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DESIGN OF BPM MODELING ON SKIN CANCER

DYNAMICS ACTUATE MODELING BUSINESS PROCESS MANAGEMENT ON SKIN CANCER SCREENING AND OPTIMIZATION

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by

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Dissertation for obtaining the master's degree in Information Management/ Master's degree in Information Management, with a specialization in Information System and Technology Management

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Abstract

With the wide application of big data platform today, many industries are eager to find a breakthrough in solving business process and information transformation. The application experience in the traditional industrial field has drawn a conclusion that there is no perfect process, and only by trying to innovate and transform the sluggish and complicated working mode can cloud data give full play to its characteristics of fast, accurate and forecast. Due to the special working mechanism of Business Plan Model (BPM) technology application in Skin Cancer Screen and Optimization, the customer group is not an isolated consumer group ---but a strong dependent candidate. Both patient uncertainty and data collection are confined, which restricts quantitative analysis by reference to many simulated data. However, it is also where we seek to improve effectiveness such as addressing cancer screening issue. Through the analysis of universal healthcare systems and cancer diagnosis processes, we hope to create new BPM solutions that combine dynamic data with dynamic business platforms. This also provides a theoretical reference for the multi-function and expansion space of the medical system in industry 4.0.

Keywords

BPM; Governance; Skin Cancer; Screen and Optimization; Skin Inspection; Framework

INDEX

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

CT	Computerized Tomography
MRI	Magnetic Resonance Imaging
LNM	Lymph Node Metastasis
CG	Computer Graphics
TUS	Tele-Ultrasound Scan
PaaS	Platform as a Service
BPM	Business Process Management
IBPM	Intelligence Business Process Management
CPS 5C	CPS 5Componetns Architecture
EMR	Electronics Medical Records
IoT	Internet of things
IaaS	Infrastructure-as-a-Service
BPR	Business Plan Reengineering
BPA	Business Plan Analysis
BPMMM	Business Process Management Maturity Models
BCC	Basal Cell Carcinoma
SCC	Squamous Cell Carcinoma
MC	Melanoma Carcinoma
MCC	Merkel Cell Carcinoma
CBCC	Cutaneous squamous Basal Cell Carcinomas
CSCC	Cutaneous Squamous Cell Carcinoma
KS	Kaposi Sarcoma
KA	Keratoacanthoma
AK	Actinic Keratosis

SGC	Sebaceous Gland Carcinoma
PaaS	Platform as a Service
CS	Customer Satisfaction
PHS	Primary Healthcare Service
PHSF	Primary Healthcare System Framework
LR	Logistic Regression
MDD	Model-Driven Design
SDM	Shared Decision Making
SDMN	DM-Model
MDA	Multi-Dimensional Analysis
MDD	Multi-Dimensional Decision
GA	Genetic Algorithms
SA	Self-adaptation
SS	Scatter search
ASY	Ant Systems
ACO	Ant Colony Optimization
PSO	Particle Swarm Optimization
MeAg	Memetic Algorithms
PSO	Particle Swarm Optimizer
RLP	Resource Leveling problem
DC	Dynamic Consent
BPMN	Business Process Model and Notation
DFSS	Design for Six Sigma

1 INTRODUCTION

1.1 BACKGROUND AND PROBLEM IDENTIFICATION

Skin Cancer is a malignant tumor caused by invasive and spread to other tissues or organs of the body (Gupta et al., 2016). There were 150,627 cases of melanoma in Europe in 2020 (Globle Coalition, 2021), and Portugal had 3,488 cases in 5 years, with a prevalence rate of 34.21% per 100,000 people of all ages.

Malignant lesions of skin cancer are usually occurring in conditions of prolonged exposure to ultraviolet and radiation from the solar, or long-term irritation of the skin by chemicals, as well as chronic irritant inflammation, including chronic ulcers, radiation dermatitis, and lupus erythematosus(PDQ Adult Treatment Editorial Board, 2020). Depending on the symptoms, skin cancer cells, with long-term cellular transformation and multiplication, present as Basal Cell Carcinoma (BCC), Squamous Cell Carcinoma (SCC), Melanoma Carcinoma (MC), and rare types of skin cancer including Merkel Cell Carcinoma (MCC) and fibrosarcoma of the skin.

Cutaneous squamous Basal Cell Carcinomas (CBCC) is usually asymptomatic in its early stages and vary in form. It can be spidery or ulcerated and often occurs in areas with hair, such as the scalp, around the eyes, nose, and nasolabial fold. Diagnosis of basal cell carcinoma is mainly confirmed by biopsy after skin examination. (PDQ Adult Treatment Editorial Board, 2020)

Cutaneous Squamous Cell Carcinoma (CSCC) is a type of skin cancer that occurs in superficial epithelial tissue, has atypical features, and may invade or metastasize from the tumor in situ. Its prophase lesion is defined as actinic keratosis. Risk factors for skin cancer refer to UV -Exposure, suppression of immune mechanisms, and human papillomavirus. A biopsy is the preferred diagnostic method, and Computerized Tomography (CT) scan, Magnetic Resonance Imaging (MRI) scan, Positron emission Tomography (PET) scan, and other techniques are considered as needed in different cases. (Dinnes et al., 2018)reference

Melanoma, which develops from a melanin nevus to a malignant tumor, is common in areas of the body that are exposed to radiation, such as the face, ears, limbs, and neck. Since malignant melanoma is threatened with its higher malignancy degree and rapid metastasis, early screening detection is recommended for people at high risk.

In addition, rare skin cancers can also be observed randomly. For example, Merkel Cell Carcinoma (MCC) is a kind of neuroendocrine Carcinoma, which is mainly diagnosed in the elderly over 70 years old in the occurrence of mainly in the face, head, or neck. Accounting the immune system of the elderly is weak, warning of spreading the virus reminds its jeopardizing status(Becker et al., 2017). Kaposi Sarcoma (KS), which develops from immune system damage caused by Kaposi's sarcoma herpes virus, can also spread in the mouth, lungs, and digestive tract. type of non-Hodgkin's lymphoma presents as a rash or mass on the skin(Radu & Pantanowitz, 2013). Keratoacanthoma (KA), is usually assumed a benign precursor to squamous cell carcinoma unless it stops growing(Schwartz, 1994)(Parekh & Seykora, 2017). Actinic Keratosis (AK) is particularly to those over the age of females with a history of organ transplantation or underlying increased developing Squamous Cell Carcinoma (SCC) once under the loss of unprotected destructive radiation persistently in condition (Trakatelli et al., 2016).

Sebaceous Gland Carcinoma (SGC) in different parts grows slowly, but it is still possible to metastasize(Kibbi et al., 2020).

Malignant melanoma assertion is one of dependable medical diagnosis clues on Skin Cancer, which is extensively applied through obtained from skin lesions by pathology (Friedman, Rigel, and Kopf 1985). During this detection technique approach, the melanoma cells could be amplified under a microscope until no evidence of cancer cells is confirmed. Although it is not only one of the malignant categories as researched to prevent malignant cells spreading out on other organs and tissue endangering human being's health, from earlier diagnosis relying on imagological examination as a regular method of adjuvant therapy provide relative tracking of identification to detections has been navigated into leading automatically artificial cancer inspection techniques since last century.

In Industry 4.0 era, in joint of Computer Graphics (CG), Artificial Intelligence (AI) and Tele-Ultrasound Scan (TUS) technology will be trusted centralizing for communicating a channel of between assisting in analyzing metastasis verisimilarly and recognizing on cancer tissues invasion environments (Hossain and Muhammad 2016). In view of this point, each terminal located in patients, dermatologists, tertiary medical institutes will also become the incentives to sense risks existing within the complete cancer screening process. How to transit the novel optical imaging identification data collected by spectrometers in 20Gbit per second traveling velocity quickly and without distortion through the network to Platform as a Service (PaaS) and enable it to formulate cancer open-source solution archives deployable to dominate and reproduce, that will be one of the keys to influencing of synchronizing multi- dimensional digital detection schemes on making cancer screening decision (Freet et al. 2015). Whereas to farewell to those mountainous holographic operations on data-input and documents with intolerable error-rate, adopting Cloud BPM model design enable instantaneous access to visit each disengaged metadata in wireless condition without any time and space restrictions that will come true in 5G times (Esteva et al. 2017).

Business Process Management (BPM) is a systematic approach to identify, map, document, design, implement, measure, and control business processes. BPM embraces the increasing IT support to improve, innovate, and manage processes thoroughly, determining business results and creating customer value, achieving thus the business goals with greater flexibility. (ABPMP 2013)(Leshob et al., 2018)

The dynamic dataset will generate in a conversation of producing, possibly in structure or non-structure text (configuration, cognition, cyber, and connection of crystallization), which is enabled to converse into machine-understandable Electronics Medical Records (EMR) in criteria of CPS 5Componetns Architecture (CPS 5C) (Lee et al., 2015). Regarding gaps understanding, to discover more countermeasures in the path of business process resolutions, this context is attempting to build up the business management process model as guidance for architecting an integral part of the map of enabling allocative resources to share and interaction among terminals of Skin Cancer on Screen and Optimization engagement. On BPM model design in medical science, the terminals at the command line of workflows are no longer statically served only targeting officials, operators, and doctors in hospitals, also probably are as computers, workstations, servers, or other medical resources to be activated under automatically changing control. The clinician performs remote ultrasound examination, image analysis, and diagnosis of the patient with a portable device. Furthermore, all the

BPM Model designs also will comply with the Customer Satisfaction (CS) quality evaluation of Six Sigma (de Koning et al. 2006)(Cudney & Furterer, 2016).

- **Health Claiming Event**---In this phase, the main problem rendering on events response is that most cancer screening solutions revolve around various cases. Although Multipath options provide an empirical simulation of the diversity of disease prevention, complex treatment regimens will not immediately yield therapeutic results as expected. Secondly, reasoned by loose interaction or shortage of professional consultations. referrals or involuntary pauses without concurrent advice from doctors or examinations detection results embarrass patients vacillating to determine their choice to the next stage, which will be in queue-ups almost even to the circumstance of accumulation of cases. For instance, how to motivate consultants and home nurses in streamline is required to arousing at dormant or low-response process execution as much as possible. Besides, creating work packages in conjunction with other collaborators on patterns and emergency is not ignorable. So that accelerates diagnosis examination velocity and ascertains accuracy of tumor recognition, we anticipate acknowledging vulnerable spots and bottlenecks which hurdling responsibility and interactions that deactivating in connectivity to work usage, workflow, and big data. So far as concerned, the business process management model as one part of the project management asset will be measured during implementation while attempt to allocate distribution in productivity to transform capacity into dynamic nodes to serve in balance of independencies triangulated frame of time, cost, and resource three elements.

- **Skin Cancer Diagnosis Process Optimization**---Due to existing demarcated at divisions scope specifying building online and offline services for cancer cases, we expect to delineate departmental responsibility according to decisions by the recognition of two groups of cancer disease inquirers and patients, like undiagnosed counselors and diagnosed patients. The online branch mainly focuses on the interaction between patients and doctors on skin cancer topics, question answering, and temporary advice, that is, the main service target is from posters who are deceptively concerned about skin cancer symptoms. The other category will be set at whom has been diagnosed for a long time of examinations under detecting by medical service among different stages, to acquire the symptoms evidence subjective to cancer screening investigation and evaluation, which will be gathered up in simulation conclusions of the qualitative analysis and quantitative analysis.

- **HealthCare Digital Transformation**---Encountering documental and iconographical specifications loading on disease scanning and optimizing, such as pathological report filling with convoluted terminology and indicators, how to transfer decentralized information that was generated in clinical protocols and diagnosis monitoring process into human-readable introductions, to advance grounding dynastically dimensional platform to exhibit accessibility to each end-user through intelligent instruments and equipment interactions. This BPM modal will become the intermediate medium to assign on data building component into legible integration.

- **Triage Generation and Process Standardization**---According to the analysis of different cases, we also anticipate how to reduce the waiting time of characters and increase the feedback speed of events in unit time. With the increasing number of skin cancer patients, distributive casual scenes require patient-led medical care behaviors piercing through impedance basis on the performance on medical structure limited capacity. How to precaution on the problem

of poor communication decrease reasoning by misdiagnosis will more reflect business models execution in flexibility.

2 LITERATURE REVIEW

The session of context will concentrate on the instruction of insights on Skin Cancer Screening and Optimization Strategy and Governance influencing Policy and Decision-making to Healthcare.

2.1 HEALTHCARE RESEARCH

Enhancing Healthcare Quality is undertaking to prevent the perniciousness of diseases while reducing the potential pathogenic risks adverse impact originated from society and natural environment including human-gene mutation or deletion, and also to provide the corresponding of health services maintenance towards such as medical treatment, psychological and mental counseling, occupational therapy, and targeting massive social illness and rare ness diagnosis research and investigation, etc.Through the collaboration that combines expert decision-making and patient self-management, public and private health services are activated aimfully for establishing the sustainable healthcare solutions and components to provide all public and private medical information sharing (Rich et al., 2018).

In planning decisions around health risks and disease prevention, the public health sector hopes to improve the quality of services by expanding the coverage and accuracy of screening for chronic diseases, including cancer. Decisions for debating, inferring, and explaining the action plan of screening, are considered the consistency of ethics and the goals of cancer screening, and also reminded for the existing risk of cost incurring between medical institutions and individual patients in for-profit commercial providers. Implemented in the framework of covering the public, privacy or specific groups, complementary health insurance activity, the complex process of screening requires guidance and planning, and strategy proposed by professional public health authorities.

The systematic implementation of screening programmes requires mutual consent set of criteria against which screening indicators as measurable terms and rules. High quality screening participation and good coverage as screening results will be included in the statistics of national health data as a reference object for future research in related fields. In consequence, intelligent decision making provides digital suggestions in framework of a multi-level, multi-role and multi-perspective executable plan for piecemealing the original conventional mechanical nature of administrative agencies bureaucratic restrictions on medical diagnosis strategy concern(Fabiano, 2019).

In Portugal, since Primary healthcare reformation against network functions units like family health units and community units after 2017, the changing has benefited approximately 235 family units from the performance related pay. However, chronic illness network maintenance offering inpatients home and care response and non-adult are both still to be urgent for the long term of attention in continuity (*Health System Review PORTUGAL Phase 1 Final Report,2018*).

Table2-1--Healthcare Levels Introduction in Portugal

Healthcare Levels	Roles	Activity Features	Admission
National Healthcare Service (NHS)	Encompass range scope of healthcare including health surveillance, prevention, diagnosis, and patient treatment.	Characterized as being national, universal, general, and free service to all citizens and foreign residents with public permissions.	Central Administration of the Health System (ACSS) and by the five regional health administrations (North, Center, Lisbon, and Tagus Valley, Alentejo and Algarve)
Primary Healthcare	General doctors and nurses at a physician (Doctors, Pediatricians, Geriatricians, Nurses, Nurse Practioners, Physician assistants)	Emergency Care; Urgent Care; Chronic Disease Care without self-inability; Mental Health care; Hospice Care Community Hub Management	Health centers groups including Home and Community care (agrupamentos de centros de saúde, ACES)
Second Healthcare	Medical professionals (Allergists, Infectious Disease Doctors, Ophthalmologists, Endocrinologists, Dermatologist)	Recommended by Primary care for suggestive treatment plans in prescribing medication through triage of nurse; Short-term Treatment	Hospital establishments (Hospital Center)
Tertiary Healthcare	Involved complex and advanced equipment, treatment, or procedures	Oncological Treatment; surgical interventions	Local health units- *unidades locais de saúde*, ULS
Regional Healthcare Center	Independent Healthcare Service (Managed by respective regional administrations)	Regional Healthcare Risk Assessment, Prevention	autonomous regions health services (serviços regionais de saúde, SRS) in Azores and Madeira
Private Healthcare	Independent Healthcare Service for specific groups or organizations	Special schemes parallel to SNS for the providing of healthcare. Some subsystems are financed by State or appointed medical service providers	Like National Republican Guard, and Public Security Police and military, Ministry of Justice
e-Health	Network Terminals	Applied into Healthcare Practices and Information Communications	Electronic Health Record. Computerized physician operation. Telemedicine.

			Tele-surgery. Tele-examination Consumer Health Informatics
National Network of Continuing and Integrated Care-Rede Nacional de Cuidados Continuados Integrados (RNCCI)	National Healthcare Network	For long term maintenance of chronic illness nursing and care	Convalescent units. Medium duration and rehabilitation units. Long-term and maintenance units. Integrated continuing Care Team-Home. Mental health unit Long term and maintenance units-Unidade de Média Duração e Reabilitação (UMDR) Integrated continuing care team-Equipas de Cuidados Continuados Integrados (ECCI)

2.2 SCREENING AND OPTIMIZATION

From the basic living environment, human genes, race, to work environment, the sensitivity and difference of the application of ABCDE screening principles (Lucas et al., 2016) as the standard of technical means and a series of screening factors to obtain the screening discrimination criteria and decision-making methods affecting human infection with various skin cancer diseases. To improve the screening effectiveness through dermoscopy and cloud-based services in comparing individual history data with other relevant periodic data of suspected cases the core significance of this paper as a reference is to provide a business plan model (Hossain & Muhammad, 2016) (Muthukumaran et al., 2021).

