prompt and precise diagnosis through breast tissue biopsy is essential to begin therapy for the patient. A pathologist examines a sample under a microscope during a biopsy to look for cancer cells, their growth patterns, and features in the cells and tissue that point to the subtype and grade of breast cancer. Digital pathologists are finding that incorporating artificial intelligence (AI) into their work is a

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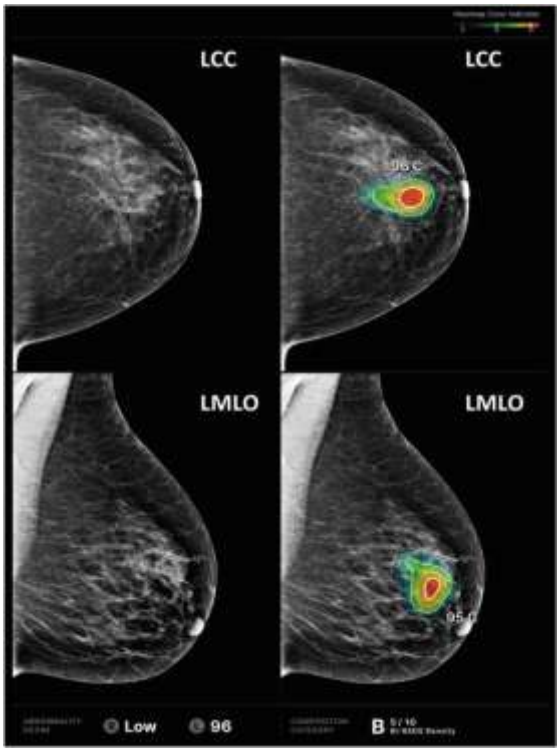
game-changer for increasing imaging sensitivity and specificity, streamlining workflow, and effectively diagnosing breast cancer.

Breast MRI can provide information about a tumor's surroundings and characteristics that are useful for diagnosing patients at high risk. AI can extract data from MRI pictures in large quantities since they are rich in complex information and substance. AI is particularly useful in this situation since it can pick up descriptive elements such as the texture, boundaries, and shape of the tumor, acting as additional "eyes." AI will enhance the use of imaging biomarkers in clinical decision-making and has enhanced MRI detection and characterization of breast cancer.



Example of artificial intelligence in two dimensional breast mammography

The figures display the AI outputs produced by L unit Inc.'s L unit INSIGHT MMG in addition to the first two perspectives (LCC and LMLO). These AI outputs include heat maps for localization and dis-play abnormality scores to suggest a cancerous tumor. On a scale of 1 to 10, a density score according to the BI-RADS category was given.

Mammography is known as MMG; left craniocaudal (LCC); left mediolateral oblique (LMLO); artificial intelligence (AI); and breast imaging reporting and data system (BI-RADS).

TREATMENT :

AI predicts clinical outcomes and therapeutic responses.

Artificial intelligence has been utilized to monitor and evaluate the prognosis of breast cancer. AI algorithms were used in conjunction with MRI scans to assess the expected response to adjuvant and neoadjuvant treatments based on pretreatment imaging. By studying imaging features and patterns, AI can help anticipate treatment responses and optimise treatment methods to improve patient outcomes . A similar approach occurs with ultrasonography, where AI predicts the response to NAC and contributes to the overall breast cancer prognosis . Furthermore, AI has emerged as a promising method for assessing chemotherapy response in post-treatment MRIs and predicting recurrence risk . In the future, AI algorithms could evaluate medical pictures like MRIs and deliver

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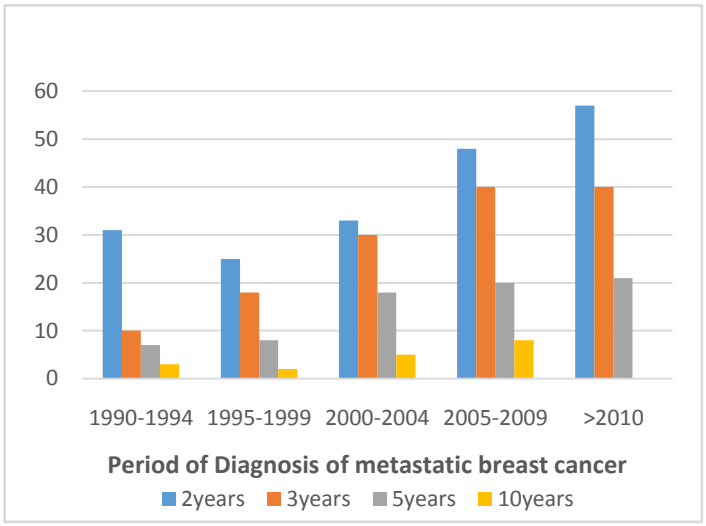

Fig : Period of Diagnosis of Metastatic breast cancer vs % Survival

The 784 patients' median survival grew from 13 to 33 months in a sequential manner. Survival after five years rose from 10% to 27%. The post-recurrence survival times were shortest for patients with high grade initial tumors; however, these patients' median survival times increased dramatically over time: from 12 to 30 months, from 16 to 38%, and from 5 to 20% at 3 years. Patients with grade 2 tumors had a 2-year median survival rate that did not become any better. A few 47 patients exhibited grade 1 tumors, and their 4-year median survival remained unchanged.

Before trastuzumab was introduced in 2000, the median survival for HER2 positive patients receiving treatment was 14 months; following that year, it improved to 29 months, with a 5 year survival rate of 2 to 31%.

2.OVARIAN CANCER

Ovarian cancer is the eighth most common malignancy in womenworldwide1. It is notoriously difficult to detect and diagnose, with screening ineffective2 and non-specific symptoms similar to menopause

Primary malignancies involving the ovaries, fallopian tubes and peritoneum often have intra-abdominal spread at the time of diagnosis (FIGO4, stage 3)

Most ovarian cancers are carcinomas (epithelial cancers), which are divided into five main histologic sub types: high-grade serous, low-grade serous, clear cell, endometrioid, and mucinous. Non-epithelial ovarian cancers are much rarer and include germ cell, cord, and mesenchymal tumors. Subtypes of ovarian cancer differ morphologically and prognostically and have different treatment options5. High-grade serous cancer is the most common form of ovarian cancer, accounting for approximately 70% of all cases6..

Epithelial ovarian cancer

This is by far the most common type of ovarian cancer. It begins in cells on the outer surface of the ovary. Many epithelial ovarian cancers begin in the epithelial cells of the fallopian tubes near the ovary or in the epithelial cell lining of the stomach (peritoneum). Then they go to the surface of the ovary. There are several types of epithelial ovarian cancer. High-grade serous carcinoma is the most common subtype of epithelial ovarian cancer.

Germ cell ovarian cancer

This cancer begins in the cells that produce eggs in the ovary. These rare tumors most often occur in people between the ages of 10 and 29 who have ovaries. There are different subtypes of germ cell tumors.

Stromal cell carcinoma

This cancer occurs in the tissue that produces certain female hormones and holds the ovaries in place. It is also a very rare form of ovarian cancer.

SCREENING

The goal of all screening programs is to detect tumors at an early age. Unfortunately, the

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effectiveness of ovarian cancer screening with transvaginal ultrasound (TVU) and serum CA125 measurement is currently unproven. None of the currently available screening tests for ovarian cancer have yet sufficiently demonstrated the basic characteristics of screening to justify routine use in the general population or in high-risk individuals.

A UKFOCSS trial is currently evaluating the use of serial CA125 measurements and ovarian ultrasound in high-risk women (lifetime risk >10%) and the results should provide definitive evidence of the benefit of screening. A more promising screening approach may be to identify new novel biomarkers to improve screening efficiency. Ovarian screening was recently discussed in that journal and will not be discussed further there.93.

Ovarian cancer screening aims to reduce mortality by detecting potentially curable stage I invasive epithelial ovarian cancer. Serum CA-125 measurements and ultrasound are used either alone or in combination [10-18]. The criteria for an abnormal ultrasound are ovaries enlarged with age, a persistent ovarian mass or a cyst with nodes and septa.

