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Towards Smart Cancer Care: AI Enhanced Monitoring and intervention

Khushboo H. Trivedi[1,*], Hiren Kumar Thakor[2]

Abstract

According to estimates from the World Health Organization (WHO) for 2022, cancer is one of the leading causes of mortality, accounting for roughly 16% of all deaths globally. The goal of the cancer community is to improve the lives of those who are impacted by cancer and to cut the cancer death rate in half during the next several years. If cancer is identified early and treated, its impact on humanity can be minimized. We examine how AI-enabled integrated medicine might improve comprehensive healthcare monitoring and cancer treatment control systems. The foundation of this comprehensive approach is the integration of various treatment modalities, such as radiotherapy, chemotherapy, immunotherapy, targeted therapy, hormone therapy, surgical procedures, palliative care, integrative medicine, precision medicine, stem cell transplantation, photodynamic therapy, radiofrequency ablation, CAR-T cell therapy, angiogenesis inhibitors, phototherapy, and electron-chemotherapy. Rapid advancements in artificial intelligence (AI) have demonstrated its potential to revolutionize biomedical cancer investigation by providing cutting-edge approaches to cancer detection, treatment, and patient care in general.

Keywords: Patient data, remote monitoring, ai in medicine, cancer diagnosis, oncology, prediction, treatment

INTRODUCTION

A World Health Organization evaluation states that cancer is a prevalent and serious disease that kills far too many people globally. Because of the heightened danger to their health, patients with cancer undergoing several treatments, including chemotherapy and radiation, may find it helpful to use digital health technologies for patient monitoring. Some cancers might be diagnosed earlier so that the stage of them is only the starting stage. If some are diagnosed late, the tumor becomes in big size. So, they need a surgery, and they are 100% curable. This app will help the people to diagnose them and how much radiation or chemotherapy will be needed to save the life of the patient. The integration of advanced monitoring systems has shown promise in enhancing patient outcomes by enabling personalized, data-driven interventions. This action plan aims to explore and innovate within the land of Cancer Patient Monitoring Systems, focusing on leveraging technology to optimize patient care.

*Author for Correspondence
Khushboo H. Trivedi
E-mail: kk25.trivedi@gmail.com

[1]Assistant Professor (Ph.D. Scholar), Department of Computer Engineering, Noble University, Junagadh, Gujarat, India
[2]Associate Professor, Department of Computer Engineering, Noble University, Junagadh, Gujarat, India

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LITERATURE REVIEW

To explore cancer patients' perspectives on real-time monitoring at home or anywhere. Table 1 represents the methods and summary.

RESEARCH METHODOLOGY

- The research methodology of cancer works to pose a serious threat to world health, with finding the decease before time, accurate prediction, and modified treatment being critical for improving patient outcome [1].

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Table1. Review of the methodology.

Method	Summary
The systematic review methodology was utilized. A literature review and content analysis of patient-facing cancer were conducted.	Many cancer apps will report to patients who have recorded previous reports. The viability of merging with electronic medical records should be investigated further since it can enhance patient outcomes and experience while also increasing hospital effectiveness of resources through improved preventative care [2].
IoT based device using sensors to detect pulse rate, temperature and blood pressure using temperature sensor.	IoT and mobile technology facilitate biotechnology that enables remote monitoring of critical biological parameters like BP, temperature, and pulse rate in cancer patients, improving treatment efficiency and cardiovascular event prevention [3].
To evaluate how ASyMS remotely tracking affects adjuvant chemotherapy patients' distressing symptoms, quality of life, supportive care requirements, anxiety, self-efficacy, and job constraints.	A medium Cohen's effect size indicates a positive clinical impact, which is important for future blended care models after COVID-19. A significant reduction in symptom load supports ASyMS for remote symptom monitoring in cancer care [4].
Two components were used in the system's development: 1. Concentrated on developing an online symptom report; and 2. Involved in creating clinical algorithms for clinician warnings and patient guidance based on symptoms.	A system alerts clinicians and offers patient self-management advice to enhance post-surgical complication detection and management post-discharge, with an ongoing pilot study informing a multicenter randomized trial to assess its effectiveness compared to usual care [5].
The real-time tumor-tracking system includes four diagnostic X-ray television systems, an image processor unit, a gating control unit, and an image display unit.	We successfully implemented a tumor-tracking and gating system that significantly enhances the accuracy of irradiating moving targets, balanced with acceptable diagnostic X-ray exposure levels [6].