Mnemonic “ABCDE” description is as follows (Lucas et al., 2016)

Table2-2--ABCDE Guidance Table

Index	Sign	Description
A	Asymmetry	The two parts from one side to the other side are not matchable same in shape and size
B	Border	Has irregular (uneven, crusty, or notched) edge to define the melanoma lesions borders with skin
C	Color	In a variety of colors, White, Blue, Brown
D	Diameter	Larger than 6 mm (1/4 inch) in diameter of melanoma
E	Evolving	Change in growth size over time or bleeding, or scabbing
(E)	Elevated	Protuberance above skin surface
(F)	Firm	Hard texture to touch
(G)	Growing	Vary irregularly

As a dynamic decision model, it aims to break through the barriers of loose organization and resource communication and provide the latest and reliable clinical and non-clinical evidence to support innovative clinical decision-making. Skin cancer screening for the dynamic model of the building will not only depend on the potential patient's information screening, cases of transverse analogy, the illness progress report, and forecast data simulation, seamlessly between patients with dermatologist and data analysis service including simplified unnecessary file handling process, low time-consuming and hospital medical personnel screening costs.

2.3 FEASIBILITY OF SCREENING

From the evaluation result of the standard parameters for melanoma screening especially on tumor thickness comparison, there is evidence of a clear relationship between mortality and early detection of diagnosed skin cancer (Shellenberger et al., 2016)(PDQ Adult Treatment Editorial Board, 2020)

The digital dermoscopy has proved greatly improve the detection operation effectiveness, but not yet reached out of totally depending on its current accuracy and specificity of remote screening heretofore (Thomas & Puig, 2017). In addition, optical technology basis on artificial intelligence application (Image Deep Learning) (Kermany et al., 2018) can be developed to explain how much capacity there is still to support the analysis of skin cancer lesions, multispectral mapping, and diagnostic confidence required for joint solutions in related fields. Common skin cancer screening techniques and measures are always mentioned as following (Situm et al., 2014)(Esteva et al., 2017)(PDQ Adult Treatment Editorial Board, 2020):

- Skin observation – magnifying lens; ABCDE guidelines.
- Skin biopsy -- local anesthesia; Pathological excision analysis.
- Microbiological Test -- skin or nail testing; A fungus or bacterium.
- Photosensitivity Test -- light source exposure test (ultraviolet, visible, infrared); Report of skin sensitivity reaction.
- Contact Test -- Test for contact dermatitis caused by allergens.
- Dermoscopy -- manual or digital dermoscopy; Timeline of state cell changes.
- Confocal laser reflection microscopy testing -- depth focus optical stratification three latitude capture, depth scanning acquisition, plane mapping, and stereo mapping, focus information collection biological sample detection.

2.4 CURRENT CHALLENGES

- Lack of adequate imaging screening results in low accuracy and efficiency in identifying cancer (Dlamini et al., 2020).
- Lack of core processing capability in data processing for skin cancer's multiple complex factors and conditions (Iyer et al., 2020).

- The relative imbalance of medical resources is mainly reflected in the lack of skin cancer doctors and excessive concentration of resource allocation waiting in Primary Healthcare Center (PHC) (Helfand et al., 2001). Meanwhile, available resources in secondary clinics are not fully activated and utilized, leading to a long waiting time for patients.

- The differentiation of skin cancer types and the single dependence of non-adult skin cancer screening methods require further refinement of screening procedures as a majority of pediatric skin cancer (Maguire-Eisen, 2013) (Pérez & Bashline, 2019).

- At present, although skin cancer screening process for regional cultural differences, and by the laws and regulations, ethics and social factors such as restriction of science and technology, has not yet fully consensus on the process of the official certified framework basis for lacking relevant security definition (Eleanor Bird et al., 2020).

2.5 GOVERNANCE AND DECISION DEFINITION

Decisions on Skin Cancer Screening and Optimization are emitted request of the Ministry of Healthcare, which grants authority to health centers and service unit authorities. In addition, the Ethics Committee and Data Security Oversight Board have protection and interpretation power over all procedures and Data processing related to the process (Fabiano, 2019).

2.5.1 PUBLIC GOVERNANCE ON PRIMARY PUBLIC HEALTH CARE

Primary Health Care (Cueto, 2004) is essential health care made universally accessible to individuals and families in the community by means acceptable to them.

The detection and collection of such data will be sent to national public health centers and regional governance centers promptly when public safety and health and environmental issues are involved. This series of programs aim to improve the quality of social public services, prevent and diagnose cancer in the early stage, and accelerate the construction of a sustainable technology platform (Rosemann & Vom Brocke, 2015)(Low et al., 2019) for cross-sector and cross-functional big data transformation. Another major feature of the project is the introduction of individual experience collation and feedback combined with data safety and feasibility, as the transition of the next stage objective of evaluating the construction of dynamic cancer database feedback mechanism, to finally achieve the effect of improving the quality of life of cancer.

2.5.2 CLINIC GOVERNANCE

By 2000, there is not yet specified on “how the health service organization framework for Australian Clinic System, but it guided defining the system implementation needs, scope, service environment, and roles and responsibilities of relevant personnel” (reported by “National Model Clinical Governance Framework, 2000). Till 2010, they have developed out standard descriptive clinical governance models commonly activating jointed among the United Kingdom, Australia, and New Zealand as guidance, where infinitely clarified “National Level, Regional Level, Service Level, Multilevel Approaches” with fewer discussion on “Quality” session involved into that framework(Phillips et al., 2010)(Buja et al., 2018).

The emergency services mechanism(Catalano et al., 2003) is also subject to the basic principles and assessment criteria of the framework. The openness of resources, centered on supporting environmental improvement and applied governance and security of services, has gradually expanded into a framework for building collaborative public sector and non-profit organizations to work on primary health care clinical governance.

Currently, we are unable to confirm the personal individual root cause of skin cancer, but the clues indicate malignant skin cancer (including melanoma, and non-melanoma) contracts risks are affiliated to human factors, ethnicity, excessive ultraviolet sunlight or instruments sunburn, skin protected area exposed to the chemical carcinogen of the environment medium factors may increase the risk. However, how to use physical media (mobile and portable devices) to obtain personal real-time data statistics and feedback to the dermatology department for diagnosis is restricted by personal survival and living environment and status, as well as limited, acknowledge the prevalence of finding the root causes of skin cancer in patients at the primary stage. For example, statistics on how long some potential patients have worked with chemicals, the proportion of vitamin-D in their bodies, the length of time they have been exposed to direct and indirect ultraviolet radiation, and the detection of their skin conditions basic on “ABCDE” guidance skin self-examination. Normally, the results of visual detection and professional instrument detection combined with the actual conclusion process including pathological picture recognition, time series analysis and comparison of tumor changes, analysis, and comparison of similar pathological pictures and other factors will morph into the main influencing components for the dynamic acquisition of individual skin cancer screening results.

2.5.3 DATA GOVERNANCE IMPACT DECISION

After the introduction of the logistic regression (LR) model based on traditional risk quoted judge only learning model based on X-ray image depth and blend to rebuild based on the above two methods of model contrast test unceasingly, scientists have been driving up AI algorithms for some auxiliary judgment accuracy and clinical use. However, in the primary screening of skin cancer (including melanoma and non-melanoma tumors), the rationality and effectiveness of the data process still need to be deduced through valid data and analysis, to provide suggestions for improvement of the process for relevant medical physicians and experts.

In 2011, Governance Definition (Elango et al., 2010) was discussed in the organization's poor management of information, such as ambiguous goals, lack of resources, and inconsistent processes, which caused conflicts among people in the organization and conflicting decisions. To avoid unreasonable confusion, the governance framework is more advocated to strategize for interactions with balancing each side of stakeholders that is essential to be proved scope of acceptance first. RACI models definition map (Rose, 2013) figured out who would be responsible for a decision including data-collection, options-identifications, and recommendations, etc.,. Conflicts from different perspectives may lead naturally to impacting security, performance, and quality. Without the clinicians, managers, and members of governing bodies will not have individual and collective responsibility.

For example, Model-Driven Design (MDD) application approach has upgraded traditional methods of challenging with intrinsic complexity of integrating large-scale business processes and existing applications (Perez-Castillo et al., 2019), that is, introducing data warehouse metamodel and platform-specific transform models can present scenarios from a pilot project in technological solutions. The

Behavior-Driven Design (BDD) (Freet et al., 2015)(Moe, 2019) will be goal-oriented and record test process and test results. With the assistance of deep learning tools and remote intelligent devices, skin cancer experts can automatically cross-compare similar skin cancer pictures and diagnosis results and preliminarily infer conclusions. At the same time, the BDD development mode will also provide feedback to the error processing center to summarize the specific reasons for the process error and feed back to the system development staff.

2.5.4 ENFORCEABILITY BY AI AND GOVERANCE DECISIONS

AI tools connect different data sources to support the screening of skin cancer patients for potential risk and collection of skin cancer-like symptoms. The algorithm was used to predict the difference between symptoms and conclusions. However, how to solve the transfer and identification problems of different file formats across systems like graph-zip in High-Definition presentation and dynamic-replay, filter effective data connection points, and import the efficiency of flow data transfer has become one of the challenges that affect the rapid response of organizational decisions (Ting et al., 2019).

Whereas the concern raised from standing on making it easier enforceable on organizational decision and protocol standardization within the process of data transformation and migration, is to present the information transparency and flexibility without any loss from protecting primitiveness of information. To explore the reasons of lagging and delaying against feedback in decision-making due to bias, it will provide the evidence for reducing complexity for involving skin cancer screening decisions and precision from AI reliability.

The input of a large amount of data that can only be introduced manually, and the complexity of the algorithm will introduce and generate a large amount of garbage data, which will lead to insufficient and incomplete data, and the formed AI model will generate data bias. It is morally necessary to design unbiased artificial intelligence models by removing unrepresentative data and reducing the error of fuzzy comparisons (Bennett & Hauser, 2013)(Jetzek et al., 2019).

2.6 DATA SECURITY AND RISK

By introducing remote digital application services in the medical Internet of things and intelligent applications, data leakage has become the focus and concern of security experts. When Data Exfiltration and Data Tampering fail customers to use normally, the illegal theft of personal privacy information, and the great loss of the reputation of the organization and relevant stakeholders. Fundamentally this may not save the protected product agreement to reach an understanding. Data Snooping (Jazdi, 2014) may also have a psychological impact on the patient. In the course of disease treatment, data can be altered randomly and lead to serious medical accidents.

The main reasons for data leakage are as follows:

- Phishing emails and websites --users click on links with Trojan viruses without any purpose and are directly implanted into the client devices, resulting in the contamination of the computer storage devices.

- The communication port will be modified due to the large-scale and complex hacker attack on the medical health care data, failing in the normal transmission of network data.

- End-to-end data loss directly leads to telemedicine diagnosis failure, photo resolution distortion, inability to compare other relevant images, machine language inability to recognize images sent by the client, and other problems.

In the cloud data platform solution, the basic principles of data governance are Effectiveness, Performance, Security, Accountability, and Risk Awareness. How to transform concurrent and continuous processing of cyber security and data elements (Identify, Protect, Detect, Respond, Recover) (Lee et al., 2015) into dynamic data services(I-scoop, 2017)(Jetzek et al., 2019). To consider the core problems of data consider its current risk management practices, threat environment, legal and regulatory requirements, business/mission objectives, and organizational constraints, such as network security enforcement levels.

Share Decision Making Flexibility--Shared Decision Making (SDM)-- a non-compulsive medical solution for sharing diagnosis and treatment process decisions between patients and physicians. In this way, the medical staff can directly and transparently communicate the treatment methods and procedures to the patient without any bias, which could decrease the patient's concern about the risks and burdens. The diagnosis of each clinical case beyond the patient's personal case information will collect key disease detection evidence nodes, for accumulating decision files in the public medical care resource exploration and similar symptoms in the medical record archive.

The SDM-Model (SDMN) -- provides a selection mode for decision-making, which can be either a multi-party conversation or a professional mode. The eco-sharing mode promoted can provide patients with automatic answers and visits for consultation on disease problems and can also make suggestions and expressions with their understanding and troubles about the disease artificially. At the psychological tracking level, this approach can provide a reference for the follow-up investigation of patients' emotional expression factors. Consequently, Multi-Dimensional Analysis (MDA) and Multi-Dimensional Decision (MDD) can be applied to extract discretionary solutions optimally (Zionts, 1979). The development and application of the Metaheuristic Algorithm (Robbins & Monro, 1951) provide mathematical analysis for finding different solutions (Genova & Guliashki, 2011) (Rieck et al., 2012)(Bomhof-Roordink et al., 2019).

Table 2-3--Metaheuristic Methods

No.	Metaheuristic Methods	Descriptions
1	Genetic Algorithms (GA)	strategies for intensification of the search use offspring
2	Self-adaptation (SA)	search process in some regions of the search space with cooperation research
3	Scatter search (SS)	generates systematically a set of dispersed points and convex or non-convex combinations of subsets

4	Ant systems (ASY) Ant Colony Optimization (ACO)	a constructive procedure that enables generate a new solution of the emergency
5	Particle Swarm Optimization (PSO)	makes steps from its current position to a new position and this motion is determined as a sum of three vectors: inertia, competition, and cooperation
6	Memetic Algorithms (MeAg)	a hybridization of evolutionary or any population-based approach with separate individual learning or local improvement procedures to solve a given problem
7	Particle Swarm Optimizer (PSO)	Is an s solution that computational methods optimize a problem by iteratively regarding given measure or candidate solutions, different gradient descent, and quasi newton methods
8	Resource Leveling problem (RLP)	Calculate the effective path in which start, and finish dates are adjusted based on resource limitation to balance the demand for resources with the available supply

2.7 DATA TRANSACTION STRATEGY

The organizational governance model of public welfare organizations includes five basic models: advisory committee model, cooperative governance model, policy committee model, sponsor governance model, and management team model (Elango et al., 2010)(Jetzek et al., 2019). At the same time, due to the continuous promotion and adoption of community participation as a new intermediate responsibility service center, the view of establishing a mutual trust channel and cooperative repeater between the community and non-profit organizations is gradually derived into a mixed governance model.

The structure of the organization is divided into policy committees and administrative committees(Stinchcombe, 2000)(Lunenburg, 2012)("Governance by Committee: The Role of Committees in European Policy Making and Policy", 2000). Policy formulation and implementation are the responsibility of the Policy Council. Under the policy committee model, the relationship between the board and the staff is a partnership. It can be divided into a management committee, working committee, policy governance committee, and collective committee. According to different social needs and environmental constraints, public health centers in each region will adopt different governance models.

Table 2-4--Governance Dimensions

Governance Structure	Dimension	Features
Centralized or largely centralized structure	Single authority Less Transparency Poor Accessibility	Local health units are primarily led by employees of the state

	Institution-based Trust Fewer incentives on law	
A decentralized or largely decentralized structure	Community Partial Transparency &Trust Community-based	Local health units are primarily led by employees of local governments.
Mixed structure	Local Transparency Targeted Accessibility	Some local health units are led by employees of the state, and some are led by employees of local government. No single structure predominates.
Shared or largely shared structure	Complete Transparency based on codes Strong Accessibility Interactive	Local health units might be led by employees of the state or by employees of local government. If they are led by state employees, then local government has the authority to make financial decisions and/or issue public health orders; if they are led by local employees, then the state has the authority

2.8 CASE STUDY

For personal health information, patients' privacy belongs to sensitive content, and both technical processing and non-technical application in storage, transmission, and sharing are protected legally.

- UK Public Health England (PHE) plans to implement Cancer Taskforce Cancer Strategy for England 2015-2020. Implement coordinated and exploit Cancer prevention and detection governance measures and strategies across organizations. Sharing expertise, and creating, which emphasizes synergy and cost savings, are the three areas.

- NRCARS provides clear data support for the establishment of a professional framework for cancer assessment and health impact that will be useful for the commissioning of the patient, professional, media, communications, and professional facilities.

- The “Privacy Act of 1974-The Privacy Act, 1996-Health Insurance Portability and Accountability Act, HIPAA, 2003- Privacy Rule & Security Rule in HIPAA” came into effect gradually shaping the personal Health Privacy protection laws and regulations in The United States. The privacy rules (Protected Health Information, PHI) are involved. From the database file sorting and division, the personal Health information archived includes two parts, (Electronic Medical Record, EMR, and Patient-Generated Health Data, PGHD). From the perspective of privacy rules, identification Health Information (IIHI) can be defined as a subset of Health Information, which can assist in providing individuals with sustainable personal Health care records, and physiological conditions. Even though many countries have enacted laws regarding data security and the scope of data use, the personal information of 25 million AMCA patients was hacked in 2019. The breach of experimental data, personal and financial data, social security accounts, and medical information led to the bankruptcy of AMCA's parent company and the suspension of Quest Laboratories.