Because physiological changes such as hemorrhagic cysts can lead to false positives, it is important that only persistent abnormalities are considered abnormal. The glycoprotein serum marker CA-125 is elevated in 80% of ovarian cancers, most of which are advanced at presentation, but CA-125 is elevated in only 50% of stage I ovarian tumors.

CA-125 is also insensitive for mucinous and germ cell tumors, but those tumors with a good prognosis are less prominent on screening..

Radiologists should be aware of the current literature on ovarian cancer screening in order to appropriately address patient concerns about disease prevention and screening strategies. Results of comprehensive screening tests vary depending on screening methods and study design . Studies using CA-125 alone reported a higher percentage of advanced tumors with fewer stage I tumors; however, more recent studies using serial CA-125 measurements have shown better results . If ultrasound is used primarily, more stage I tumors are detected, but because ultrasound lacks specificity, many women with abnormal screening results may undergo unnecessary surgery for benign disease.

Another problem is that screening, especially primary universal screening, may identify borderline, germ cell, or granulosa cell tumors, which are biologically less aggressive. Alternatively, high-grade serous tumors may develop and progress to an advanced stage between examinations , and primary peritoneal cancers may occur without a palpable ovarian mass.

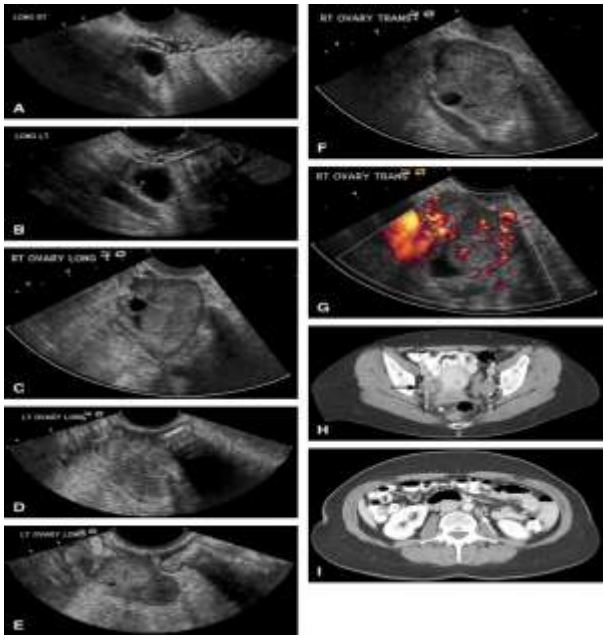

Fig. A 53-year-old woman with a family history of ovarian and breast cancer developed bilateral stage III high-grade papillary serous ovarian cancer with a 6-month interval between ultrasound examinations. (A and B) Ultrasound revealed bilateral simple follicles, normal-sized

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ovaries with a volume of 6 ml bilaterally; CA-125 was normal at 16 U/ml. (C–G) Ultrasound 6 months later; the volume of the right ovary increased to 19 ml and the volume of the left ovary was 16 ml. The ovaries contained solid hyper vascular masses and had a lobulated outline. The CA-125 level was elevated to 67 U/ml. (H and I) CT scan showed bilateral ovarian enlargement (black arrow) and leiomyomatous uterus. There was also left paraaortic adenopathy (white arrows) and small pelvic ascites.

DIAGNOSIS:

Tests and procedures used to diagnose ovarian cancer include:

Pelvic examination: During a pelvic exam, your doctor will insert gloved fingers into your vagina and simultaneously press down on your abdomen to feel (palpate) your pelvic organs. The doctor also visually examines the external genitalia, vagina and cervix.

Image tests: Tests such as abdominal and pelvic ultrasounds or CT scans can help determine the size, shape and structure of your ovaries.

Blood tests: Blood tests can include organ function tests to help determine your overall health.

Your doctor may also test your blood for tumor markers that indicate ovarian cancer. For example, the cancer antigen (CA) 125 test can detect a protein that is often found on the surface of ovarian cancer cells. These tests cannot tell your doctor if you have cancer, but they can provide clues about your diagnosis and prognosis.

Surgery: Sometimes your doctor can't be sure of your diagnosis until you have surgery to remove your ovary and are tested for signs of cancer.

Genetic testing: Your doctor may recommend a blood sample to look for gene changes that increase the risk of ovarian cancer. Knowing that you have an inherited DNA change will help your doctor make decisions about your treatment plan. If you wish, you can share the information with blood relatives, for example siblings and children, as they may also be at risk of getting the same gene changes.

TREATMENT:

Chemotherapy and surgery are typically used in the treatment of ovarian cancer. In some circumstances, alternative therapies might be employed.

Surgical Procedures for the excision of ovarian cancer comprise:

One ovary is removed surgically. Removing the afflicted ovary and its fallopian tube during surgery may be necessary for early-stage cancer that hasn't progressed to more than one ovary. Your ability to procreate may be preserved by this surgery.

Both ovaries are removed surgically. Your surgeon may remove both of your fallopian tubes and ovaries if you have cancer in both of them and there are no indications of more malignancy. Because your uterus is left intact after this treatment, you could still be able to conceive using donor eggs or your own frozen embryos.

Surgery to eliminate both

Chemotherapy:

Chemotherapy is a pharmaceutical treatment that employs chemicals to destroy the body's rapidly proliferating cells, especially cancerous ones. Chemotherapy medications can be ingested or administered intravenously.

Chemotherapy is frequently used to eradicate any cancer cells that may have persisted following surgery. It can be used before to surgery as well.

Hyperthermic intraperitoneal chemotherapy is a procedure in which chemotherapy medications are heated and administered into the abdomen during surgery. Before they are emptied, the medications are left in situ for a predetermined period of time. After then, the procedure is over.

Personalized treatment:

Treatments with targeted drugs concentrate on particular flaws in cancer cells. Targeted medication therapies can kill cancer cells by exploiting these vulnerabilities.

Your doctor may test your cancer cells if you're thinking about targeted therapy for ovarian cancer in order to identify which targeted therapy has the best chance of impacting your cancer.Hormone replacement treatment

Drugs are used in hormone therapy to prevent the effects of oestrogen on ovarian cancer cells. Because some ovarian cancer cells utilise oestrogen to fuel their growth, oestrogen blocking may aid in the cancer's management.

Treatment options for certain types of slow-growing ovarian cancers may include hormone therapy. It can also be a possibility if the cancer returns following first-line therapy.

Immunotherapy:

Immunotherapy makes advantage of the immune

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Radiation therapy
High-energy radiation beams are used in radiotherapy to destroy cancer cells.

For ovarian cancer, you could receive radiation therapy to:
handle advanced cancer if alternative therapies aren't appropriate for you; assist with symptoms like bleeding, agony, or discomfort.

3.UTERINE CANCER

Endometrial cancer is the most frequent gynecologic cancer, affecting an estimated 25.7 out of every 100,000 women annually.1. The death rate from endometrial cancer has risen by 21% in the last 20 years,1 even with improved diagnostic and therapeutic options. The patterns observed in the US point to a worldwide issue. Although endometrial cancer is more common in industrialised nations, it has also been noted that Asian and lower-middle-income nations have high rates of the disease.2,3 13,606 women were affected by endometrial cancer in 2012, the greatest number of instances of gynecologic malignant tumours in Japan, with a morbidity rate more than that of cervical cancer in 2007.Endometrial cancer (EC) is one of the most typical cancers offemale origin, and it has a survival rate of 83% after 5 years ofbeing diagnosed and has a high prevalence in developed countrieslike Europe and North America. which can be attributed tosedentary lifestyle and genetics. EC has been classified into twotypes depending upon their reliance on oestrogen for decades.Type 1 EC endometrial cancer is considered oestrogen-depen-dent, while type 2 is oestrogen independent. Both of these types can be belligerent, with a bad prognosis. Other classifications include histological ones such as epithelial carcinomas, mixed and epithelial, mesenchymal tumours, endometrial stromal and smooth-muscle tumours, gestational trophoblastic diseases, and other malignant tumours[One of the most common diseases to affect women, endometrial carcinoma (EC) has a high incidence in developed nations and an 83% survival rate five years following diagnosis. such as those in North America and Europe, which are related to heredity and sedentary lifestyles. For many years, EC has been divided into two groups based on how much they rely on estrogen. While type 2 EC endometrial cancer is oestrogen independent, type 1 is thought to be oestrogen dependent. The prognosis is poor for both of these kinds, and they can be aggressive. Other classifications include histological ones, which include mesenchymal tumours, endometrial stromal and smooth-muscle tumours, epithelial carcinomas, mixed and epithelial tumours, gestational trophoblastic disorders, and other malignant cancers.