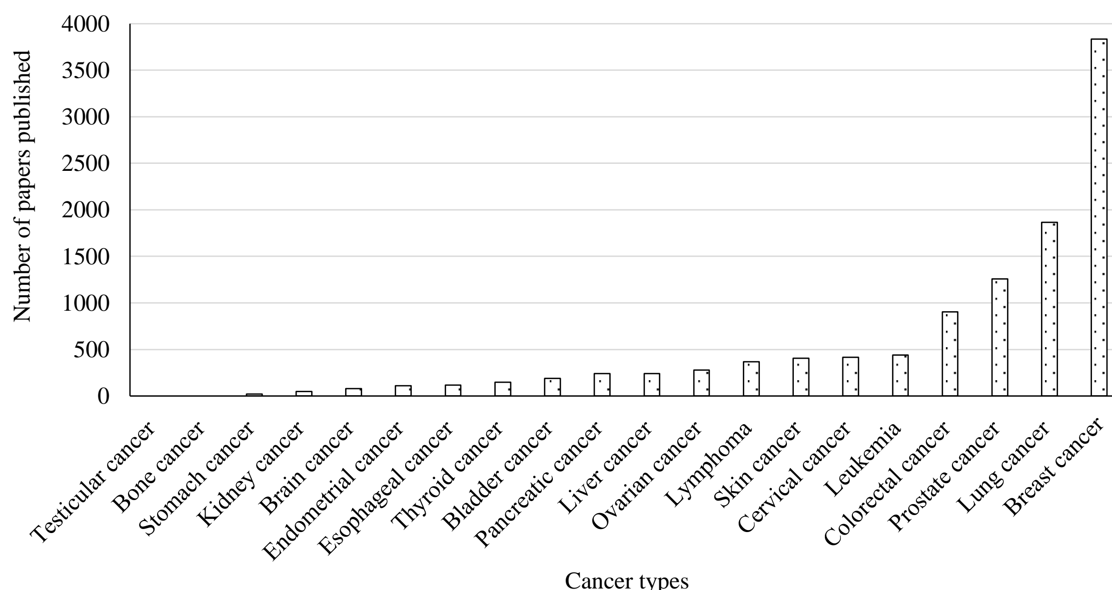

Figure 1. Numbers of papers published for different organ cancers.

- With its extraordinary potential to improve cancer research and clinical practice, artificial intelligence has emerged as a promising strategy to transform cancer care. Numbers of papers published for different organ cancers are shown in Figure 1.
- The relevance of the quickly developing topic of artificial intelligence (AI) in cancer research is demonstrated by the number of papers published on the subject and the number of AI-based models used to treat various tumors [7].
- With a detailed examination of cancer applications, AIML seeks to provide a comprehensive overview of oncology applications and show how these subfields can improve patient care, diagnostic accuracy, and efficiency [8].

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- Because machine learning, a branch of artificial intelligence, can accurately anticipate outcomes and interpret complicated data patterns, it has been widely used in cancer research. Numerous studies have examined the use of machine learning in cancer research, offering insightful information on both its advantages and disadvantages.

Techniques for Survival

A publicly accessible program's symptoms are used to estimate survival. Age and the year of diagnosis are the primary factors, and there is an interaction between age and the year of diagnosis. The application uses flexible parametric survival models to calculate net survival. A number of models are fitted with up to five degrees of freedom for time-dependent effects and the baseline hazard function. The best-fitting versions built around AIC and BIC are compared using a likelihood ratio test, and scaling tests are employed to look for oversensitivity. The Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) are used to assess the relative goodness of fit in order to select the best-fitting statistical model. This planet has a large number of survivors [9].

Survival of Adults

- Adult cancer survival is calculated for those between the ages of 15 and 99 years. In accordance with the International Cancer Survival Standard (ICSS), the age is restricted to 99 years. Many adults who are diagnosed with cancer will pass away from causes unrelated to their illness. Predictions of adult survival are net predictions of survival that only show how cancer death affects patient survival.
- The performance of the healthcare system for cancer patients is measured objectively by net survival, which is determined by comparing the survival of cancer patients with the expected survival of the general population with the same age, sex, and socioeconomic status profile [10].

Survival in Childhood

- Overall survival is appropriate to include in the publication on cancer outcomes for children in England since children's mortality is extremely low (except for mortality in the first few months after birth) and almost all deaths in children with cancer would be caused by their malignancy.
- The hybrid, period, and cohort techniques were used to conduct the analyses. Each publication's expected survival is 1, 5, and 10 years.