- The serious consequence caused by network attacks makes the system collapse, the data flood, the use of false data, and duplicate data directly affect the credibility of data. Dynamic ecosystem health to assist decision-making, like the "bank" operation mode "CHRIS Dynamic Consent (DC)" method, Oxford University "SPRAINED" project, the University of Manchester "GenBank" project, Japan's "RUDY" project, and the patient groups genetic alliance "PEER" platform, and so on to upgrade the original low efficiency "E-Consent" version is safe and effective for health data sharing as the core idea of open a new window.

2.9 BUSINESS PROCESS MANAGEMENT

2.9.1 BPM APPLICATION IMPORTANCE RESEARCH

The Design for Six Sigma (DFSS), discussed how to improve customer satisfaction (Cudney & Furterer, 2016). A maturity BPM model is persistently optimizing and reorganizing the resources to undertake the upstream and downstream of the business through sorting and screening(van der Aalst et al., 2007)(Perez-Castillo et al., 2019). Simply covering business process actions cannot activate specific tasks stakeholders and data transmissibility in attenuated, congested, or duplicative functional performance, when burdensome and intricate BPM models in many enterprises and organizations come to draggle operation.

Redundant and unnecessary entity setup, as well as the complexity and inefficiency of the execution process due to the vague planning of functional boundaries, are often the two main hurdles to the successful implementation of business processes. Reducing the coupling degree between units and role layers always requires the seamless connection of highly integrated intelligent dynamic modules, and the processing machine that can deal with various emergencies flexibly strengthens against the priority of digital transformation and the logical processing sequence of event processing. Confronting at this point, Big-data, Data-Cloud collection, and sharing are available to be auxiliary data-driven boost into evoking intelligent model, the balance of fault-tolerant capability, and improve the request response speed. However, whether event-driven(Sun et al., 2021), function-driven, or task-driven method, the technical requirements for the key elements of executable capability are extremely trenchant. That expresses in reducing the pressure on the server-side means that each drive module has a corresponding data control response. For the urgent demand of the intelligent transformation of medical institutions, more units containing superb medical skills and can sophomore technological servers be essential the physicians, and communication channel utility (Dimarogonas et al., 2012)(Ji et al., 2021).

Excavating data mapping plasticity through optimizing cancer workflow will pursue establishing a BPM model that conforms to medical care. Given the purpose of decision-making to promote task efficiency and effect the high-level management goal of BPM is the interaction that demands to be achieved through the introduction of low-level management goals to generate decision values. It is essential to reevaluate vulnerabilities and also transform successful experiences into strategizing outline of the business plan (Hoerbst et al., 2011)(Barbazza et al., 2019).

2.9.2 BPMN 2.0 INTRODUCTION

The Business Process Model and Notation (BPMN) is a set of graphical notations that can express complex Business Process languages. To realize the standardization of business process modeling and

to reduce the loss of information transmission caused by the communication barriers during process decision-making, management, and technical development, introducing the concept expression of a basic business process can provide a dynamic view reference for the rapid realization of business optimization and transformation. (Von Rosing et al., 2014)(Romao et al., 2019)

BPMN2.0 (Von Rosing et al., 2014), following the introduction of the standard specification for workflow engines, provides uniform icon notations for the sequential flow of activities and decision tasks, system tasks, and script processes, and ensures semantic integrity and extensibility of business exchange modeling.

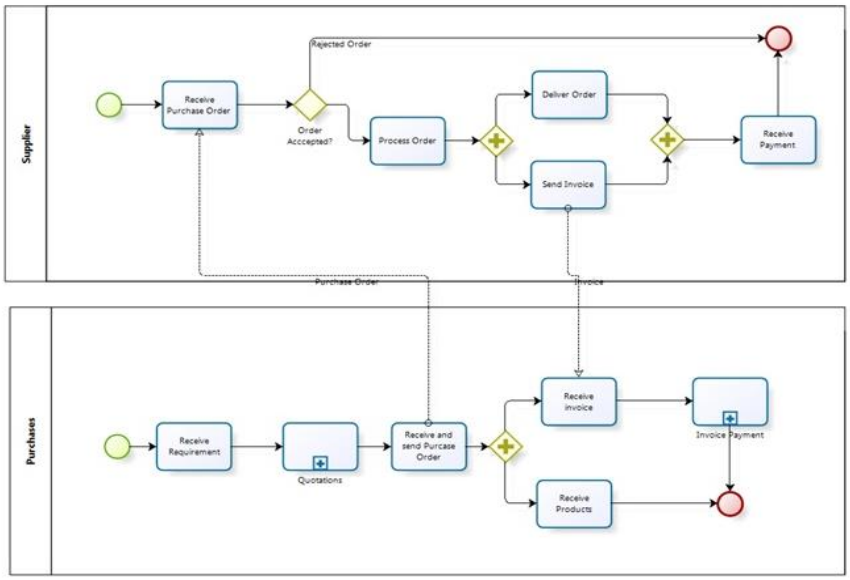


Figure 2-1--BPMN Application Example

2.10 MEDICINE-META-ANALYSIS IMPORTANCE RESEARCH

The medical structure activated in the way of improving quality of service for patients will be under effective control in the occurrence of the disease is the direction and value chain of all medical staff(Ferreira et al., 2018).However, the process execution of current the medical and health system framework has exposed the weakness without any aspiration towards quality supervision participation and customer satisfaction reflexivity.

It is of great significance to study medical service organizations planning healthcare management on skin cancer screening process with asset audit and analysis In the scope of sustainable healthcare management (Rich et al., 2018), customer relationship is related between medical decisions and regulatory agencies relation, medical clinics, and biological information acquisition and detection departments relation, and patient and care units' relation, social insurance, and welfare, and beneficiaries' relations, etc., in which multiple interests or non-interests as oriented substantial forms are presented the granularity or intensity performance from the interactional services, dependence, or collaboration.

Data from clinical diagnostics and trials, including accuracy and precision, provide physicians with evidence and reference from previous case solutions(Martin et al., 2019a). Although genetic science and optical instruments have been used to trace the root causes of disease for decades from the era of oral records to currently automatic distribution and sharing of information in systemization, independence of each case with obvious differences in diagnosis strategies. The potential characteristics of local malignant skin cancer tumors detected in ABCDE guidance, and the 7-point Checklist are memorized by the electronic medical record system, but the tumor invasion trend could not be inferred from the deductive cases. A visualize experimental meta context graph can be transferred measurable clew into artificial intelligence algorithms applications (Waldmann et al., 2012)(Szel et al., 2021).

2.10.1 PROCESS MINING IN MEDICAL DIAGNOSIS APPLICATION RESEARCH

The goal of online sustainable decision strategizing (Li et al., 2021) is flexible to adapt the experience to analyze and validate the determinative orientation of the business sides, where it is, to make the value of data beyond simple data reporting and summary through reducing bias and security risks. This will divert more towards statistical applications, concentrating on the tractive and predictive optimization with functionally operating collaboration and innovation by each digital indicator. Robust communication skills can be tactile sense behind the data, relying on sensitive mapping tubes constructing in the cohesions of connecting hardware and software environments. This can enable to reduce the influence of decision for bias or cognitive inertia caused by asymmetrical information standings as a result of subjective judgment. In another view, the data-mining clues can make each node and element play the leading role in handling emergency countermeasures automatically, swiping out of the process chaos caused by invalid conductions.

Table 2-6--Medical Process Ming Experience Table

No.	Title	Author	Reference	Year	Description
1	BPM Support for Patient-Centred Clinical Pathways in Chronic Diseases	Marek Szel ˛agowski, Justyna Berniak-Wo´zny and Cezary Lipinski	(Szel et al., 2021)	2021	1. Healthcare change impacts personal medical treatment decision-making 2. Telemedicine implementation benefits patients and medical workgroups in advantage including: (1) less cost at consultation. (2) mild workload at hospitalization. (3) expand multi-communication service opportunities at video and signal transmission 3. Stand the point of view at dynamic BPM realization to solute diagnosis and therapy process in the framework of cost-effective evidence-based medical care standardization and guidance. 4. Recommendation on information collection procedure for chronic diseases 5. Prompt possibility of involving ML/AI to replace human resource activity during appointment and post-analyzation as introductive verification, but also figure out security and data privacy risks during data transmission.
2	Experimental application of Business Process Management technology to manage clinical pathways: A pediatric kidney transplantation follow up case.	Andellini, M.; Riesgo, S.F.; Morolli, F.; Ritrovato, M.; Cosoli, P.; Petruzzellis, S.; Rosso, N.	(Andellini et al., 2019)	2019	1. Obtain relevant parameters and approaches from pediatric disease research which will be de reference to integrate clinic management pathways through disease research in pediatrics. 2. Existing the difficulties on information sharing and storage as observed in research including: (1) Patients always have Repeated requests for access to their medical records in situations of appointment expiry. (2) Time-cost on task confirmation and coordination 3. Infer the feasibility at targeting the clinic applications monitor framed with service-oriented architecture design, which is an optional method of enabling protocols, specifications, and clinic activities integration in the management process as described three steps: (1) The patient can access the case template that has been defined. (2) Automatic reminder of daily planned operations. (3) Introduce the patient disease event import mechanism
3	Business model innovation by international social purpose organizations: The role of dynamic capabilities	MuthuDe Silva; OmarAl-Tabbaa; ZaheerKhan	(Silva, M. d. 2021)	2021	1. Specify based-principle is one of BPM performance measures to direct healthcare especially clinic decisions-making in transparency, justification, and accountability. 2. Capture the appearing difficulties in health care management like communications gaps and understanding between managers and clinicians from a case discussion analysis. 3. IT commitment in chronic disease prevention and management is important to note that improvements can improve the efficiency and safety of healthcare management and process. 4. To provide suggestions for data fragmentation management of healthcare systems like reconciliation and merge.

					5. To stress the BPM introduction outcomes during applying the innovative approach into quality assurance and control intervention such as: (1). Digitalization feasibility. (2) Training. (3) IT Tools engagement. (4) Principles --transparence. (5) Reduce extraneous load.
4	Clinical Pathway Analysis Using Process Ming and Discrete-event Simulation: an application to INCISIONAL HERNIA	Raksmey Phan Vincent Augusto Damien Martin	(Phan et al., 2019)	2019	1. Observation contains: (1) Unexpected incidence like surgery impact and risks leakage. (2) Patient cost evaluation 2. Discrete data and events during the scenarios of clinical pathways definition in simulation 3. Illustrate Methodology basis on process mining in steps: (1) Data collection from administration patch. (2) Data extraction against data query. (3) Algorithm application. 4. Define the criteria for monitoring data capacity (1) patients' numbers engaged. (2) disease incidents rate.
5	Talent Management Vulnerability in the global healthcare value chain: A GENERAL SYSTEMS THEORY PERSPECTIVE	Eddie G. Montgomery. Victor Oladapo	(Eddie G. Montgomery, 2014)	2014	1. The importance of training qualified personnel for effective utilization of healthcare management resources was emphasized. 2 The unbalanced experts' attrition rate of medical staff may become one of the unstable factors for the continuous maintenance of medical services.
6	Interactive data cleaning for process mining: a case study of an outpatient clinic's appointment system	Niels Martin, Antonio Martinez-Millana, Bernardo Valdivieso, and Carlos Fern´andez-Llatas	(Martin et al., 2019b)	2019	1. Explicate the data identification and data migration issues influencing quality 2. In the processing of data cleaning, data inconsistency is produced between data set. And data-based assessment. 3. Data Quality issues were discovered at Timestamps, like Missing or Overlapping, and ordering violation.
7	Leveraging Data Quality to Better Prepare for Process Mining: An Approach Illustrated Through Analysing Road Trauma Pre-Hospital Retrieval and Transport Processes in Queensland	Robert Andrews, Moe T. Wynn, Kirsten Vallmuur, Arthur H. M. ter Hofstede, Emma Bosley, Mark Elcock and Stephen Rashford	(Andrews et al., 2019)	2019	1. Claim the Process Diagnostic Method (PDM) steps as following: (1) Log preparation in event extraction (2) Log inspection on initialized process framework. (3) Control flow analysis on event and model logs. (4) Performance analysis on processing productivity (5) Role analysis on resource access to organizational division. (6) Transfer outcoming of data. 2. Adapt PMPM in stage 2-Data as Process Ming Methodology targeting at quality assessment. (1) Collect the research questions for planning. (2) Extract the existing data. (3) Specify the event logs to data-processing. (4) Provide insight from data analysis (5) Achievement evaluation (6) Review the process detection.

3 METHODOLOGY

In this chapter, methodology will be elaborated into the sessions of “Research Strategy”, “Action Identification”, and quality management strategic applications in “DMAIC Method”.

3.1 RESEARCH STRATEGY

In terms of complying with the technical specifications of business processes, meeting the recognized governance principles, adapting to big data and cloud computing technologies, and promoting the construction of Intelligent BPM health platform, we propose the following methods in execution:

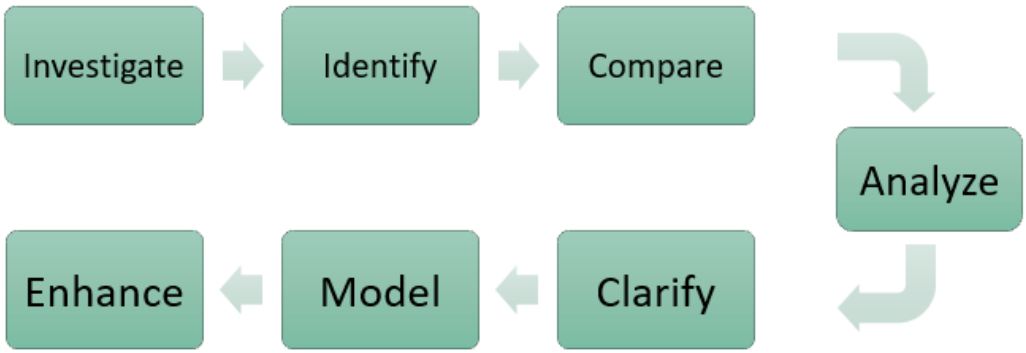


Figure 3-1--Methodology Scheme (prepared by author)

- Investigate--The form of expert interviews and determine the work assignment mode of the existing BPM model.
- Identify--To recognize existing skin cancer screening models and capture operational processes (objects, standards, pipeline, stream, principles, responsibility, tasks, priority, steps, time spending, rules, and codes) and the different objects and data flows involved in skin cancer screening. Give out the Specification on standard Identification and Rules.
- Compare--the clinical and remote screening procedures for cancer screening and the process changes that resulted from the introduction of the skin-detecting technique. Indicate the responsible party and priority of the task, as well as the verification steps and verification methods.
- Analyze—Current state (AS-IS) Critical Analysis and What-IF-Analysis in Simulation
- Clarify—Including static parameters and dynamic parameters.
- Model—Future Skin Cancer Screening Process in TO-BE Model
- Enhance--BPMN data flow flexibility, recording flow, staging, and grouping tasks.
- Validate—Model will be reviewed by experts with Questionnaires, and the answers will be identified after Interviews collected.