SCREENING:

There is no screening test for endometrial cancer. The present method to detecting and treating endometrial cancer requires all patients to be able to recognize and report symptoms, as well as adequate intervention.4 The current approach to endometrial cancer screening may become problematic in the future, resulting in discrepancies in access to appropriate care.4 Black women were less likely than white women to recognize postmenopausal bleeding (PMB). In this situation, Black women had a greater probability of dying from endometrial cancer within 5 years than White women.5,6 The incidence of endometrial intraepithelial neoplasia (EIN) and endometrial cancer is considerable in pre- and perimenopausal women who have abnormal uterine bleeding (AUB),7 although.

STAGES :
Endometrial cancer is the most prevalent type of uterine cancer,is indentified in 3 stages the most common stage of diagnosis is stage 1 .

STAGE 1A:
The cancer only affect the endometrium or less than half of thr myometrium which is uterine smooth muscle tissue.
1B: at least half of the myometrium has cancer .

STAGE 2:
The cancer does not spread outside of the uterus instead it is contined in the stromal connective tissue of the cervix.

STAGE 3A:
Direct extension or metastasis of the cancer to the serosa and adnexa.
3B: The parametrium or vagina are affected by cancer.

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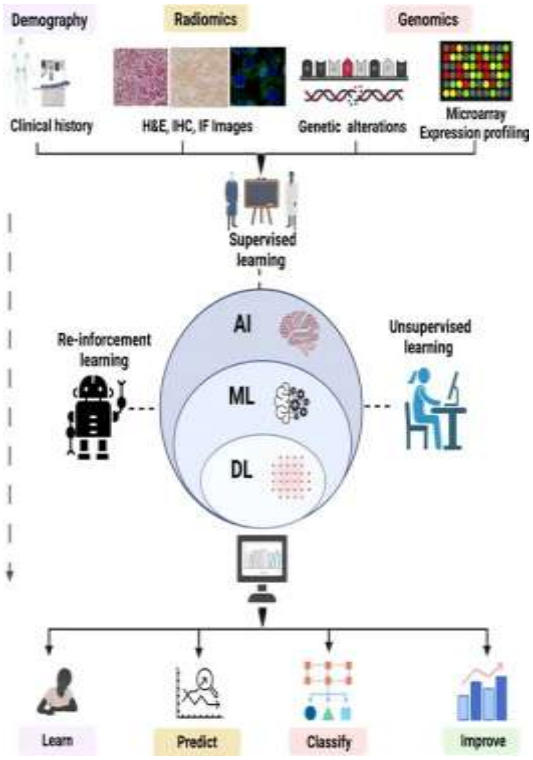

Fig. A summary of reinforcement learning, unsupervised learning, and supervised learning. The overview of machine learning shows how statistical models and algorithms that computational techniques employ to accomplish a certain goal without explicit programming are analyzed and tested. The picture depicts the supervised, unsupervised, and reinforced algorithms used in domains such pattern recognition, object identification, language interpretation, and genomics, as well as the subdisciplines of artificial intelligence (ML and DL) and their subtypes. The ML algorithms analyze, refine, forecast, and categorize the data.

DIAGNOSIS AND TREATMENT :

Current diagnostic and therapy options for endometrial cancer:

Artificial neural networks have been applied in medicine.

Rapid expansion. They have been utilized to distinguish between ovarian tumors and other neoplasms before surgery. Although neural networks can give more accurate results than chance, its practical application in endometrial cancer is restricted . Approximately 42,000 women die each year from this malignancy, which is typically detected after menopause . Only 4% of females with EC are under 40 years . EC often causes abnormal uterine bleeding in pre- and post-menopausal women.

Females commonly have post-menopausal or intermenstrual bleeding.inexpensive, practical, and reduces patient suffering. Pipelle's main problem is insufficient sample collection for histological evaluation. Some studies

Evidence suggests a link between provider and patient factors and sampling failure. According to German research, Pipelle and D&C diagnoses were nearly comparable in 95.5% of cases [27]. D&C increases the risk of uterine and cervical damage, making it less effective than pipeline. However, pipeline has a higher failure rate.

The principal imaging methods, MRI and TVUS, have limitations. TVUS requires a qualified practitioner to perform. However, the availability of MRIs remains a challenge. MRI is regarded more specific than TVUS.

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Diagnosis :If someone has symptoms suspisious of uterine cancer further test are done various test diagnosed uterine cancers varying from a simple biopsy procedure done in OPD to an endoscopic procedure.

Owing to assumptions that endometrial cancer starts in the uterus ,a Pap test's finding typically fail to represent it.therefore a sample of endometrial tissue should be removed and screened for cancer cells under a microscope. each of the procedure should be used.

	Total Patients recruited(N=273)	Serology data for patients receiving one dose(N=267)	Serology data for patients receiving two dose(N=265)
Median Age (IQR), Years	63(15.3)	63(15.5)	63(15.0)
Median duration from previous dose	-	-	28(14)
Sex, n(%)			
Male	135(49.5)	131(49.1)	131(49.4)
Female	138(50.5)	136(50.9)	134(50.6)
Cancer type, n(%)			
Haematological cancer	40(14.7)	38(14.2)	38(14.3)
Breast cancer	52(19.0)	51(19.1)	50(18.9)
Prostate	9(3.3)	9(3.4)	9(3.4)
Renal	7(2.6)	7(2.6)	7(2.6)
Others	12(4.4)	12(4.5)	12(4.5)
Treatment Received, n(%)			
Targeted therapy	49(17.9)	48(18.0)	47(17.7)
Immunotherapy	23(8.4)	23(8.6)	23(8.7)
Systemic chemotherapy	98(35.9)	96(36.0)	95(35.8)

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4.CERVICAL CANCER

The health of women is still greatly threatened by cervical cancer, which is still the primary cause of cancer-related deaths in this population. With early detection and screening, the cancer is easily avoidable. Even though advances in technology have greatly enhanced the early detection of cervical cancer, there are still a number of factors that make accurate diagnosis challenging. Artificial intelligence (AI)-based medical diagnostic tools have grown more popular recently, and they are quite useful for cervical cancer screening and detection. Their advantages include less time consumption, a decreased requirement for technical and expert staff, and the absence of prejudice due to subjective considerations. Thus, our goal was to talk about how artificial intelligence (AI) can be applied to cervical cancer screening and diagnosis, especially to increase the precision of early diagnosis. The use and difficulties of utilizing.

It is the only cancer that may be completely prevented by using primary preventive measures, which include early identification, prompt treatment, and the 9-valent human papillomavirus (HPV) vaccine (2).

One of the 15 genotypes of the carcinogenic HPV virus causes persistent infection of the cervical epithelium, which accounts for almost all occurrences of cervical cancer. The progression of a persistently infected epithelium to cervical precancer, invasion through the epithelium's basement membrane, infection of the metaplastic epithelium at the cervical transformation zone, and persistent HPV infection are the four main stages in the development of cervical cancer (3). Girls and young women can be protected against HPV infection with the HPV vaccinations. However, the current HPV vaccination coverage rate is quite low.

ability to identify early lesions that could progress to cervical cancer without picking up on short-term HPV infections or benign abnormalities that could result in overtreatment or other screening-related risks (5). While the death rate from cervical cancer has decreased and the discovery rate has increased due to ongoing advancements in screening methods, the majority of deaths still happen in low- and middle-income nations (8). Many of the newly developed effective screening programs are unable to be implemented or sustained due to inadequate health infrastructure (9, 10). Furthermore, not all manual screenings are 100% accurate (11), which leaves certain associated lesions undiagnosed in a timely manner. Therefore, creating a cervical cancer screening technique that is both more affordable and accurate essential.