Taking Age, Sex, and Cancer Type into Account

- Age-standardized survival estimates are used to increase comparability over time and between demographic groups. To enable comparisons across the various populations, the data must also be standardized by sex and cancer type in order to create the all-cancers composite index [11].
- Estimates are normalized for age using weights derived from the International Classification of Survival Standard (ICSS). Additional weighting is used to standardize for cancer type and sex. The weights used for standardization are displayed in Table 1.
- Every parameter for the all-cancers survival index was modified using the same set of standard weights. Because the survival index accounts for variations in the characteristics of cancer patients by age, sex, or disease type, it can be used to compare cancer patients over time.
- This modification is required because, in the absence of uniformity, variations in the characteristics of cancer patients may lead to variations in survival. For instance, even if survival at each age, for each malignancy, and in each sex remained constant, the overall cancer survival in each CCG may vary only due to modifications in the characteristics of its cancer patients [12].
- The survival index can be compared over time since it accounts for changes in the demographics of cancer patients by age, sex, or cancer type. The identical collection of standard weights was used for manipulating the all-cancers survival index data. This modification is required because, in the absence of uniformity, variations in the characteristics of cancer patients may lead to variations in survival.

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Table 1. Weights used for standardization.

Cancer type	Age-group	Age weight	Male weight	Female weight	Cancer type weight	Final ICSS-based weight
Breast	15 to 44	0.070	-	1.000	0.167	0.012
	45 to 54	0.120	-	1.000	0.167	0.020
	55 to 64	0.230	-	1.000	0.167	0.038
	65 to 74	0.290	-	1.000	0.167	0.048
	75 to 99	0.290	-	1.000	0.167	0.048
Colorectal	15 to 44	0.070	0.500	0.500	0.167	0.006
	45 to 54	0.120	0.500	0.500	0.167	0.010
	55 to 64	0.230	0.500	0.500	0.167	0.019
	65 to 74	0.290	0.500	0.500	0.167	0.024
	75 to 99	0.290	0.500	0.500	0.167	0.024
Lung	15 to 44	0.070	0.500	0.500	0.167	0.006
	45 to 54	0.120	0.500	0.500	0.167	0.010
	55 to 64	0.230	0.500	0.500	0.167	0.019
	65 to 74	0.290	0.500	0.500	0.167	0.024
	75 to 99	0.290	0.500	0.500	0.167	0.024
Other	15 to 44	0.070	0.500	0.500	0.500	0.018
	45 to 54	0.120	0.500	0.500	0.500	0.030
	55 to 64	0.230	0.500	0.500	0.500	0.058
	65 to 74	0.290	0.500	0.500	0.500	0.073
	75 to 99	0.290	0.500	0.500	0.500	0.073

- For instance, even if survival at each age, for each malignancy, and in each sex remained constant, the overall cancer survival in each CCG may vary only due to modifications in the characteristics of its cancer patients.
- At least three patients in the subgroup, or a cumulative survival of at least one person-year for those in the subgroup, are required for 1-year survival analysis.
- At least five patients in the subgroup or cumulative survival for those in the subgroup of at least five person-years are required for 5-year survival.
- At least five patients in the subgroup or cumulative survival for those in the subgroup of at least ten person-years are required for 10-year survival.
- A weighted average of all the survival estimates of the five age categories (15 to 44, 45 to 54, 55 to 64, 65 to 74, and 75 to 99 years) is used to age-standardize survival estimates for breast cancer in women and age-sex-standardize survival estimates for colorectal and lung cancers.
- Even for these highly prevalent cancers, it can occasionally be hard to provide reliable estimates of survival for one or more age groups due to the very small number of patients in a CCG.
- The most common age group for this was those aged 15 to 44 years. In this case, the corresponding value for parent geography is used to replace the missing values. For instance, the appropriate estimate from the STP of which a CCG is a part, is used to replace any missing values.
- Both the all-cancer composite index and the specific cancer sites use this value substitution.

RESULT

There are several forms of cancer in humans, including but not restricted to lungs, brain, ovarian, breast, laryngeal, pancreatic, cervical, and ovarian cancers. The goal of AIML is to provide a thorough overview of its applications in cancer and demonstrate how these subfields may improve patient care, analytical accuracy, and efficiency. Because AIML can accurately predict outcomes and evaluate multipart data patterns, it is widely used in cancer research. The doctor and patient panels contribute to this system. The application must first be downloaded and installed on the users' mobile devices. Until

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the user removes it, this program will stay on the device indefinitely after it has been installed. This will be the patient's first time registering for the application. Upon authorization, the patient will receive a username and password. Every time the patient uses the app, he can log in with this login and password. Once the patient has logged in, they must choose a filter type. Filtering is done by area, specialty, reports, and devices. The list of doctors will appear once the filtration category has been chosen.

The app will list the number of radiation treatments, chemotherapy treatments, and their respective amounts, as well as the type of expenses incurred if surgery is performed. The patient will submit all the records and biopsy results. The app will show the list of the top doctors, followed by all patient fees in the area. The patient can also check the doctor's calendar and find an appointment at a time that works for him. The patient can learn about cancer treatments using this software, and they will comprehend all the details, including chemotherapy, radiation, duration, etc. This web-based solution solves the problems of patient overview, appointment scheduling, and management.