3.2 ACTIONS IDENTIFICATION

Through background investigation and question sorting for skin cancer screening, we have clearly obtained the main actions and descriptions involved in the current process. Here, they are summarized into the process description and displayed in the table, so as to analyze the problems existing in the current screening process (AS-IS

Table 3-1--Actions Descriptions Identification

Activity	Main Steps	Descriptions	Processes Invoke
Skin Cancer Diagnosis	Face-to-Face Diagnosis	Main Detection for Skin Cancer particularly to those who are not trusting the Tele-dermoscopy or Non-Remote-Equipment-Holders. Need to take exam in Clinics	Self-Examination Process
	Remote Diagnosis	dermatologist guides the procedure through a dermatoscope in Semi-Remote-Detection / Tele-dermatology or Fully Remote Detection Equipment Training	Self-Examination Process
Treatment	Surgical Treatment	Biopsy Surgery for pathological examination by obtaining the suspicious skin tissues	Radiologist Appointment Process
	Preoperative Observation (Prepare for check-up)	Regular Periodic Checking against high-risk groups including genes screening	Self-Examination
	Treatment Advice	Advise by dermatologist, pathologist, GP, radiologist, and other relative examinees after examination in summarized report or images.	Self-Examination. Dermoscope Detection Process. Image Assessment Process
Remote Skills	Dermascopes	Digital Dermascopes Non-Digital Dermascopes Portable Skin Cancer Examination Application	Dermoscope Detection Process.
	Self-Examination Assessment	Self-risk estimation and suspected skin cancer screening	Self-Examination Process
	Dermatology Confirmation	Dermatologists draw conclusions based on experience, comparison of images, pathology, and genetic examinations	Dermoscope Detection Process.
Devices Interaction	CT Scan	Test result of soft tissues variations in details and if exists any internal organs were spread of melanoma in suspicious spots	Image Assessment Process
	MRI	Detect the degree of structures nearby particularly non-melanoma skin cancer affected places on eyes or salivary glands.	Image Assessment Process
	TUS (Tele-Ultrasound Scan)	High resolution images of tissue structure of skin application surface were obtained by ultrasound non-invasive imaging technology, and the diagnosis was compared with clinical and dermatoscopy images of suspected skin cancer	Image Assessment Process
	FDG-PET	Adjuvant detection of tumor stage with skin cell changes and lymph node metastasis	Image Assessment Process

	X-Ray	Support detecting in the images of the lymph nodes enlarging to bones caused by melanoma spreading	Image Assessment Process
Nursing Quality	Triage	Assignment by skin cancer disease detection degree and priority in the risk of treatment based on resources and inspection needs	Practice Check-up Appointment Process Radiologist Appointment Process
	Schedule Arrangement	Request a diagnosis from a doctor, clinic, dermatologist, imaging specialist, or pathologist	Dermoscope Detection Process Practice Check-up Appointment Process. Radiologist Appointment Process
Administration	Policy and Decision	Regulate and publish the examination methods, instrument implementation methods and parameter standards, screening and examination period, diagnostic treatment, case analysis approach, non-technical participation screening route, etc.	Administrator or Technician Skills
	Screening and Optimization Statistics	Report based on individual screening and community screening results are aggregated	Administrator or Technician Skills
Electronic Medical Records (EMR)	Anamnesis	Personal skin cancer screening experience and screening results	Practice Check-up Appointment Process Radiologist Appointment Process Dermoscope Detection Process
Dermoscopy Detection	Dermoscopy tutorial steps	Differentiate between Melanocytic and Non-melanocytic Lesions. Differentiate between Benign Melanocytic Lesions and Melanoma. Propose a data-driven oriented BPM model scheme that can be adapted to screen human completion tasks and RPA automatically triggering business flows.	Dermoscope Detection Process
Patient Psychology	Training	Personal skin cancer basic knowledge and related equipment use counseling	Self-Examination

3.3 DMAIC METHOD

Quality Management aims to eliminate deviations in business processes, reduce defects and work-in-progress (WIP), and increase manufacturing capacity and speed of operation. In the transformation design of business processes, the introduction of Design for Six Sigma's (DFSS) strategic philosophical thinking is helpful to improve customer satisfaction and promote sustainability of service quality competitiveness (Ruben et al., 2018).

Extended from DMAIC, one of data-driven management conception mode, business process problem discovering and process optimization designing in healthcare management framework can be elicited as following steps:

- 1st step-Define — To Define the problem in the Medical Care field particularly in Skin Cancer Screening. So far as now we have discovered a lot of issues among medical sources utilization, disease treatment, and patients from research. All the exposure issues will be clarified into the current-- AS-IS definition during BPM model designation.

- 2nd step-Measure —To Collect Data on the current process (AS-IS). The relative data originating from Skin Cancer Screen and Optimization will refer to all Structural and Non-Structural format files, documents, scanned images, etc. which will be introduced into the engagement of the whole process.

- 3rd step-Analyze — To enhance Interpret Data and exclaim suggestions. To escalate more ponderable information that could be executable for transformation and transactions for the future (TO-BE), we also need to quantify the result of each main and sub-process workflow in metrics for delivery.

- 4th step-Clarify — To Clarify BPM objectives of the outcome and benefits regarding current BPM activities measurement, we will set the momentum and intense purpose with specific goals towards performance improvement and changing improvement, which will help us to understand intelligent BPM implementation importance by data-drive conceptual design.

- 5th step-Assume — To Assume process and sub-process implementation in scalability and agility. In this step, we will identify each enhancement on changing to process along with expecting to improve the performance of our operations and to reduce risks of bottlenecks by resolving explorative issues, it is necessary to create integration scenarios for productivity improvement upon using automation and process standardization in the scope of cost confined. Besides, the complexities in our business processing, we will consider how to make more integrations and a new repository of data to meet needs with agility.

- 6th step-Improve — Building up one reliable BPM model will depend on what we will have explored with technological skills and analytical methods in our business process. The new model will be declared in optimized design to screen out how much efficiency has been improved in actualization.

- 7th step-Control —To Confine negative impact on improvement by deviation verification and reduction. Undesired deviation threshold setting in the BPM model will cause stressful tasks loading or incompact activities streamline, which will seriously impact seamlessly connecting to actualization between business and technology strategy.

3.4 NATIONAL HEALTHCARE STRATEGY

National Healthcare Strategy (NHS) is an integrated implementation of a national-level health service, where the medical care system under this system covers the medical care benefits of the country and legal aliens residing in the territory of the country (Barbazza et al., 2019). The national health institutions are the implementors of national health protection entrusted by national law. Most public Health center physicians are affiliated with the Primary Healthcare Service (PHS), which means that citizens are entitled to make an appointment with a PHS physician through Electric Medical Record System (EMRS) Registration to engage those diagnoses and screening of chronic and terminal illnesses such as skin cancer identification and treatment (Tanbeer & Sykes, 2021). Under the service of the EMRS framework, both the request from participation and the response by physicians are designated as the responsible role protected by the public health department for the appointment, referral, consultation, and payment of a series of a disease services engagement.

Table 3-2--Tumor Staging Symptoms

Stage	Melanoma Symptom Features
Stage 0	Exist only in the outer layer of the skin without invading the inner tissue
Stage 1	Exist only in the outer layer of the skin without invading the inner tissue The outer layer (epidermis) may be ulcerated Tumor's thickness may be between 1mm and 2 mm or less than 1 mm. No ulcers. Not spreading to adjacent lymph nodes.
Stage 2	Tumor thickness greater than 2 mm. Happens ulcers. Not spreading to adjacent lymph nodes.
Stage 3	Have spread to surrounding tissue.
Stage 4	Have metastasized to other organs, lymph nodes, or areas of the skin far from the original tumor
Recur	Reappear in its original position or in another organs after treatment

3.4.1 ELECTRONIC MEDICAL RECORDING SYSTEM

Electronic Medical Recording System (EMRS) is an operational medical administration and clinical data management system commonly utilized in the Primary Healthcare System Framework (PHSF) (Buja et al., 2018) (Low et al., 2019), which covers the functionality including patient appointment, medical records, image capture, and process maintenance, and effectively supports administrative decisions, medical decisions, diagnostic processes and data classification, and summary, etc..

Cloud EMRS system (Muthukumaran et al., 2021) provides direction and channel for scientific large-scale data processing. Behind processing, real-time data and analysis Associates cloud data sources with internal database storage systems to simulate and generate reliable data while maintaining long-term fault tolerance and self-learning capabilities. It also shares datasets with dermatologists, oncologists, imaging, and pathologists' access to databases of similar anamnesis, improving the

granularity of accurate predictions by machine algorithms. However, due to the high level of technical personnel required for a fully server-side EMRS deployment, the increased operational costs will bring the burden of medical diagnostic costs, which has been conscious one of the bottlenecks in the current transformation of medical systems to medical data transformation (Khan et al., 2014).

3.4.2 RECOGNITION OF ENTITIES

An entity is signified by a symbol in a business process and, as part of process standardization, an individual or attribute to a process that can operate, invoke, commit, store, record, etc. When entities are represented in the form of files, they will be specified the triggering of information processing, whether structured or unstructured. Entities are as originators and receivers of system task execution, either can be exposed for internal or implicit attributes if they are data or documents.

Currently under the roles of involved system and data form in description as in the following table:

Table 3-3--System and Data Forms Engaged Process Introduction

System	Description	Engaged Processes
Electronic Health Record	Patient Basic Information Anamnesis Clinical History	Self-Examination Practice Check-up Appointment Process Radiologist Appointment Process
Pre-appointment checklist	Check for suspicious lesions and patient family history	Self-Examination
Report	Quick check-up report Complete check-up report	Dermoscope Detection Process Practice Check-up Appointment Process. Radiologist Appointment Process
Email/Mail	By email – sending all the information in electronic format, except the imaging exams By postal mail – sending all the information in physical format	Administrator or Technician Skills Image Assessment Process
Telecall	For appointment, training, and consulting	Self-Examination Practice Check-up Appointment Process
Derm.AI	A framework for proceeding Dermatological Images Analysis and Skin Cancer Screening	Image Assessment Process
Euromelanoma System	Europe Melanoma Patients Management Database	External Communication Service

Here is the Entities enrolled system service with Input and Output present as following:

Table 3-4--Data Flow Recognition

Entity (Healthcare Unit/System Service)	Input/Output (Report/Database)
Stage & Grade of Carcinoma	Stages and grades of skin cancer Report (Stage 0, I, II, III, IVA, IVB, T1-T4, N0-N3, M0)
Radiology & Imageology (HC Unit)	FDG-PET Report, CT Report, X-Ray Report, Dermoscopy Report, Biopsy Report, MRI Report, etc.
Biopsy (HC Unit)	Patient Information, Gross description, Microscopic description, Diagnosis (Tumor Type, Tumor Size) Other Information
Public Source (Service)	HAM10000 Images (Public multi-source dermatoscopes)
Computation Center (Unit)	Algorithme List and Rules

3.5 SKIN CANCER CLASSIFICATION

Skin Cancer classification in research (PDQ Adult Treatment Editorial Board, 2020),(ENCR, 2015):

Table 3-5--Skin Cancer Classification (Example)

Neoplasm Classification	Subtype	Histopathological Feature	Recognition	Risk Factors
Melanoma (PDQ Adult Treatment Editorial Board, 2020)	Superficial spreading Melanoma. (Longo & Pellacani, 2016)	Skin surface raised, irregularly growing, dark brown, black, or pink. (ENCR, 2015)	Female: legs. Men: Head, neck, chest, abdomen, back (ENCR, 2015)	BRAF mutation (Rabbie et al., 2019)
	Nodular Melanoma (Situm et al., 2014)	Asymmetrical, greater than 6mm; (ENCR, 2015) (Gershenwald et al., 2017)	Legs, torso, head, (ENCR, 2015)	PD-L1 expression (Giavina-Bianchi et al., 2020)
	Lentigo Maligna melanoma (Occidental et al., 2020)	There may be dents (ENCR, 2015)(Scope et al., 2012)	Legs, torso, head, (ENCR, 2015)	sun-exposed skin. elderly white population (Situm et al., 2014)
	Amelanotic melanoma (Gong et al., 2019)	Nodules, mostly black projections, or papules(ENCR, 2015) (Cheung et al., 2012)	--	Not easy to see (Gong et al., 2019)

Acral lentiginous Melanoma (Goydos & Shoen, 2016)	Observe on palms, soles, and nail beds.	All Races (ENCR, 2015)	Asian or African (Goydos & Shoen, 2016)
Mucosal melanoma (Olla & Neumeister, 2021)	Occurs on the mucosal surface. no pigmentation, and the position is not obvious (ENCR, 2015) (Jovanovic et al., 2013)	The gastrointestinal tract, anus, vagina. Women (ENCR, 2015)	--

3.6 INTERVIEW AS METHOD FOR QUALITATIVE SURVEY AND VALIDATION

Qualitative research is an analysis process that relies on the continuous acquisition of corresponding data from observation, interview and participant description and recording. Such non-digital data will assist in understanding objectively existing social phenomena and individual event experiences(Liang, 2019).

As the scope of the survey is very abstract, collecting the experience of experts based on semi-structured interview mode to guide and find the defects and key points caused by the lack of experience, as one of the bases for feasibility analysis(Adams, 2015). This model survey can be combined with the rich experience of participants, and at least 4 or 5 experts can explain in detail and elaborate on the open thinking of the problems in joining or separate group. The questions are aimed to investigate the security implications of data governance strategies and the feasibility of remote skin cancer screening through expert surveys.

Furthermore, Open-ended in-depth interview Qualitative Validation is a method conducive to objective evaluation of technical conclusions from the perspective of experts' experience. In order to respect the validity of narrative details and setting, interviewees explain and clarify emerging facts and supporting positions through several rounds of multi-dimensional exploratory questions. Question design without leading hints or answers and simply and clearly informing interviewees is the main strategy of this expert interview.

Table 3-6--Research Questions and Answers

Research Questions	Answers by Experts
RQ1: How do you concern about the open expansion of data accessibility and admission that various users own during executing the remote skin cancer screening process?	EP1: Data must be secure and only available to whom the patient allows. EP2: With the world becoming digital, the privacy protection is a growing issue in the modern medical environment, which includes the issues of skin cancer screening area.

	EP3: I think it's very important to consider the confidentiality and security in every information process. EP4: Data can be accessed from a variety of sources ranging from hospitals to the Department of Health. Electronic medical records systems and giving patients control over permissions to view their record, sometime become incompatible. Personal finance information bank accounts info can create security issue.
RQ2: How do you concern the privacy protection during the data opening transition to cloud service framework when executing Skin Cancer Screening?	EP1: Doctors have an obligation to protect patients' privacy, regardless of the type of examination performed EP2: Any information given by a patient must not be passed to a third party either intentionally or unintentionally. As the consequence, it is essential that the highest level of security and digital protection is used when storing patient data in hospital or clinic. For example, hospital/clinics should uphold strict confidentiality procedures to ensure staff member is familiar with the confidentiality content and understands what information should not be shared outside of the working environment. EP3: Personally, I wouldn't concern about the privacy protection as long as the information is properly encrypted. EP4: During Skin cancer screening, data transition to cloud service is no easy feat. To protect patient privacy while transition must balance delivering standards of patient care and meet the strict regulatory requirements set by HIPAA and other regulations, like as the EU (GDPR) General Data Protection Regulation.
RQ3: Do you think digital dermatoscopy can help with remote skin cancer screening?	EP1: Yes, it can. But remote screening for skin cancer requires the mobilization of a large number of medical staff. EP2: It is a fantastic modern method for monitoring skin cancer, especially in the country with ununiform population distribution. It is no doubt that dermatoscopy with proper training can help with diagnosis of skin cancer. especially for the residents in remote area. It is

	essential for government to set up a vital objective when developing digital health in terms of cancer diagnosis/care in remote care. For example, providing adequate training to radiographer/photographer to manage mobile dermatoscopy unit which sends all of the photographs electronically to the city dermatologists and oncologists, who evaluate the images, and give diagnosis. EP3: I think it's a great improvement opportunity in the process. EP4: Digital dermatoscopy is performed by a microscopic examination of the entire surface of the skin, locating lesions, photographing them, and representing them on complete body. It will help detection of skin cancers in the early stages of development, which helps to mitigate it.
RQ4: What do you think about the role of community clinics in skin cancer screening?	EP1: Depends on the clinical expertise of the clinician. The best trained doctors are dermatologists. EP2: To implement an effective community-based programme in remote area, an issue of staff shortage needs to be solved. Extending nurses' code of conduct may take on some functions of doctors, so that to reduce the cost and to improve the service provision. It is a common use of specialist nurses to help with diagnosis and treatment in remote setting hospital. However, the skin cancer screening protocol should be followed. EP3: The role of this type of clinics is undoubtedly very important considering the high rate of patient reception. EP4: Pharmacists can detect people with skin cancer risk factors amongst their users. This intervention can be considered in multidisciplinary strategies of skin cancer screening.
RQ5: What do you think about the main obstacles to implementing remote screening?	EP1: We use remote screening in Portugal with no problems. EP2: Building a team remotely (a virtual team to implement screen service) could have the major obstacles to it. First, the process needs a leader

	who holds the interactions between co-workers. Government invests into the adequate hardware to ensure the consistent and proactive communication especially in remote-work environments. In another word, it gives a right person the right role with the sufficient investment at designated set time for communication and collaboration. EP3: I believe that the biggest obstacle is access to technology and knowledge about its use by the different patients. EP4: Lack of knowledge and expertise of remote service provider; Lack of awareness of advanced technologies; Lack of remuneration (not billable in the MBS), increased workload and too time consuming. Psychological factors that can prevent or delay people from seeking medical advice from physicians.

4 STUDY

4.1 IDENTIFICATION OF AS-IS PROCESS

According to the investigation that currently medical institutions have not carried out universal screening for skin cancer yet and the principle of voluntary consideration of suspected patients, the individual screening results for skin cancer are usually collected statistically by national medical institutions.