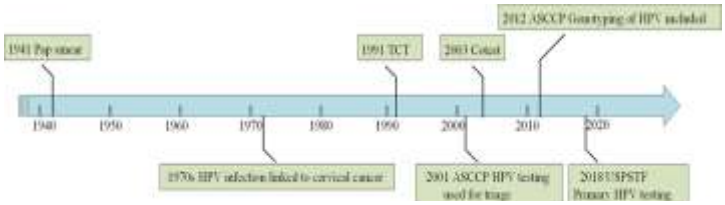

FIG : Evolution of cervical cancer screening methods

SCREENING :

The most recent guidelines from the World Health Organization include three screening techniques for the early identification of cervical cancer: HPV testing, cytology (which includes both liquid-based and conventional pap smears), and visual inspection with acetic acid (VIA) (16). Since VIA is only employed in situations where the other two are not feasible, we concentrated on the first two techniques. Cervical exfoliated cells are brushed and used as test samples for cytology and HPV testing. While cytological examination use a microscope to identify cells removed from the cervix for potential cervical cancer or precancerous lesions, HPV testing finds high-risk forms of HPV infection in the cervix (17). The development of cervical cancer screening techniques is depicted in Colposcopy-guided biopsy, however, is still the gold standard for diagnosing cervical cancer.

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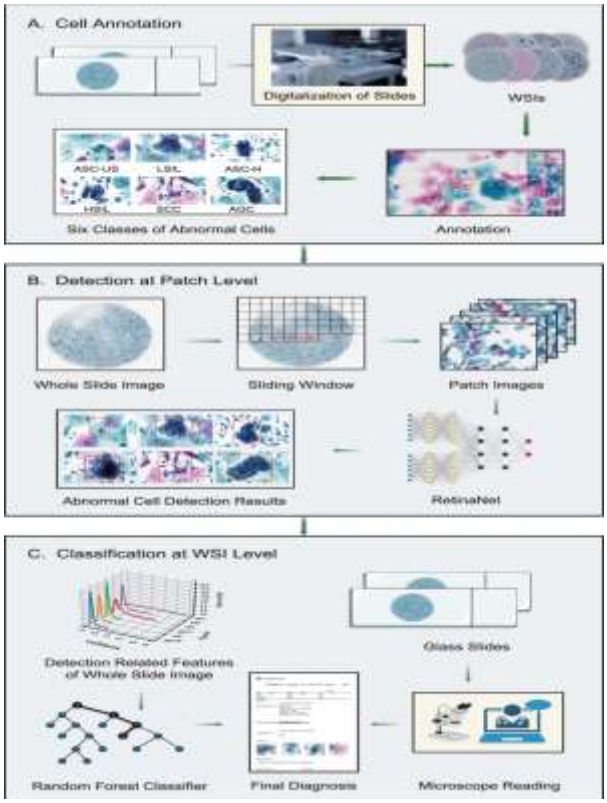

FIG : The AICCS Workflow

DESCRIPTION:

Prior to acquiring and preprocessing WSIs, cervical liquid-based preparation samples that were gathered and maintained using the sedimentation liquid-based preparation method (A) must first be digitalized. When a WSI passes quality inspection, it is subjected to patch-level detection, which entails breaking it up into smaller patches using a sliding window technique and annotating abnormal cells according to TBS 2014 (B) criteria. The WSI-level classification model receives its input from the cell detection model's output. The patch-level cell detection model's output is used by the WSI-level classification model to produce potential cytology grades in accordance with TBS 2014, including ASC-US, LSIL, ASC-H, HSIL, SCC, and AGC (C). The information of the Section C classification at the WSI level for the microscope reading comes from Biorender The Publication's Verification.

AI also helps with the early detection of cervical cancer LNM.

The accuracy of computed CT and MRI in detecting lymph node involvement ranged from 83% to 85% had strong specificity, ranging from 66% to 93% (74). In 2018, the cervical cancer staging system was updated to include lymph node status for the first time.

Cervical cancer with lymph node involvement on imaging or histology was diagnosed as stage IIIC (66). Wu et al. created a DL model based on preoperative MRI to predict LNM in cervical cancer patients. In T1WI, the AUC for intratumoral and peritumoral DL models was 0.844, whereas the hybrid model including tumor image information from DL mining had a higher AUC.

TREATMENT:

Currently, the lack of experience, quantity, and medical problems among physicians limits the accuracy and universality of diagnosis and treatment. Early screening, diagnosis, treatment, and prognosis for cervical cancer remain significant issues.

This paper focuses on using artificial intelligence (AI) to diagnose and treat cervical cancer using MRI and CT images. This includes lesion segmentation, local staging, and LNM detection.

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Artificial intelligence has been extensively researched and utilized to the diagnosis and treatment of cervical cancer.

It has improved cervical cancer lesion segmentation and local staging on MRI, as well as early diagnosis of cervical cancer LNM and computed tomography, resulting in more accurate and specific early prediction. and diagnostics, boosting the efficiency of cervical cancer diagnosis and therapy, assisting physicians in making decisions.

5.COLORECTAL CANCER

Colorectal cancer (CRC) is the third most prevalent malignancy and the second major cause of death globally [1]. The World Health Organization predicts around 1.9 million new cases and 935,000 deaths in 2020, accounting for approximately

One-tenth of all cancer diagnoses and deaths [1]. Despite advancements in CRC healthcare, the global incidence and mortality rates are projected to climb by 15% by 2030, reaching over 2.2 million new cases and 1.1 million deaths [2]. Identifying effective ways for early diagnosis, treatment, and prognostic prediction of CRC is crucial for improving survival rates.

Artificial intelligence (AI) technologies, specifically machine

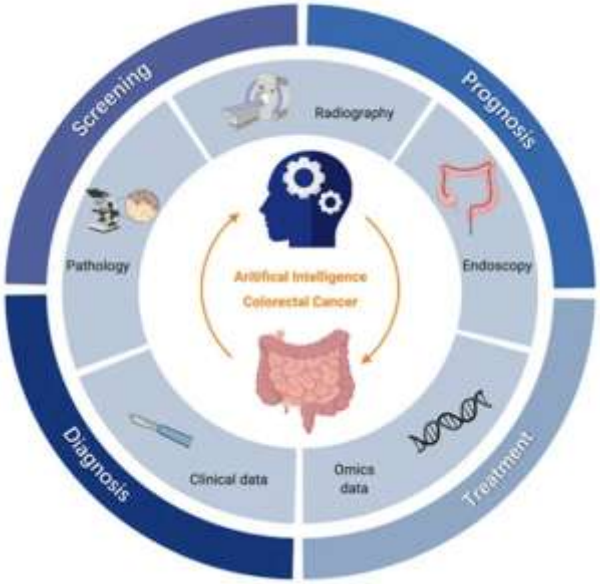

FIG. : Clinical applications of AI in CRC. The inner circle depicts the primary data types in CRC research, such as radiological pictures (e.g. CT, MRI), endoscopic images, pathological images, clinical data, and omics data.

The circle depicts the four important clinical elements of CRC: screening, diagnosis, therapy, and prognosis. AI has specialized tasks for each clinical part, which are illustrated in boxes outside the circle. Overall survival (OS), disease-free survival (DFS), and neoadjuvant radiation (nCRT).

Screening;Endoscopy is the gold standard for CRC screening, supplemented with fecal occult blood tests (FOBT). However, these procedures rely on clinical experience and can lead to omissions and misdiagnoses.

The utilization of endoscopic imaging datasets and EMRs, AI-assisted endoscopy for polyp diagnosis, and high-risk prediction models based on clinical and omics data are predicted to enhance the accuracy and efficiency of CRC screening.

Diagnosis :*Radiography and pathological investigation are used to diagnose and stage colorectal cancer (5). Advancements in image recognition technology can enhance medical picture readability, eliminate experience differences, and reduce misdiagnosis rates.

Treatment:Common treatments for CRC include surgery, chemotherapy, and radiotherapy [7]. AI can evaluate novel therapies and tools, including neoadjuvant radiation and chemotherapy.