DISCUSSION

Morphology and behavior codes are included in the next edition of the International Classification of Diseases for Oncology. Performance codes indicate whether or not the tumors are engulfing, whereas morphology codes indicate the types of cells present in the cancer. All confined tumors are considered “cancer” for the purposes of adult cancer survival.

Child Cancer

- According to the third edition of the International Classification of Childhood Cancer, any child aged 0 to 14 years who has been diagnosed with a primary malignant tumor of any organ or a non-malignant tumor of the brain and central nervous system (CNS) is permitted to be included in the survival evaluations. Skin cancers, secondary malignant neoplasms, and unidentified malignant neoplasms were not included.

Primary Type of Cancer

- A primary stage of cancer is when the tumor initially appears in a single body part, such the stomach, and typically indicates the type of cancer that the patient has been diagnosed with.

Metastatic or Secondary Type Cancer

- A secondary or metastatic cancer is one that has grown or inherited from primary cancer; it might extend beyond the primary cancer's different organs (known as distant metastasis) or be found in the same location or organ as the primary cancer (known as local metastasis).
- The basic cell biology and morphology of metastatic cancer should be identical to those of the original malignancy.
- Metastatic cancer is typically not defined as the spread of original tumor cells within the lymph node system. Metastatic malignancies are categorized as stage 4.

Cancer Stages

- Although a patient's disease stage may change over time, many malignancies have a staging system that attempts to indicate how far along the disease has progressed. The stage is often noted at diagnosis. This is not always the case, as the majority of brain tumors lack a staging system.
- The main tumor's growth at the time of the patient's initial hospitalization is indicated by the cancer stage at diagnosis. It is measured and documented in accordance with internationally accepted standards, frequently those set forth by the Union for International Cancer Control. The TNM staging method, which is the most widely used staging standard, is composed of three parts: (1) Tumor size (the T component); (2) Nodal attachment of the lymphatic system (N); and (3) Metastatic spread (M).
    - *Stage 1:* Usually tiny, the initial tumor is located inside the body organ where it first began to grow.

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- *Stage 2:* According to the primary tumor site, the lymphatic system may be involved if the underlying tumor has not migrated to other areas of the body.
- *Stage 3:* The main tumor is bigger and can have invaded the lymphatic system and nearby areas of the body.
- *Stage 4:* A secondary or metastatic tumor is the result of the initial tumor spreading to at least one other area of the body.

- A tumor cannot be staged for a variety of reasons, such as the fact that some samples obtained do not yield reliable results or that some patients are too ill to have the operation required to get enough tissue sampling for staging.
- The Cancer Survival for England publication treats the missing stage as a distinct category and generates survival estimates for patients with "unknown" stage in addition to the other known stage categories.
- If there is no staging system for the combination of a cancer's morphology and site (topography), it is deemed unshakable. For instance, primary malignant ileal melanoma is not regarded as stage able.
- The International Staging approach, a distinct staging approach for multiple myeloma, features three stages of disease development. The staging data are not comprehensive enough to be carefully and reliably reliable enough for publication by stage, as is the case with certain other cancer sites that are included in the adult cancer survival in England publication.
- Included were patient-facing applications that catered to adults (18 years of age or older), had a cancer emphasis, and allowed users to enter patient data. Apps intended for children, healthcare professionals, organizations, and schools were not included, nor were those that were not in English. Apps that concentrated on a single cancer symptom (like fatigue) or cancer kind (like breast cancer) were also eliminated.
- This is because we wanted to learn more about symptom reporting generally, and an early scoping search revealed that these applications were more focused on specific disease-related problems than on complications in general.
- Additionally, apps that required login information from a healthcare practitioner were removed because they could not be accessed and, consequently, reviewed.

CONCLUSION

- The world's patient-facing cancer apps were the subject of a systematic app review and content synthesis.
- Collecting systematic apps with the cancer patient monitoring and making good app for the patient.
- The design is set up to enable users to access the booking system using a cell phone as a web browser, a desktop computer, or a portable computer. We employed a client-server architecture and a thin client-server.
- The medical scheduling system's client-side and server-side elements are web-based. In the client method, the client's job was to show data and information on the screen, while the server handled nearly all the processing work on demand. The web browser is the client in thin client-server architecture.
- Except for a basic web browser, which is often included with most PC operating systems and practically all modern standard mobile phones, users will not need to install any software on their PCs thanks to this architecture. Additionally, clients would not need a powerful computer; they could use any desktop computer, laptop, or notebook that has a web browser. Because the servers would be frequently subjected to severe loads, they would need more hardware configuration.

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