Table 4-1--Identified Process & Module Name

Number	Process/Module Name	Type
1	Self-Examination	Process
2	Dermoscopy Detection	Process
3	Image Assessment	Process
4	Practice Check-Up Appointment	Process
5	Radiologist Appointment	Process
6	Integration Treatment	Sub-module
7	Exclude Skin Cancer	Sub-module
8	Case Second-visit	Sub-module
9	Disease Consult	Sub-module

4.2 AS-IS MODEL

AS-IS BPM model flowcharts are divided by process and modules. Suspect Cases of Skin Cancer as the start-up consideration of microprocessor, it will evoke patients to have completed their Self-Examination at home in the first step before all the preparation has confirmed up into pending for appointment on Face-to-Face Check-Up stage, possibly they can memorize down self-assessment result through detected by potable dermoscopy assisted in a remote consultant as their requested in the meanwhile but that is an only optional choice for themselves to decide for further screening enrollment. In the coming next will be the Radiologist Examination phase to support inspecting whether main organs and the trunk has been featured with cancer cell metastasis in risk. That Radiological Detection as the indispensable section will also contribute the full resolution images trimmed or resettled to store into the comparison archive in the local. Then after all is done at the dictation of whole process screening, a consultant will advise patients self-tracking to avoid exacerbation in positive.

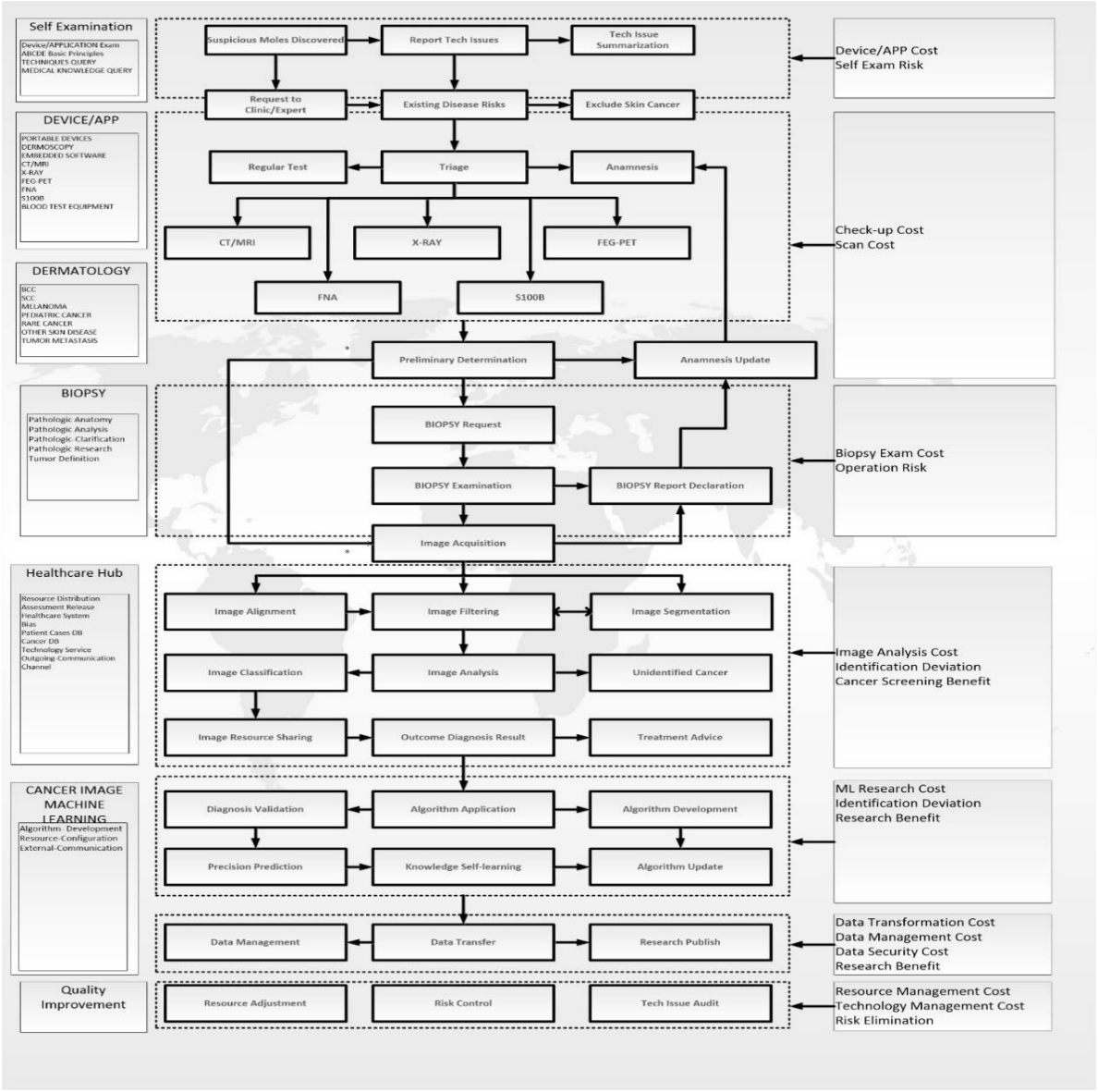


Figure 4-1--Skin Cancer Screening Status Diagram (AS-IS)

4.2.1 AS-IS SELF-EXAMINATION PROCESS

In the self-examination Process, users can choose to fulfill portable devices observation via dermoscopy, but they are not going to be recommended following that mentioned choice to determine once without any certain medical background knowledge related to skin cancer behind themselves. In another opinion, regarding skin cancer detection applications often corresponding with local health center system when register as a medical account of a system like EMR, the users will get a mock screening report or are supposed to be suggested a face-to-face checkup at a hospital in several minutes of responding a high-resolution picture in the hand of their skin or a friend's. Clinic will explain or serve the software basic operation questions or issues timely in shots as well. Importantly at the end of this phase, users can send their initial self-assessment report to the clinic or dermatologist unit

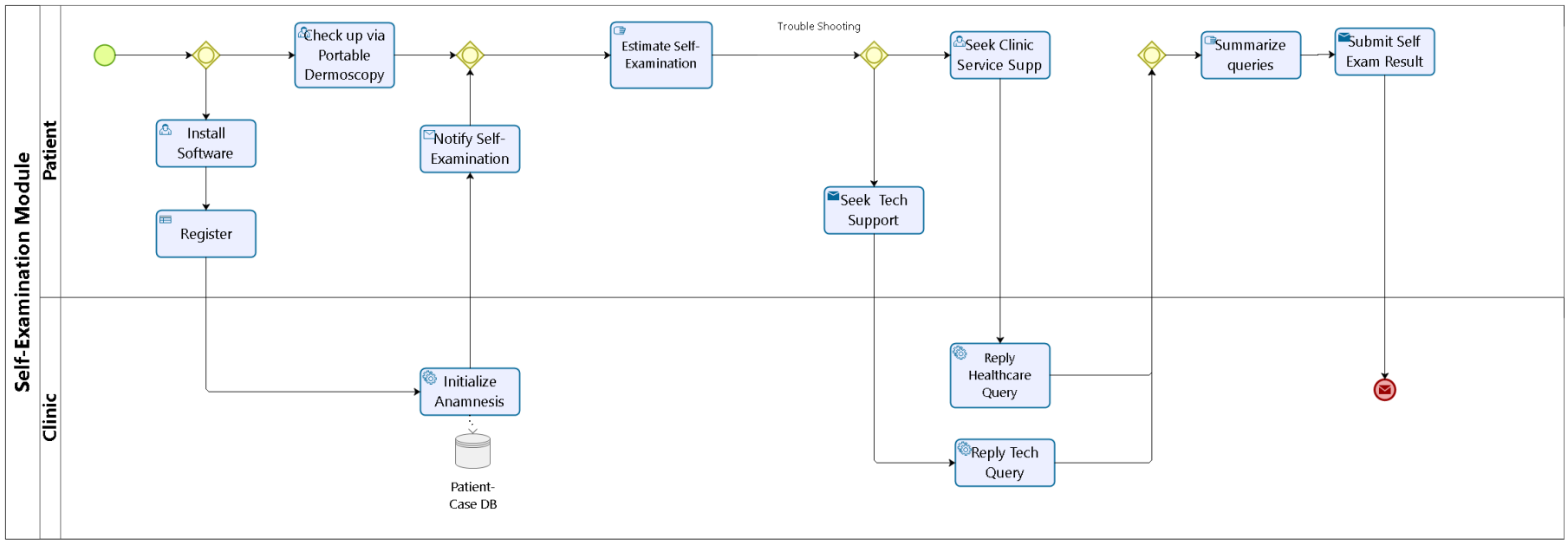


Figure 4-2--Self-Examination Process Diagram (AS-IS)

4.2.2 AS-IS DERMOSCOPY DETECTION PROCESS

In this process of Dermoscopy Detection, Clinic will demonstrate the initial checking from candidate mapping result whether is the same description with regular Skin Cancer Classification List or not. Patients will have to attend full-body skin examinations in the condition of doubting,

Involved the detecting tiny moles particularly on melanoma that may be presented such as in the scalp, nails, and eyes regions, hand-held instruments applications always express in challenge to those non-professional operators. At meanwhile, in situation that pathological sections are inevitable after dermoscopy detection confirmed in biopsy test, which leads to a possibility of malignant tumor metastasis result to other organs or tissues. Hence, the pathology laboratory will be processed for tracking these pathological images again against the cases analysis and reference.

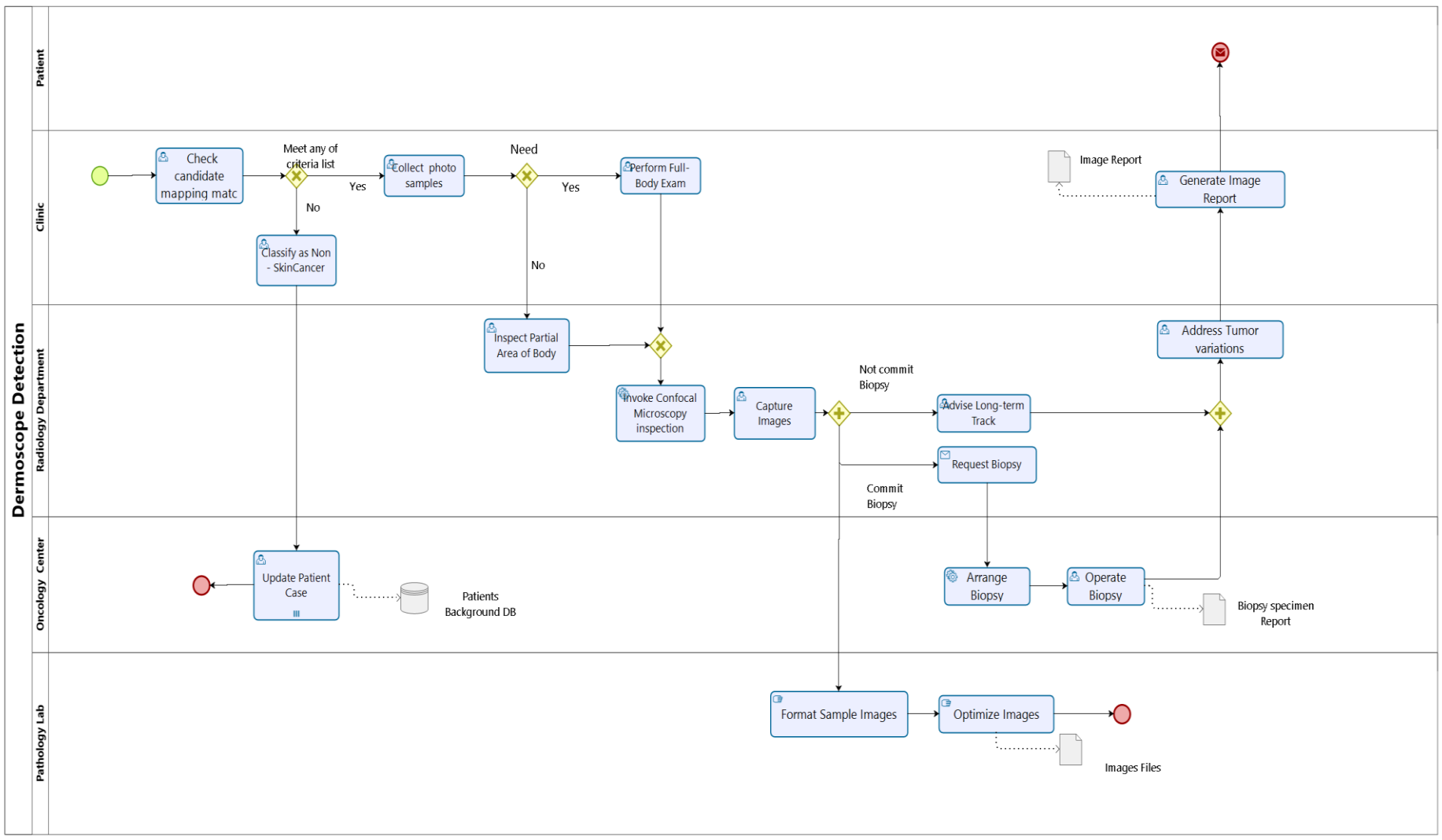


Figure 4-3--Dermoscopy Detection Process Diagram (AS-IS)

4.2.3 AS-IS IMAGE ASSESSMENT PROCESS

In Image Assessment process, after the tumor center will classify images beyond different types of skin cancer till the location of tumor sections has been determined, and then compare them with the original images of the same type of different skin cancer types declared in HAM10000 public images space. Results produced from the oncology department will be archived whether the results detect a tumor-like map that matches a certain type of skin cancer. The health center's task is regularly updating the archives of new pathological images it receives to analyze their clarity and accuracy and to describe their specificity.

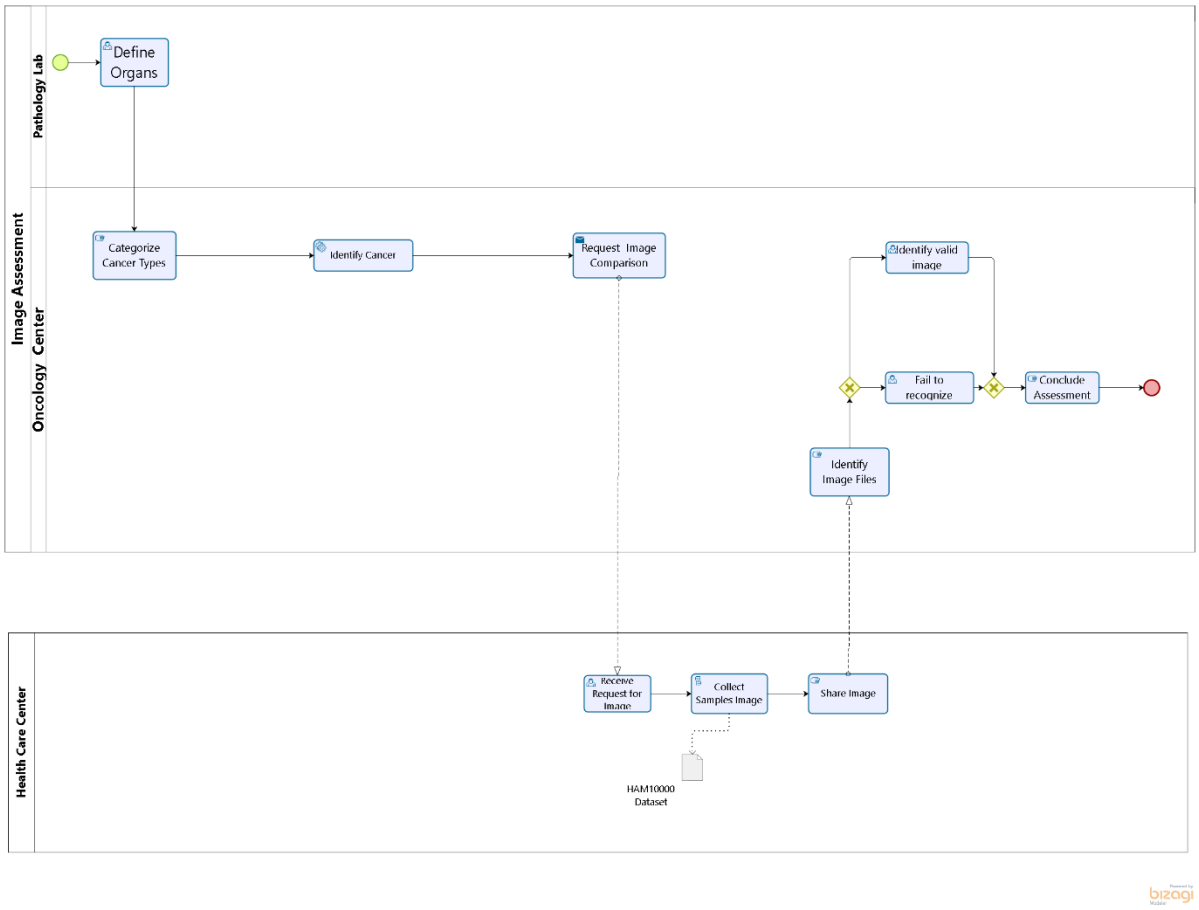


Figure 4-4--Image Assessment Process Diagram (AS-IS)

4.2.4 AS-IS PRACTICE CHECK-UP APPOINTMENT

In the "Practice Check-Up Appointment" process (Figure 3.4), by following informing Cancer Exam advice from Oncology Center, the patient will make a reservation of appointment for arranging exam with Clinic and Dermatology Department in real date of advance. The helpdesk located at Clinic is responsible for assisting the triage service line when the new schedule booking abrupted is in the discussion.