Prognosis:Improve patient care by providing more precise and effective treatments. Prognosis for CRC comprises predicting recurrence and determining survival duration [3]. Statistical methods, such as the Cox regression model, are

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commonly employed to predict progenosis; however, data-driven machine learning approaches .

Using multidimensional data can improve survival predictions and disease progression tracking.

This review provides a complete analysis and summary of the scientific developments. AI technologies have practical applications in CRC screening, diagnosis, therapy, and prognosis. This article provides a comprehensive overview of the present state of AI in these areas. We examine the limitations and obstacles of clinical AI application and the necessary efforts to address them. We hope this material is useful for doctors and researchers interested in using AI for CRC care.

2. Overview of Artificial Intelligence

The concept of artificial intelligence was first coined in the 1950s [8] and continued rapid development into the 21st century. Thanks to the technical support of infrastructure hardware and the continuous development of databases [9], the explosion of artificial intelligence has also progressed in the medical field. This section describes the basic concepts of AI, ML and DL and focuses on CRC, with particular reference to common algorithms and available data types.

2.1. Basic Concepts of Artificial Intelligence

Artificial intelligence focuses on the use of advanced research and \predictive computing techniques to process all kinds of data, enabling decisions that mimic human intelligence [10]. ML is a subfield of artificial intelligence that allows a machine to become more efficient with training experience. The most important learning models are mainly supervised learning, unsupervised learning and reinforcement learning [3,11]. The importance of semi-supervised learning is also increasing; this combination of supervised and unsupervised learning allows the use of both unlabeled and labeled data. The models differdepending on the type of input data and require different algorithms. Typical algorithms include logisticregression (LR), support vector machine (SVM), naive cells (NB), gradient boosting(GB), classification trees, and random forest (RF). The collection of huge amounts of data led to the development of DL, a subset of ML. DL techniques provide smarter computer networks and better predictive power by developing multiple layers of artificial neurons. The available neural network (NN) approaches for CRC research are convolutional NN (CNN) and recurrent NN (RNN). DL methods are widely used in medical image classification, image enhancement and segmentation. The basic concepts and relationships of AI, ML, and DL are shown in Figure 2a.Basic ML and DL workflows are shown in Figure 2b. The ML process can be broadly divided into four steps: data preprocessing, feature extraction, feature selection, and classification/regression. DL processing combines these four steps to design a function and classification/regression. The critical difference is in understanding their properties; In ML, feature extractions are done manually by humans, while in DL AI automatically generates various features [6]. 2.2. Data category2.2.1. Image Information CRC's most significant AI developments and improvements have Relevant information can be extracted from various image data, such as tumor segmentation, feature extraction and model building, and finally quantitative tumor assessment. In CRC research, we mainly focus on these four common types (Figure 3).Image analysis is enhanced with very specific algorithms. Identifying suspicious polyp sand distinguishing between normal and abnormal are key factors for accurate diagnosis, which is particularly important for early detection of CRC and improving patient prognosis..

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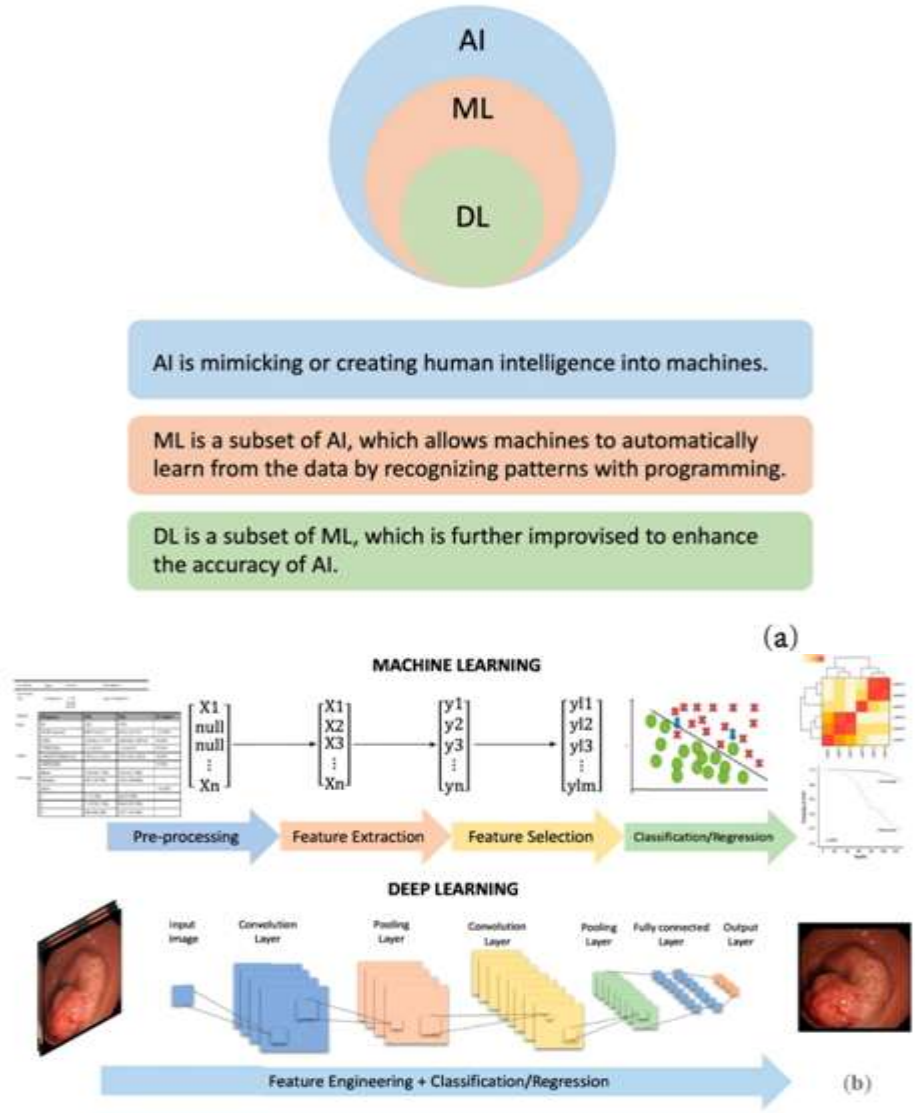

FIG: Basic concept of AI, ML, and DL (a) The relation ships of AL, ML, AND DL; (b)The relation ships of AL, ML, AND DL; The work flowing of ML, DL

SCREENING:

Colorectal Cancer ScreeningCRC is the third most common malignancy in men and women [24]. This leads to a significant increase in cancer-related deaths worldwide [24]. About 60–70% of CRC patients with clinical symptoms are diagnosed at an advanced stage of the disease [25]. However, early detection can improve clinical outcomes for patients by avoiding treatment delays and reducing CRC mortality and morbidity [26].CRC is a highly preventable disease and routine screening seems to be an important step to reduce the incidence of this malignancy [27]. Changes from a normal mucous membrane to a malignant tumor and then to a malignant lesion take almost 15-20 years.The polyp-cancer sequence progresses slowly, and eventually it can take 10 years or more for colonic polyps to become malignant structures [28].Effective screening methods have been developed to detect abnormal tissues thatmay indicate a malignant precursor lesion or an incipient tumor [29-31].CRC screening methods include invasive (colonoscopy and flexible sigmoidoscopy) and minimally invasive (capsule endoscopy), imaging studies(computed tomography colonography), blood and stool tests such as guaiac occult blood test (FOBT), stool immunochemical analysis. test (FIT) and the multi-

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target fecal DNA (MT-sDNA) test [32,33]. Machine learning algorithms can be used as non-invasive and cost-effective methods for CRC risk screening in large populations using personal health data [34].

Colonoscopy :

Detection and removal of precancerous lesions during colonoscopy is extremely importantto reduce the risk of developing CRC. Several studies have shown that although colonoscopy is considered the "gold standard" screening test, it is not perfect [35].It is indeed worth mentioning here that interval cancer can sometimes be detected in patients with a previous negative colonoscopy [35]. Interval colorectal cancer is a primary cancer that is diagnosed after a negative timed screening test within the interval corresponding to the screening interval. Indeed, previous studies have shown that 8.6% of CRC cases occur within 3 years after a negative colonoscopy **[36]..**

High adenoma detection rate (ADR) is inversely correlated with adenoma miss rate(AMR) and CRC risk after colonoscopy [37,38]. Corley et al. showed that every 1% increase in adverse events is associated with a 3% reduction in the risk of developing CRC and a 5% reduction in the risk of fatal CRC [38]. Overall, adverse events can vary from 7% to 53% between different endoscopists [38]. During the procedure, AMR values also vary greatly, from 6% to 27%, depending on several factors [39]. Current evidence indicates that these factors include the quality of preprocedural bowel preparation, weaning time ,operator experience and training, use of sedation, speed of cecal intubation, visualization of curves (blind spots), use of imaging endoscopy, and flat or small(≤5 mm) and small (5 mm) polyps [38,40–42]. Regarding lesion size, a systematic review and meta-analysis showed that adenomas larger than 1–5 mm, 5–10 mm, and more than 10 mm had AMRs of 26%, 13%, and 2.1%, respectively. [43].Furthermore, several studies show that the rate of adverse events can increase up to 30-50% whenan additional observer participates in screening colonoscopy [44,45].Since the risk of developing CRC is high, the help of real-time automatic polyp \detection systems can significantly reduce missed diagnoses and help doctors detect polyps in real time. This topic represents a particular and growing interest in colonoscopy assisted by artificial intelligence and recent advances in technology and modern science. Currently, technological advances are considered a necessary step to minimize the risk of diagnosis and help endoscopists see and evaluate precancerous polyps. Indeed, the important role of computer-aided detection (CA De) and diagnosis (CADx) systems in automatic detection and further characterization of polyps during colonoscopy has recently been recognized [5]. Current new techniques have been used to facilitate the detection of adenomas using deep learning techniques. To correct the harmful effects, computer algorithms driven by CNNs can detect and accurately determine the presence of malignant lesions [46]. CNN represents a type of artificial neural network and deep learning technique that is very effective in medical image analysis [47] (Figure 2)..

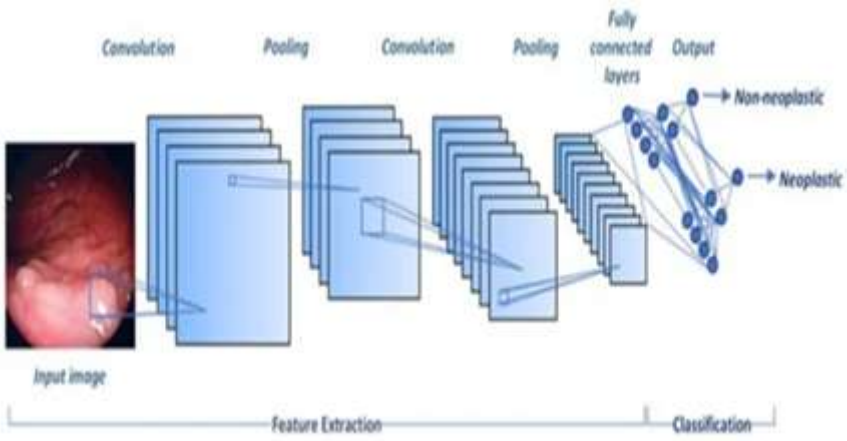

Figure. Convolutional Neural Network (CNN) model for colorectal polyp classification. A CNN is a multilayer artificial neural network that typically consists of three types of layers; convolution, pooling and fully connected layers. Removing the attribute from the input image is done in the first two layers. Fully combined layers are used to combine these functions into the final output. CNN, convolutional neural network.

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Recently, in the first prospective randomized controlled trial, Wang et al. high ADR values of the current automatic detection of polyps were due to the d[48] Investigated the effect of a deep learning-based CADe model on the detection of polyps and adenomas.Of the 1058 patients, 536 were randomized to conventional colonoscopy and 522to computer aided detection (CADe) colonoscopy. Hollowblue trace boxes appeared on the screen to highlight aspecific area of interest and show the polyps detected by the algorithm. The results obtained in the CADe group showed an increase in both side effects (29.1% vs. 20.3%, $p < 0.001$) andthe average number of adenomas detected per patient (0.53 versus 0.31, $p < 0.001$) compared to the standard colonoscopy group. Interestingly, the high ADR values of the current automatic detection of polyps were due to the detection of a large number of small polyps (185 vs. 102, $p < 0.001$). The results of this study also showed that there was no statistical difference between the two groups in the detection of large adenomas (77 vs. 58, $p = 0.075$), but a significantly higher number of hyperplastic polyps was detected in the CADe group (114 versus 52, $p < 0.001$). The effect of AI-assisted colonoscopy indetecting small polyps that may eventually go unnoticed even by highly trained endoscopists iswidely known. Although the association between malignancy and small polyp sizetends to be underestimated, a high detection rate of small polypsmay reduce the risk of CRC interval. Mori et al. [49] showed that CADx assistance during colonoscopy can also help endoscopists distinguish neoplastic from non-neoplastic polyps,leading to a "diagnosis and differentiation" strategy for the latter.

Virtual colonoscopy

Virtual colonoscopy or computed tomography colonography (CTC) is a modified computed tomography (CT) examination first described in 1994 by Vining etal. [50]and is an alternative screening tool to routine colonoscopy in CRC patients. To improve the detection and classification of colorectal polyps, AI-based algorithms can provide computational solutions for optimal diagnostic performance and image quality in CTC. According to the textural analysis method of Haralick Song et al. [51] introduced a virtual pathology model to investigate the utility of advanced differentiation including gradient and curvature. The results of this study showed that the \area under the receiver operating curve (ROC) (AUC)for distinguishing between colored lesions (tumors and non-tumors) improved from 0.74 (using only image intensity) to 0.85. : seen (also using textures of higher order differences). In another study, Grosu et al. [52] developed a machine learning method to discriminate between benign and precancerous CTC-detected colon polyps in an intermediate-risk asymptomatic CRC sample. The current classification algorithm showed promising results with a sensitivity of 82%, a specificity of 85%, and an AUC of 0.91.At the same time, AI can help with other complex problems, such as automatic detection of flat neoplastic lesions, ultimately reducing the risk of cancer. According to the Paris classification, adenomas can present as either protruding (peduncular and sessile) or non-protruding (elevated, flat and depressed) lesions [53,54]. In fact, the presence of flat colorectal adenomas may represent an aggressive tumorigenesis pathway and be a determining factor in the increase of AMR [55]. In a previous study, Taylor et al. [56] designed a CADe model to investigate its diagnostic ability for early-stage flat CRC (T1) using CTC .The CADe system with three sphericity settings showed that an inverse correlation was observed between adenoma detection sensitivity and sphericity(83.3%, 70.8% and 54.1% for sphericity 0, 0.75 and 1) and direct correlation precision and sphericity. Therefore, this study demonstrates that new applications of computer systems using CTC can effectively detect even flat CRC..

Capsule endoscopy (CE)

CE is a minimally invasive technique that is generally well tolerated by patients and can be used as an alternative screening method for CRC, especially for incomplete colonoscopy. Colon capsule endoscopy usually relies on the use of laxatives and requires manual interpretation and analysis of the imagesobtained to detect colorectal lesions.Generally, the capsule moves through the gastrointestinal (GI) tract depending on intestinalmotility. However, the extended CE reading, which can take about 45 minutes, can be particularly time-consuming [57,58]. It is worth noting that AI-based techniques can lead to significant adverse results by automating the reading and review of results and reducing the associated risk of human error [59,60]. Blanes-Vidal et al. [59],developed a new algorithm to match polyps detected by CE and colonoscopybased on three variables: their estimated size, location and morphology. This

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study also proposed another algorithm based on deep convolutional neural network for automatic detection and localization of colorectal polyp [59]. The current innovative AI-assisted modelyielded high sensitivity (97.1%), specificity (93.3%) and accuracy (96.4%) in polyp detection compared to manual polyp detection..