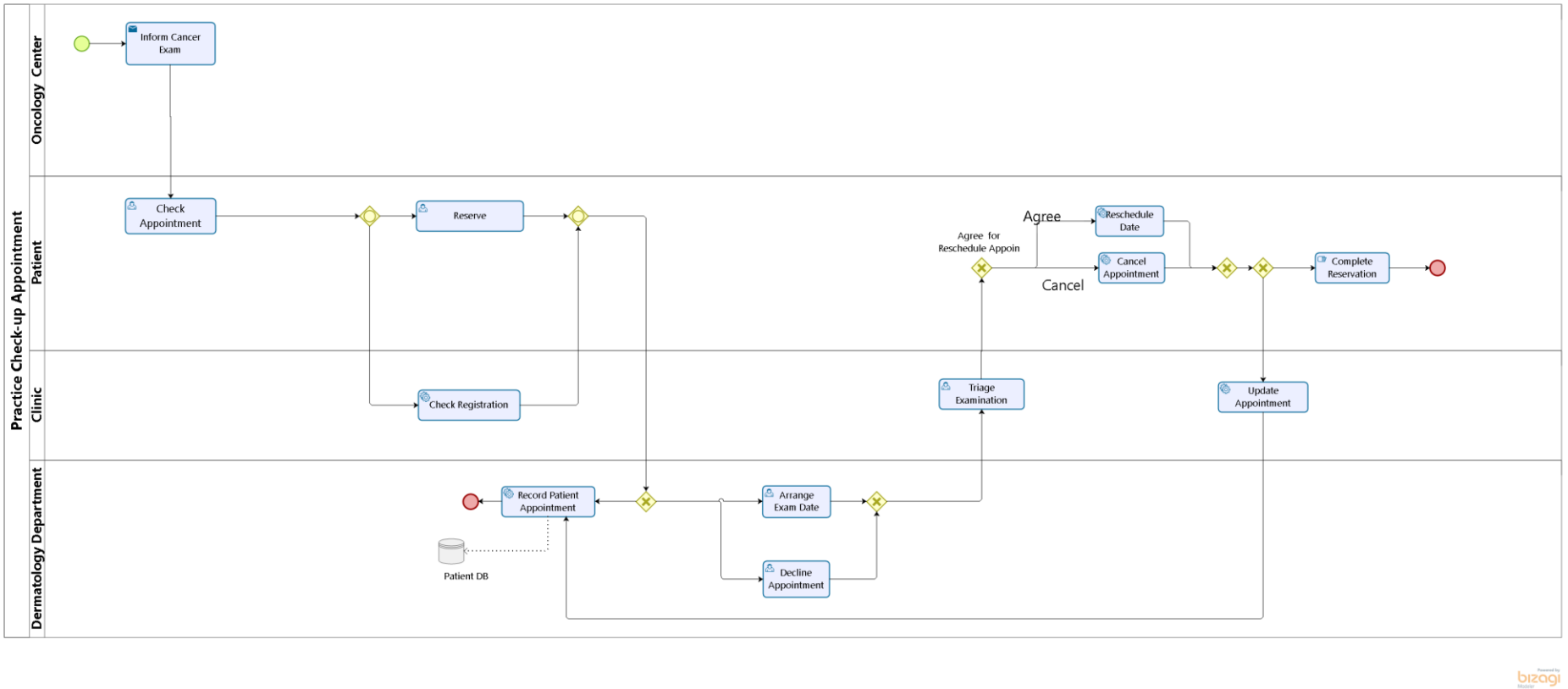


Figure 4-5--Practice Check-Up Appointment Diagram (AS-IS)

4.2.5 AS-IS RADIOLOGY APPOINTMENT

In the Radiologist Appointment process, Clinic will double-check the appointment if the existing reschedule has been updated with the patient in the EMR system. The dermatologist will review medical records to further determine whether there will have to stand in queue for waiting for X-Ray, CT/MRI, or PCG-PET scanning arrangement with Radiology Department operations. Not all the patients or cases are essential to accept all kinds of Imageology Examinations, while is conditional or optional. In the terminal, anamnesis will also be updated with the latest images report.

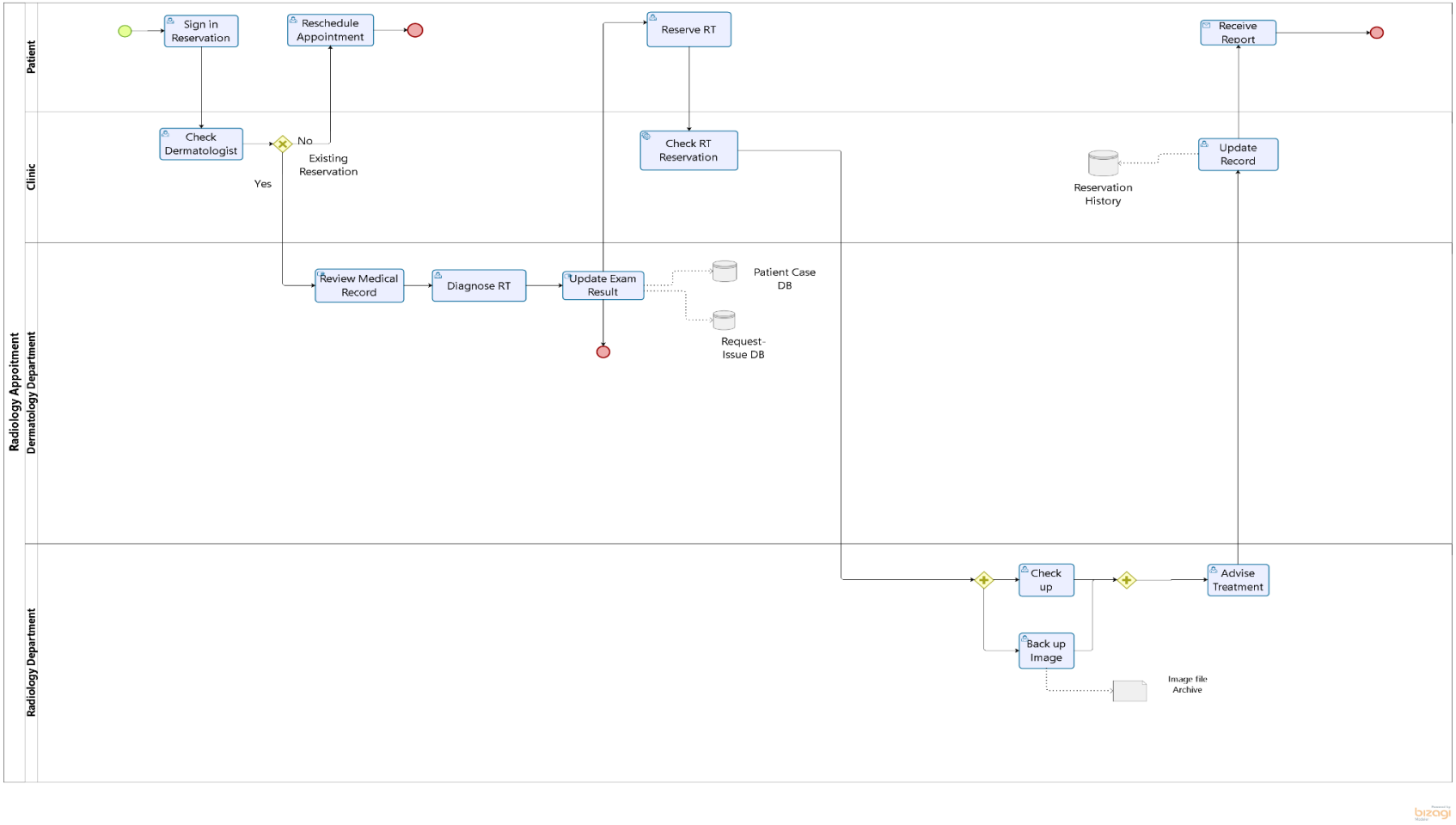


Figure 4-6--Radiologist Appointment Diagram (AS-IS)

5 CRITICAL ANALYSIS

The design of this model is an attempt to meet the transition of healthcare information technology and platforms to increasingly digital and automated applications. It also provides a theoretical reference for the development and optimization of a similar model's process design to the cancer screening process. At present, in most of the digital transformation processes, there are many constraints in the process of module process and parameterization, and security risks and hardware problems brought by algorithm research and development and big data storage still need to be solved.

- Regarding different scenarios adaptation, such as "Cancer Classification Definition", a special group of patients and other rare skin cancer will have to be formulated a large picture of image database with intelligent algorithm application to optimize technology-aided prediction.
- Moreover, the "Appointment" function of patients, diversified technical means of remote skin cancer screening will be explored by medical terminals and non-medical technician's communications without any data security interruptions, in aiming to solving problem of patients unable to seek medical treatment nearby due to difficulty in an appointment

Table 5-1--Critical Analysis

Issue Name	Description	Assumption
Define screening process principles	Assess Self-examination accuracy and effectiveness	Popularize basic skin cancer testing with community healthcare hub ABCDE guideline; 7-point checklist (aka Glasgow checklist);
	Monitor Healthcare and Clinics screening process and procedure	Collect effective technical data and transfer the parameters into dynamic meta-reference and service with analogy including like: PRISMA-DTA Checklist; Source of patient samples (fixed or randomized); Adaptability matching and patient sensitivity of skin cancer detection technology; The detection indexes include whether to introduce deviation calculation and threshold assumption; Testing technology implementation and standard deviation;
Self -Examination	The network is not available to support submission for generating self-exam estimation results by the format into EMR	Timely online corresponding is required to assist patients in installing client software
	Self-examinations basis on dermoscopy operation is in not in line with the procedure	Standardize remote self-testing instructions and procedures; Statistics on disabled participations status; Provide multimedia and community publicity with training
	Patients may not be able to get a whole-body test for bias, existing disease, or living conditions	Provide selectional remote examinations like combine dermoscopy and distance- dermatologist mixed mode
Appointment and Triage	Unregistered residents may not be screened for full-body examination in clinics	Multiple appointment services in the agency will release the inadequate resource pressure
	The patient cancels the appointment for a communication gap or other unconfirmed reasons.	Refunction the scheduling system by investigating the main reasons for more than two failed appointments and remedying them with technical measures. For example， EMI may occur in patients who have CIED implanted so that a Dermoscopy with magnets is used for testing
Practice detection	Screening for the perspective case when rare skin cancer classification is detected	To assess the risk of screening for rare skin cancer subtypes regarding different stages for example, when it is unclear if the same safety margins should be applied for the respectable stage III on primary tumors
	Radiology is not possible as inadequate equipment in remote areas	Construct remotely image exam analysis and monitoring service upon the structuring and exchanging diagnostic parameters in the protected medical channel of intermediate access authorization and permission
	The range of non-invasive tissue that may be excised by resection of tumors with indistinct boundaries is uncertain during surgery	Compare various techniques for detecting skin resection edges to ensure minimal damage through the solutions candidates
	Data of diagnosis and treatment systems at different levels are not updated synchronously, leading to information asymmetry	Strengthen internal communication and coordination

Image recognition and prediction from melanoma various tracking	Image formats exist in a variety of formats, and the style is not clear in the process of storage and conversion, which makes it impossible to be used for algorithm analysis and cross-department reference	Need to unify the image format and production produced in specification to avoid secondary image processing
	Diagnosis of dysplastic nevi may result in an inaccuracy calculation on melanoma lesions estimation	Through the development of AI and gene mapping, light source screening, 3D technology detection, and other joint applications to locate and predict dysplastic navies early development status
Expert diagnosis and advice	Single diagnosis cannot be applied as a complete screening result for insufficient professional experience	Arrange more professional training to expedite motivation on physician's diagnosis and treatment ability
	Due to insufficient authority or software incompatibility, remoted diagnosis cannot be implemented.	Clarify the different level of authorities and cross-platform configurations

5.1 SIMULATION ANALYSIS

Simulation Analysis is a result verification method using partial virtual reality data after model construction(Damij et al., 2008). This approach parameterizes and displays views for local models and events, with monitoring the completion of each module and event executed in the BPM model in duration. What-IF-Analysis is one of the techniques used by hypothesis analysis to measure the impact of conditional fluctuations. According to the condition setting of different performance indicators, the data lost during initialization is repeatedly tested and the overload or insufficiency is analyzed to find the best solution.

Initial Parameter Setting in Self-Examination Model (AS-IS) of different resources including General Practitioner (GP), Nurse and Technician. (Example):

Assuming 200 instances of Self-Examination for the patient to be proceeding in 30 days, each daily work loading duration last 8 hours from 9 am to 6 pm, the process, tasks, events, gateway, and completed status will be presented in figuring “Event End” result with instances fulfilled as accepted from start events acceptance.

1st Scenario: SelfExam (AS-IS) process is set 60 minutes waiting time to start.

2nd Scenario: Save waiting time for each execution step, like Waiting time is reduced to 45 minutes during each patient self-examination implementation separately.

3rd Scenario: Improve Utilization working proportion like one technician can be a candidate as an alternative service in the “Estimate Self-Examination “step.

4th Scenario: Attempt to add new resource with one nurse and one General Practitioner (GP) for serving the whole process but remaining only one technician as still.

Table 5-2--Skin Cancer-Self-Examination What-IF-Analysis Utilization Rate

Resource	Scenario	Utilization
GP	SelfExam （AS-IS）	66.25%
GP	SelfExam （TO-BE） -SaveWaiting	81.90%
GP	SelfExam （TO-BE） -ImproveUtilization	86.98%
GP	SelfExam （TO-BE） -AddNew	76.97%
Nurse	SelfExam （AS-IS）	69.92%
Nurse	SelfExam （TO-BE） -SaveWaiting	86.43%
Nurse	SelfExam （TO-BE） -ImproveUtilization	96.35%
Nurse	SelfExam （TO-BE） -AddNew	94.74%
Technician	SelfExam （AS-IS）	75.52%
Technician	SelfExam （TO-BE） -SaveWaiting	77.40%
Technician	SelfExam （TO-BE） -ImproveUtilization	64.16%
Technician	SelfExam （TO-BE） -AddNew	63.49%

The resource utilization by tasks proceeding contrast in the chart.

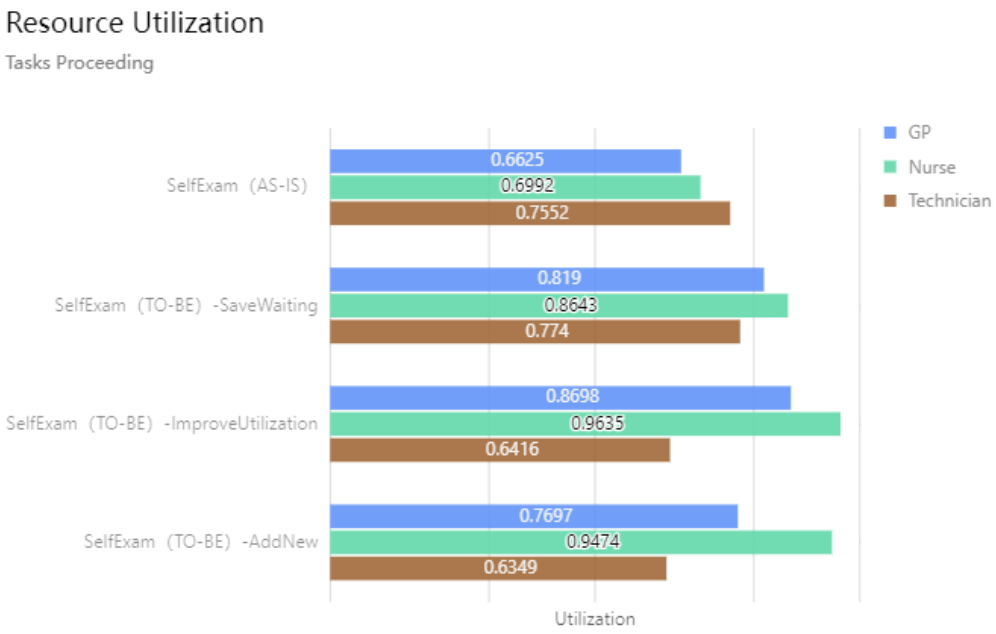


Figure 5-1--Resource Utilization Task Proceeding

5th Scenario Given 40% of patients decided to accept Dermoscopy for skin-cancer examination in a remote way, which means more nurses and GP are expected to enroll as training guides or entirely consultants.