Blood tests

In addition, the impact of AI-assisted technologies on blood tests to detect CRC at an early stage is being widely studied. In relation to blood fluorescence spectroscopy, Soares et al. [61]proposed a classification model consisting of a binary SVM (first level) and a one-classSVM (second level) classifier. At the first level, CRC samples were distinguished from normal samples (87% sensitivity, 95% specificity). As for non-CRC samples, the second level had either non-malignant lesions or none at all (60% sensitivity,79% specificity).In general, blood test results and demographic characteristics can be used to estimatea person's risk of developing CRC. A complete blood count (CBC),including findings suggestive of either microcytic iron deficiency anemia ora combination of anemia and increased red blood cell distribution width (RDW), can help physicians assesscancer risk [62-64]. Indeed, previous studies showed that RDW had a sensitivity of84% and a specificity of 88% for right-sided colon cancer [46]. In a two-country retrospective study, Kinar et al. [63] used electronic medical records from two independent (related) groups of individuals (Israeli and UK datasets) and built a predictive model (MeScore®, Calgary, Alberta, Canada) using artificial intelligence to identify high-risk individuals. for CRC.Taking into account some parameters (age, gender and CBC data collected 3-6 monthsbefore cancer diagnosis), comparable results were obtained between thesetwo different populations. Indeed, the results obtained (for the Israeli and UK validation sets: AUC for CRC detection were 0.82 ± 0.01 and 0.81, specificity at 50% sensitivity 88 ± 2% and 94 ± 1%) suggest, that the current risk prediction model should \ n is also generally used in other groups to identify individuals who require further clinical evaluation and screening. This study showed that the combination of this model and FOBT contributed to a 2.1-fold increase in cancer detection in the Israeli :dataset. In addition, Kinar et al. [65] proposed the use of additional characters to improve the accuracyof the CRC risk prediction algorithm.The present study [66] evaluated a machine learning-based algorithm that incorporatespatient baseline characteristics and demographics and CBC test results toidentify patients at increased risk of CRC who may benefit from more intensive screening.The ColonFlag® software uses age, sex, and CBC data, including parameters of inflammatorycells, platelets, and red blood cells, to create a risk score for each individual.This application of artificial intelligence to routine blood tests is considered a passive test and a valuable way to identify patients with ahigh risk of developing CRC, especially if scores exceeddefined thresholds.The process of detecting and isolating circulating tumor cells from peripheral blood samplescan also be used as a new method to detect CRC. In a cohort study of47 subjects, the CellMax (CMx®) platform, an AI system based on the aforementioned procedure, achieved 80% clinical sensitivity and specificity [67]. In addition, studies usingmachine learning techniques show that applications of artificial intelligence canhelp analyze certain serum proteins, including leucine-richalpha-2-glycoprotein 1 (LRG1), epidermal growth factor receptor (EGFR), among -alpha-trypsin inhibitor of heavy chain family member 4 (ITIH4), hemopexin (HPX) and superoxide dismutase 3 (SOD3) to detect CRC with 70% sensitivity over 89% specificity(AUC = 0.86) [68]. Today, blood-based screening methods have been developed to detect the tumor at an early stage..

DIAGNOSIS:

As more and more technologies see AI as an aid, it is not surprising that diagnostic methods for cancer detection have gradually adopted ways to diagnose patients with greater accuracy and precision (Huang et al. 2019). Another added advantage is its ability to process large amounts of data and extract information that experts simply cannot see (Huang et al. 2019). Efforts to improve medical imaging methods began by exploring how deep learning can improve cancer detection using imaging and various tools that enable better scanning and faster image interpretation ,providing better workflow and image quality. or improve image quality by adding3D image extraction techniques (Liu et al. 2018; Poplar 2019; Thompson et al. 2018;He et al. 2018).While imaging techniques seem like natural ways to incorporate AI,the potential use in the diagnosis of pathologies and genetic diseases seems equally promising anddeserves equal attention. This could lead to changes in current medical testing methods or open up new ways of seeing diseases as they

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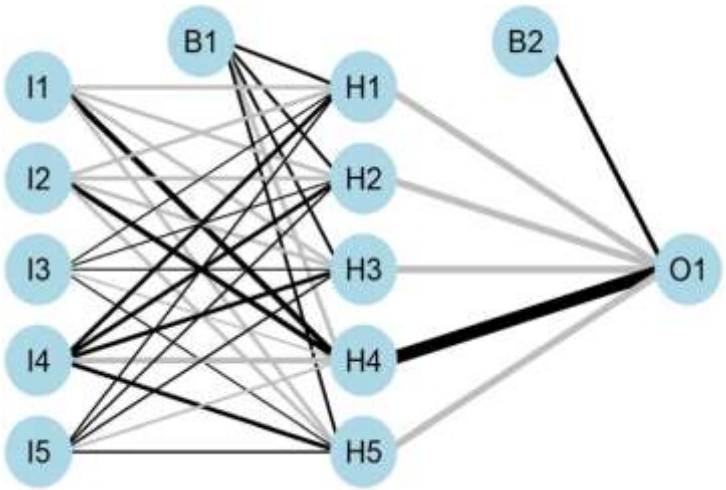
occur. Overall, improvements to current imaging or testing methods can make a difference.

ENDOSCOPY AND MRI/ CT:

ImagesUnderstanding the application of AI to visual image interpretation beginswith an understanding of another dimension of AI, namely convolutional neural networks. These areartificial neural networks (ANN) that only process any parameters of the image data (Wu2017) (Figure 2). By taking large data sets (images), they can learn and findpatterns to recognize new things, and being a branch of artificial intelligence, they allow optimization and are able to learn new things. (O'Shea and Nash 2015). Another remarkable thing aboutimaging and AI is that the information received by computers and interpreted byAI in real time is called computer vision, which includes all the information that comesfrom the camera or videos. Of course, there is a leap forward in how we can apply methods ofCNNs and computer vision to one of the most powerful toolsfor colorectal cancer, the endoscope. As for CNN, the most popular way to detect objects is thereplicated feature approach, which uses copies of a similar feature detector to look at them in different locations (Le 2018). Other important features include that it can cause freeparameter reduction, "is able to reproduce in full scale and direction" and usesfeature types that allow "your map of reproduced detectors" (Le 2018). This hasthe double advantage of "not making neural networks invariant to translation" and because it allowsthat useful functions in one domain are useful in all domains, also known as invariantscience (Le 2018).The first steps toward improving the endoscope come from a technology called segmentation,which comes from the ability of computer vision to separate objects into different ones,rather than just one large object (Yuheng and Hao 2017). Most importantly, the segmentationwould ideally allow distinguishing the anatomy and also distinguishing between normal andcancerous masses (Kayalibay et al. 2017). To figure out what is "normal" and "abnormal" one can use pattern recognition toidentify the spatial input which, when combined with neural network architectures like CNN, allowsspecies discrimination. Zhang et al. recently noticed that hollow bodies canhave problems with unwanted artifacts (patient, signal or equipment related).



Figure

Presentation of an artificial neural network (ANN) with input layer (I), hidden layer (H), switching layer(B) and output layer (O). The connections between each node are dynamically adjusted according to the suggestions of the training. A positive correlation is shown by a black line, while a negative correlation is shown by a gray line. Line thickness is of relative importance. Such an ANN allows new input and produces specific outputs) because the instruments are actively moving and can change things, creatingunwanted artifacts that can prevent proper diagnosis (Zhang and Xie 2019). Theylooked at the various available data to try to add methods to specify how to minimize the number of artifacts collected by a segmentation application. Recently, Ali et al conducted a much larger and similar project to compare 23 different algorithms using common datasets for segmentation in endoscopy (Ali et al. 2020).They found that, for the most part,

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the detection of artifacts was similar betweenalgorithms, but the biggest problem was handling larger artifacts that couldcause serious problems due to potential misinterpretations. findings or false positive findings (Ali et al. 2020).More direct methods have been tried in endoscopy using CNNs to directly diagnose polyps. The first experiments of Misawa et al. created their own customalgorithms to try to correctly detect colorectal polyps (Misawa et al. 2018). The video datasetswere run through their algorithm to correctly identify polyps, while two gold-standard expertsreviewed the same datasets and noted their results.later they were compared with an algorithm of artificial intelligence. . The results concluded that 64.5% (100/155) of fatty tissue lesions, which were the most difficult to diagnose, were correctly diagnosed by computer detection, while 94% of tested polyps were correctly detected (Misawa et al. 2018; Kudo). et al. 2019; Based on these findings, Mori et al. used the same algorithm used by Misawa et al.perform a real-time experiment (Mori et al. 2019). This time he used an endocytoscope that has more than 500x magnification but still works like a regular endoscope.Six patients were selected and all underwent the same procedure. All six patients were identified in real time as adenoma or hyperplastic polyp (Mori et al. 2019). Additional functions of the previous testincluded a color change in the corner of the screento indicate a change from a normal, alert sound, and most importantly, it could determine in real time which are cancer. or non-neoplasticby evaluating the microscopic image (Mori et al. 2019). This is hypothesized by Mori et al. that the benefits of adding deep learningto colonoscopies, beyond the obvious accuracy of diagnosis, come frommminimizing variations in the detection rate, which enables better learning toolsto enable endoscopists and their training, and reduce unnecessary polypectomies .(Mori et al. 2017). AI-related endoscopic research has flourished (Table 2)(Ichimasa et al. 2018; Nakajima et al. 2020; Lai ja ai. 2021; Yamada et al. 2019; Chen et al. 2018; Repici ja ai. 2020; Kudos kaj alaj. 2020; Mori et al. 2018; Nguyen et al. 2020; Ded-ing et al. 2020). Obstacles to the adoption of these technologies are technologicaldevelopment, lack of regulations, clinical trials, feasibility, risk of misdiagnosis and others(Kudo et al. 2019; Mori et al. 2017). Perhaps the biggest problem lies inthe nature of the system itself. Since all AIs depend on datasets to survive and grow, the set ofdatasets available for their specialization is very sparse, which means that learning new thingsis also limited by the network as a whole (Mori et al. 2017).).CT and MRI studies have also benefited greatly from the contributions of CNNs, although very little is known about their use for colorectal cancer. So far,the strongest areas where AI has been able to impact this type of imaging have come from image recognition, segmentation and classification (Yamashita et al. 2018; Shan et al. 2019),which are identical to imaging. previously mentioned efforts, although only for CT/MRI : (Zhangand Xie 2019; Ali et al. 2020; Mori et al. 2019). Another overlooked way technology canindirectly affect patient health was seen in Shani et al. who showed that usingartificial intelligence, low-dose CT images can be essentially reconstructed using learning machines..

TREATMENT:

Robotic surgery

Colon cancer treatment is entering a new era with robotic colon surgery. It is an advanced form of minimally invasive surgery. To date, the da Vincisystem (available models: da Vinci Si, X, Xi, SP) is the most widely used robotic surgical system in the world. This allows surgeons to perform very delicate or even very complexprocedures with seven degrees of freedom wrist instruments. Robot-assistedsurgery offers significant benefits not only to patients but also to surgeons. These advantages include shorter recovery and hospital stay, minimal scarring, smallerincisions, and significant reductions in surgical site infections, surgical pain, and blood loss compared to traditional open surgery [135,136]. Computer controlleddepartments allow surgeons to work with improved field of view, flexibility, dexterity,precision and minimal fatigue. The da Vinci Dual Console also enables integrated teaching and monitoring and offers the ability to transform residents' surgical training. The SenhanceSurgical Robotic System (TransEnterix Surgical Inc., Morrisville, NC, USA) is a laparoscopy-based system that allows experienced laparoscopic surgeons to perform more complexprocedures. Hirano et al. proposed the use of the present system as a safe, effective and precise surgical treatment for patients with colon cancer [137].Based on the present study, robotic surgery appeared to result in a less overt inflammatory response and lowercomplications and conversions compared to open surgery for colon cancer [138,139]. Meanwhile, there is a large literature suggesting that both robotic and laparoscopic approaches are equivalent in terms of

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perioperative outcomes in patients with CRC [140]. However, previous studies have shown betterpostoperative recovery and a better conversion rate \in robot-assisted surgery for rectal cancer [141-143]. Park et al. [144] mentioned that the conversion of laparoscopic vs. robot group was 7.1% vs. 0 (p = 0.003) when performed by an experienced user. At this point, it is important to understand that the safety andsuccess of a given surgical procedure greatly depends on theskill of the surgeons. To date, the learning curve for robotic colorectal surgery appears to be shorter than for conventional laparoscopic surgery [6].The laparoscopic approach to rectal cancer resection is considered technically difficult in many cases, including male patients, obese patients or patients with difficult pelvic anatomy [145,146]. The robotic platform offers distinct advantages because it provides access to hard-to-reach areas, such as the narrow pelvic region, and preserves the integrity of the urinary tractand sexual function postoperatively [147]. In fact, in the ROLARR randomized clinical trial, Jayne et al. reported that laparoscopic rectal surgery was associated with higher conversion rates in men, obese patients, and patients undergoing low anterior resection compared with robotic surgery [146]. Current studies have also shown that robot-assisted surgery seems more suitable to protect the pelvic autonomic nerve ..

Chemotherapy:

Cruz et al. [149] developed a model to identify the half maximal inhibitory concentration of a drug against the human colon cancer cell line HCT116 using molecular and nuclear magnetic resonance. The present method achieved an overall prediction accuracy of more than 63% on trainingand test set. Improving docking-based virtual screening is anotherchallenging problem in drug discovery. Berishvili et al. [150] created a deep neural networkalgorithm to develop anticancer drugs that inhibit PI3K alpha (PI3Ka) and tankyrase,promising targets for CRC therapy. New tumor-targeting techniques focus on the use of nanoparticles as pharmaceutical carriers [151]. Alternatively, medical nanorobotic agents may be effective in cancer therapy by achieving optimal targeting.Martel et al. [152] proposed the use of a computerized magnetotaxic displacement technique to transport drug-loaded magnetotaxic bacteria into hypoxic regions of MC-1 tumors.Ferrari et al aim to identify pathologic complete responders (CR) andnonresponders (NR) after neoadjuvant chemoradiotherapy (CRT) in locally advanced rectal cancer (LARC). [153] used a random forest algorithm to generate twoAI models. Analyzing textural features of T2-weighted magnetic resonance (MR)images, the current models showed AUC values of 0.86 and 0.83 for pathological CRsand NRs, respectively. In another study of LARC patients, Shi et al. [154]built a CNN model to predict neoadjuvant CRT response based on pretreatment and early magnetic resonance imaging (MRI,3-4 weeks after CRT initiation) data. Abraham et al. [155] used a machine learning approach to identify a signature of 67 genes (the "FOLFOXai" signature) that predicts the efficacy of oxaliplatin-based chemotherapy and combination chemotherapy with bevacizumab in patients with metastaticcolon carcinoma. Thus, these AI applications can help doctors providemore effective treatment strategies even in the early stages of CRT. Interestingly, using machine learning techniques, Oyaga-Iriarte et al. [156] conducted a study to predict whether patients with metastatic CRC would suffer severe toxicity from the drugirinotecan (showing 76%, 75%, and 91% accuracy for leukopenia, neutropenia, anddiarrhea, respectively).

II. COCLUSIONS :

In summary, artificial intelligence has shown effective in computer vision and imaging, particularly in the medical industry. It assists doctors in decision-making, reduces physician burden, and reduces misdiagnoses. Artificial intelligence has shown promising outcomes in the early detection, diagnosis, and treatment of Female cancer.

Prognosis prediction improves the sensitivity and accuracy of screening and diagnosis, and is widely applicable.

Female cancer screening can now be implemented in resource-poor areas, reducing the incidence of the disease by significantly improving specificity and accuracy while overcoming challenges such as time constraints, limited specialists, and physician bias.

Currently, there are challenges in using artificial intelligence in clinical settings, including a lack of high-quality clinical data, challenges in managing medical data, technical maintenance issues, model reliability and stability, and limited promotion in clinical applications. At the same time, the use of artificial intelligence in Female cancers screening and diagnosis will also involve ethical and privacy

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issues, such as the protection and security of patient data.

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