Resource	Scenario	Utilization
GP	SelfExam (TO-BE) -MoreDermosciopy	79.66 %
Nurse	SelfExam (TO-BE) -MoreDermosciopy	99.99 %
Technician	SelfExam (TO-BE) -MoreDermosciopy	63.61 %
		Total SelfExam (TO-BE) -MoreDermosciopy

Figure 5-2--Stress Prediction Analysis of Resource Utilization

The two nurse operation of 99.99% standing in the 5th Scenario is previewed in saturated working without any assistant. Comparatively, monotonous variations in the stable index of 79.66% (5th Scenario) around 76.97% (4th Scenario） and 63.61% (5th Scenario) vs around 63.49% (4th Scenario） Therefore, both technician and GP are more urgent for requiring remote detection to contribute their participance in intensity or proficiency for improving efficiency.

5.2 RECOGNITION OF ENTITIES

In static business planning model, Entities as the elementary symbol activate the roles of defining admission, various participating process services and directives, including groups, users, processes, and tasks. Although participate in the formulation of the basic attributes of data and the rules of the process route, the task scope between entities is sometimes vague or the communication channels flexible, resulting in the poor quality at transformation and transportation of data. Having the time delay in the waiting process would lead to the unreasonable allocation of resources alignment and the failure of functions implementations.

However, in the introduction process of dynamic data flow, the attributes of the entity are triggered by events of being into a node transformed into participating in the completion of the target of the event around the same or similar purpose activities continuously. That will prompt new requirements for the security of business models. Here is the Entity Roles, Tasks and Responsibility enrolled:

Table 5-3--Entity Recognition

Entity	Roles, Tasks & Responsibility
Administration Unit	Administration Authorization, Control, Audit
Healthcare Center	Primary Healthcare (HC) Service
Clinic	Schedule Patients Appointment and Update Anamnesis
Dermatologist	Skin Cancer Diagnosis
Patient	Suspicious or Confirming person or group with dermatoma
Nurse	Assist doctor to commit schedule appointments and confirm reservations, patient care, etc.
Pathologist	Research and produce skin pathological section results. Confirm pathology surgery operation
Radiologist	Radiologist to support CT/MRI/X-Ray Scan, etc.
Researcher	Researcher existing technical and medical care process issues.
Data Engineer/Scientist	Summarize process, service, medical science data into producing applicable Algorithm
Help Desk	Support Patients triage task
Oncologist	Analyze and Define Skin Cancer Categorization
Trigger Service	Appointment trigger EMR System to adjust medical resource
Image Archive	Image resources from outside (HAM 10000) and inside produced by Radiology and Pathology
Anamnesis DB	Patient cases examination report, files in the database
Radiological Report	Radiological Examination Result, Report, and Files in DB
Pathological Report	Pathological Examination Result, Report, and Files in DB
Dermoscopy	A kind of device to support detecting dermatoma and lesions. Also, assist observers in assessing lesions with little to no pigment

As direct engaging into medical care process, screening and then formatting in comparison of a large number of images are going to provide physicians with accurate prediction and pixel positioning above capturing quark factors out the path for algorithm optimization, which is the key to embrace into Robotic Business Process Automation. According to the recognition of entity application and sub-process, the process response assessment with measure guidance matrix is described as follows:

Table 5-4--Assessment Measure Matrix

Enrollment	Response	Measure Factor
Self-Examination	1. Request for Remote check 2. Understand self-check criteria 3. Confirm Remote/Home self-test 4. Evaluate health status 5. Assess to primary healthcare service or clinic or family doctor	1. Accept Training for preparation 2. Network conditions and instruments are available 3. Barrier-free communication 4. Grasp ABCDE principles or 7 points 5. Time of data entry for patient self-examination
Device/APP	1. Permission to the software application on the client 2. Patients can make an appointment with EMR to read the case 3. Device and equipment configuration records 4. Network security and patient information sharing	1. Install the client software 2. Adequate medical equipment, waiting for the appointment time 3. Failure rate of software equipment 4. Remote detection reservation success rate
Dermatology	1. Training on basic usage standards of Dermoscopy 2. Evaluation of techniques for expert detection on skin cancer 3. Hospitals and clinics accept skin cancer screening and detection 4. Description of known skin cancer symptoms and risks 5. Instructions for skin cancer diagnosis	1. Configure remote experts 2. Preliminary diagnostic accuracy 3. Number of tests per unit time 4. Time of medical record data entry 5. Expert review time
Radiology	1. Description of basic testing technology process 2. Assess disease types based on images 3. Determine disease progression 4. Participate in disease consultation 5. Case report compilation 6. Coordinate testing technology and non-technical problem solving 7. Disease detection and analysis are presented	1. Waiting time for an appointment in the imaging department 2. Detection time of imaging department 3. Number of tests per unit time 4. Success rate of diagnosis in the radiology department 5. Data entry time of imaging Department 6. Expert review time
Biopsy	1. Biopsy operation arrangement 2. Implementation of biopsy surgery	1. Number of tumor biopsy operations

	3. Biopsy technique description 4. Pathological report compilation 5. Disease status analysis 6. Expert opinion 7. Disease information sharing 8. Patient communication	2. Acceptable hand preparation time 3. Analysis time of single tumor sections 4. Execution time of tumor section surgery 5. Success rate of tumor diagnosis 6. Collation time of tumor pathological data 7. Expert review time
Oncology Center	1. Clarify Diagnostic criteria for tumor diseases 2. Grant data permission 3. Analyze and summarize technical data 4. Chronic disease diagnosis Program 5. Decision-making communication and cross-organization negotiation 6. External data acquisition 7. Supervise the implementation of testing methods 8. Allocating detection Resources	1. Screening decision making 2. Determination of supervisory standard and assessment 3. Data resource report 4. Determine skin cancer detection methods 5. Investigate and detect emergencies and incidents 6. Apply for the project launch plan 7. Schedule technical discussions about skin cancer 8. Update skin cancer data resources 9. Assess to implement capability
Cancer Image Machine-Leaning	1. The algorithm covers skin cancer types 2. Accuracy and difference of skin cancer screening algorithm 3. Algorithm development 4. Cross-department image sorting 5. Summary of algorithm results 5. Skin cancer data filtering and cleansing 6. Search external data and image resources	1. Tumor sample image collection time 2. Tumor image learning time 3. The algorithm assisted to calculate the screening time 4. Algorithm development time 5. Feedback time for image production 6. The number of tumors can be detected per unit of time
Healthcare Hub	1. Arrange community and remote service resources 2. Apply for permission to use medical records 3. Record resource consumption 4. Balance diagnosis and nursing capability 5. Summarize triage data 6. Trigger emergency response plan 7. Report the implementation results during the examination process 8. Collect examination feedback information	1. Time duration for registering patient appointments 2. Success rate of patient appointment 3. Number of patients confirmed 4. Patient waiting time 5. Success rate of second examination appointment 6. Feedback response time

6 DESIGN TO-BE DIAGRAMS

6.1 TO-BE SKIN CANCER SCREENING DECISION STRUCTURE FLOW

In contrast to AS-IS's principle of Self-Screening with final count-on statistics at the Health Center and Oncology Center, in TO-BE Skin Cancer Screening Process design, assign tasks are advised to follow main decisions to commit independently on different Types, and Regions, Careers, Ages and Genders different properties settled in each program. The Primary Health Center and Secondary/Tertiary Healthcare Hub perform job tasks in distributed mode.

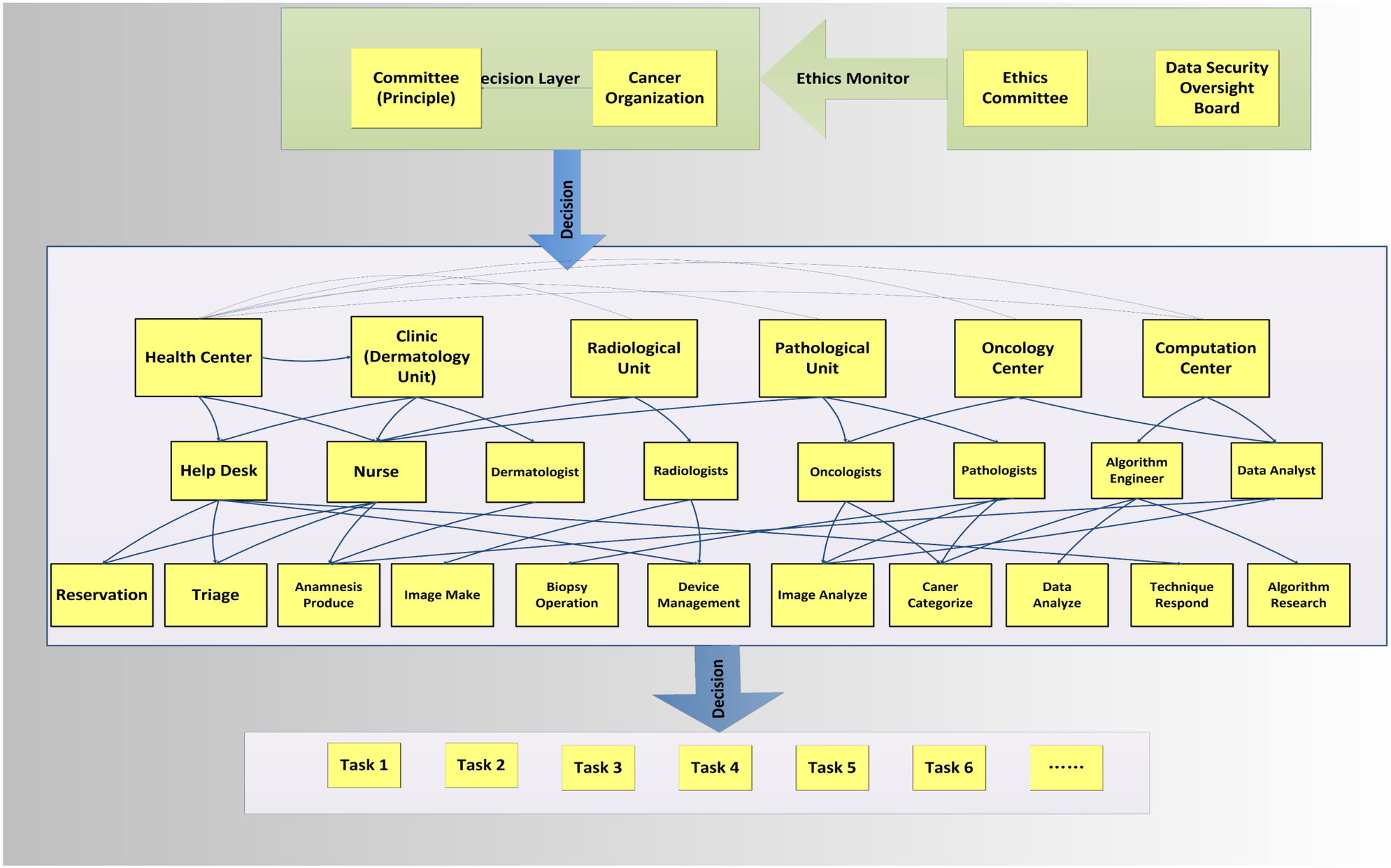


Figure 6-1--Skin Cancer Screening Decision Structure Flow (TO-BE)

For Example, The Health Center is divided into several Healthcare hubs, and each HC Hub performs corresponding tasks. The tasks performed by HC Hub1, HC Hub2, and HC Hub3 can be performed based on previous statistical data.

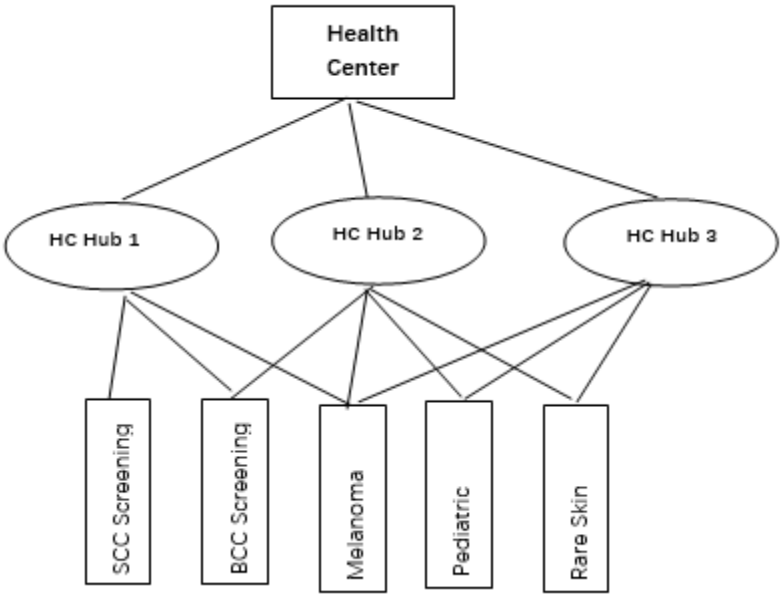


Figure 6-2--Health Center Task-tree Diagram (TO-BE)

6.2 NEW MACRO PROCESS IN TO-BE MODEL

In TO-BE phase, considering decision-making tasks and trigger service against responding unbalanced resources particularly Primary Healthcare Service and Secondary Healthcare Service assignment status, Self-Examination Process Practice Check-up, and Radiology Appointment will be merged into new Self-Screening process majority to activate node functionality roles to maintain the whole process at all. Dermoscopy Detection and Image Assessment will still commit as the same action as previously designed. Before the terminal of the Screening macro-process, Health Center will publish the report for all execution status summarization.

Table 6-1--New Process Design (TO-BE)

Process/Module Name	AS-IS Design	TO-BE Design
Resource Assignment	Not designed	New Process
Self-Examination	Existing Process	Merged into Sub Process of Self Screening Process
Practice Check-Up	Existing Process	
Radiology Appointment	Existing Process	
Appointment Trigger	Not designed	New Process
Dermoscope Detection	Existing Process	Improve Process
Image Assessment	Existing Process	Improve Process
Publish Report	Not designed	New Sub Module

The Macroprocess of Skin Cancer Screen Flow in TO-BE design as following:

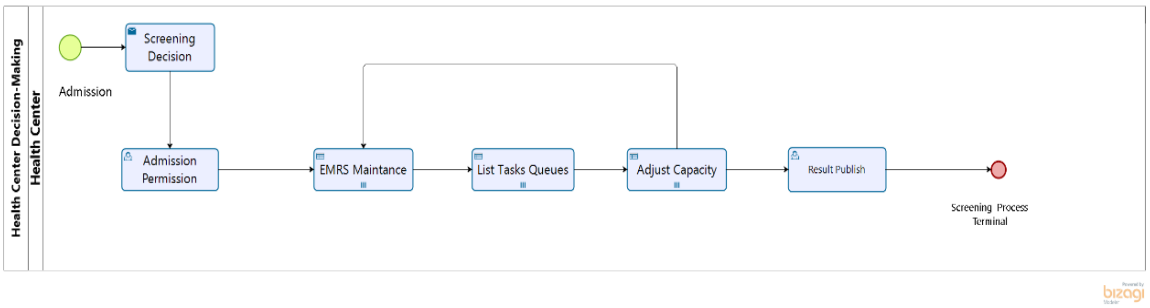


Figure 6-3-- Skin Cancer Screen Flow (Macroprocess) Diagram (TO-BE)

Task-Driven Skin Cancer Screening Flow Diagram design as following:

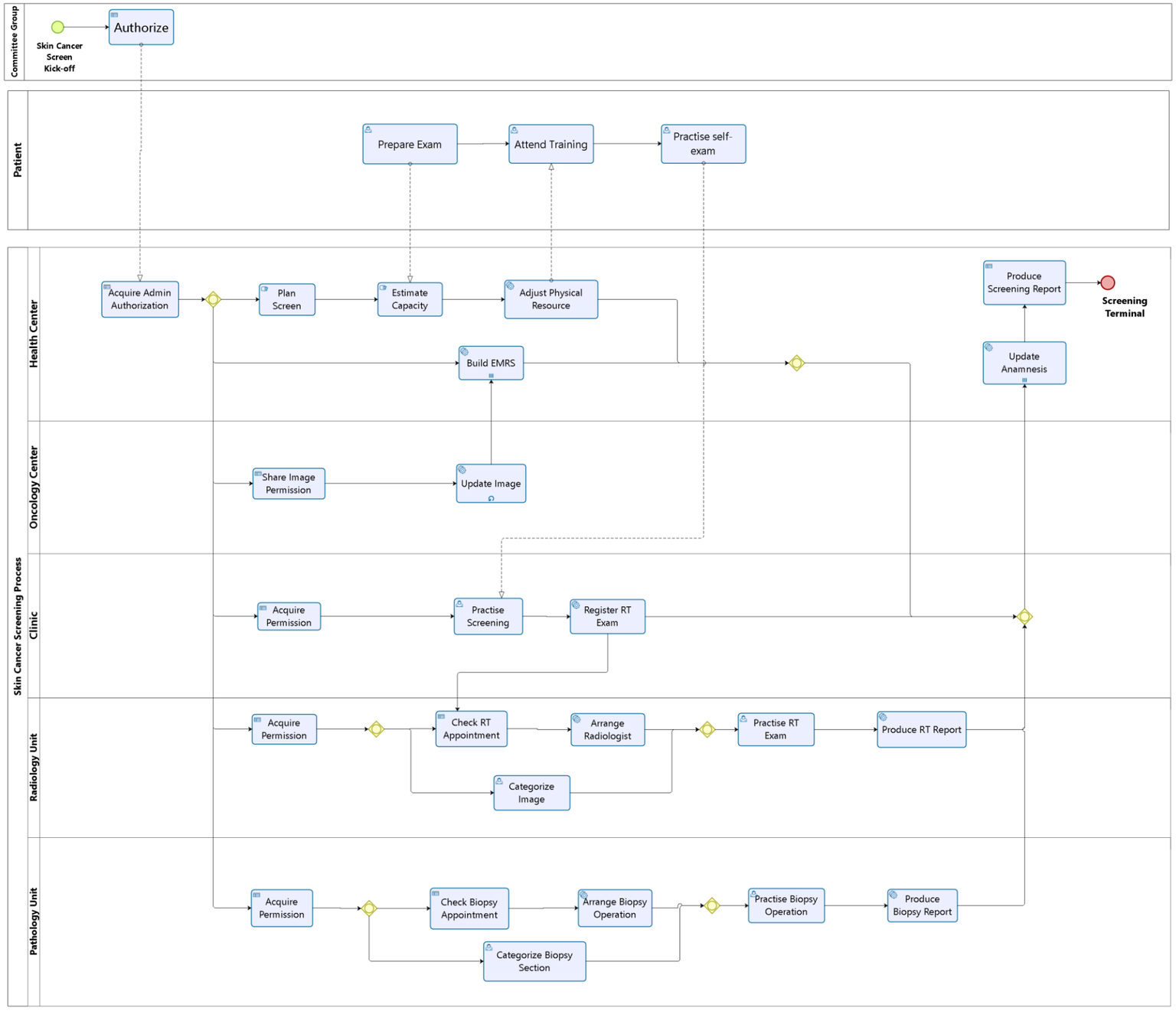


Figure 6-4--Task-Driven Skin Cancer Screening Flow Diagram (TO-BE)

6.3 NEW MODULES IN TO-BE

New Modules has been redesigned as substitute modules appearing in TO-BE:

Table 6-2--New Modules Tasks and Responsibilities (TO-BE)

New Modules in TO-BE	Task/Responsibilities
Define Screening Scope	In Primary Health Center, "Define Screening Scope" will be resettled for inclusively targeting types of carcinomas (SCC, BCC, Melanoma, Pediatric Skin Cancer, Rare Skin Cancer, etc.).
Estimate Capacity	As a resource transformer, real-time evaluation of existing available resources such as hospitals, secondary clinics, Physicians, Nurses, Equipment and Instruments, Dermatologists, Pathologists, Radiologists, algorithm application status, database, and cloud platform situation and EMRS running status.
List Task Queues	To reset upon different levels of priorities tasks including emergencies and non-emergencies events interruptions.
Adjust Physicians Resources	Arrange nearby medical treatment according to the activity status of doctors and nurses at different levels
Trigger EMRS	Alert Service Trigger automatically release and evoke physicians and nurse resource for appointment reservation if in a condition of the not-busy line

6.4 TO-BE APPOINTMENT SERVICE PROCESS

The new Appointment Service Process (Figure 3.10) not only configures different levels of EMRS permissions but also can observe the latest reservation status in real-time and feedback to the central management system. That enables to alleviate the problem of over-reliance on central deployment caused by insufficient resource capacity. However, this configuration requires that both secondary clinics and tertiary health care hubs have the same capacity to terminate emergencies in addressing contingency flexibility with increasable risk of technology fund investment.

The Appointment Service diagram represented as following:

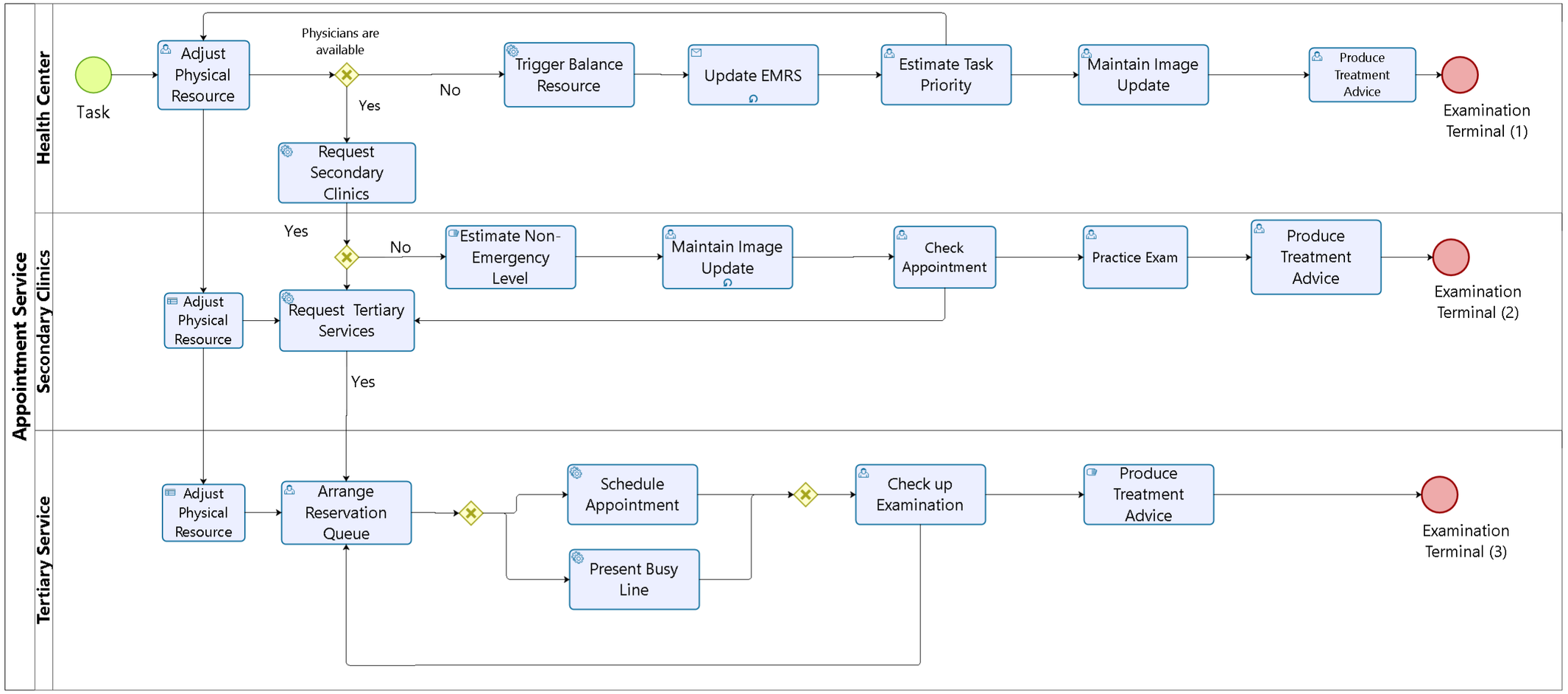


Figure 6-5--Appointment Service Diagram (TO-BE)

6.5 EMRS TRIGGER ACTIVATE IN TO-BE DESIGN

EMRS Trigger Service is going to simply design flexibilities in which any level of Secondary or Tertiary Health Hub level to reflect the appointment queries. EMRS Trigger. EMRS Trigger Module introduction are designed in the following three processes.

Table 6-3--EMRS Trigger Data Flow Introduction

Input	Output	Entity Enrollment
Patient Self-Registration Request Patient Self-Exam Estimation	Self-Exam Result Assessment	Patient
Dermatologist Appointment	Appointment Notice Anamnesis	Dermatologist
Request for Radiological Exam Report	Permission on reading Radiological Exam Report	Radiologist
Request for Radiology Exam	Agreement/Decline on Radiology Exam	
Radiological Images and Result	Radiological Exam Report	
Radiologist Advice	Radiological Treatment Solutions	

EMRS Trigger is not only the respond of medical service of resource balance, but also as the main integral service of medical data collector and distributor through automatically resource estimation and reconfigure the elements in format or non-format as request from clinics, radiologists, patients, or dermatologist, etc. Moreover, EMRS Trigger will be also the corresponding analyzer to extract the relative skin cancer images backgrounds from Anamnesis and historical Pathological Archives to transfer forward Healthcare Hub, Oncology Analyzer, and Computation Center.

Here is the Radiology Appointment Diagram design in TO-BE), Self-Examination Diagram, Practice Check-up Appointment Process in Diagrams:

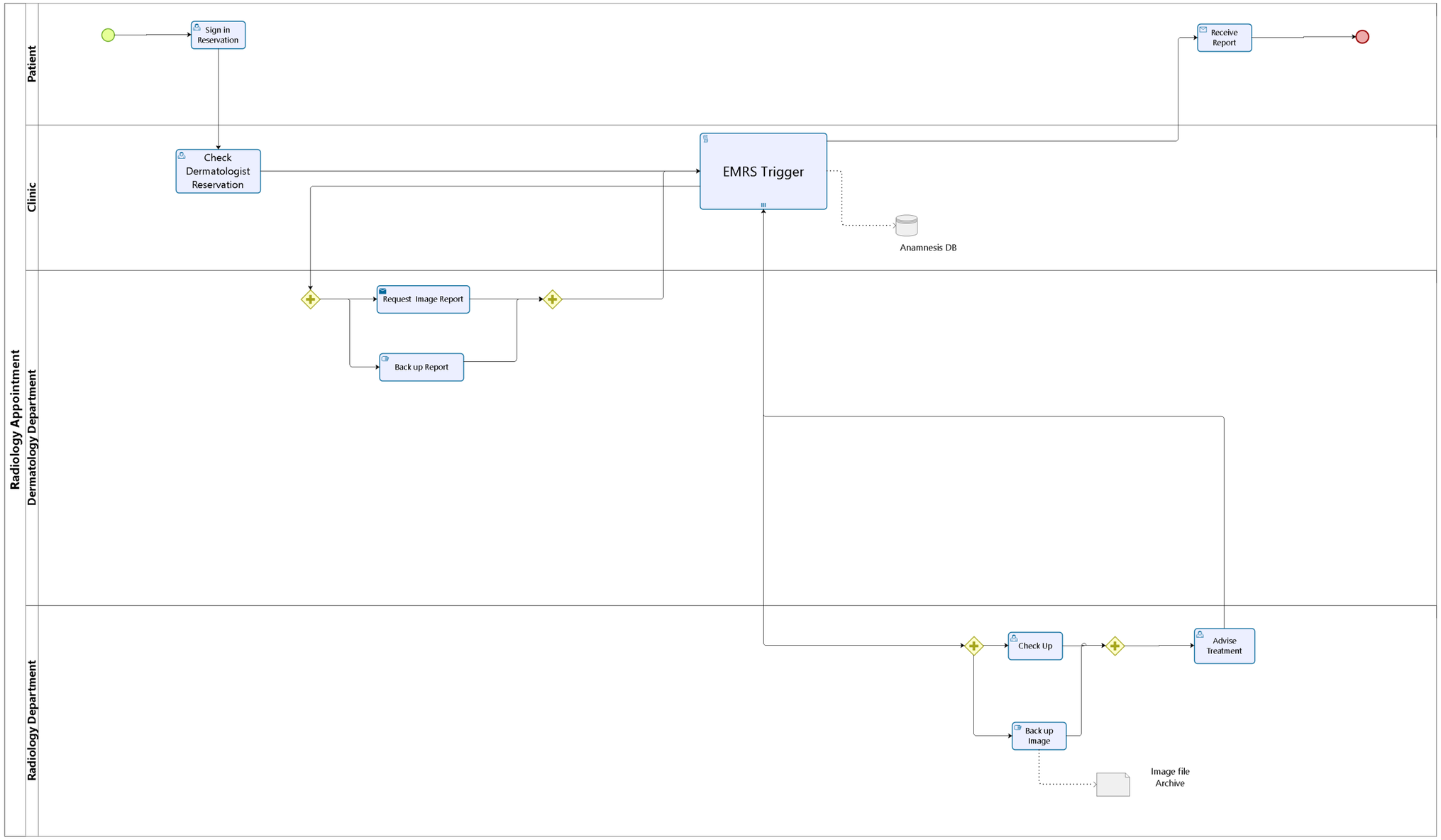


Figure 6-6--Radiology Appointment Diagram (TO-BE)

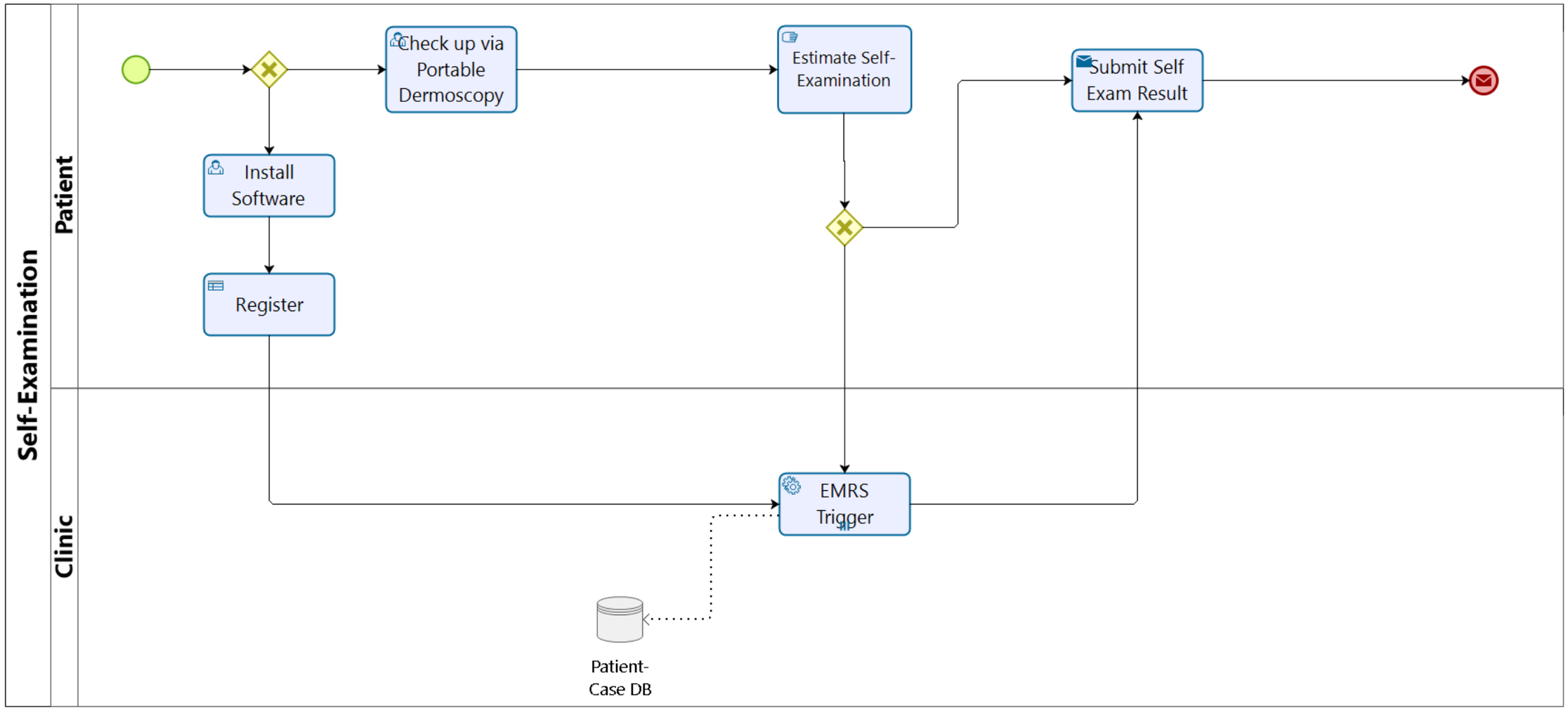


Figure 6-7--Self-Examination Diagram (TO-BE)

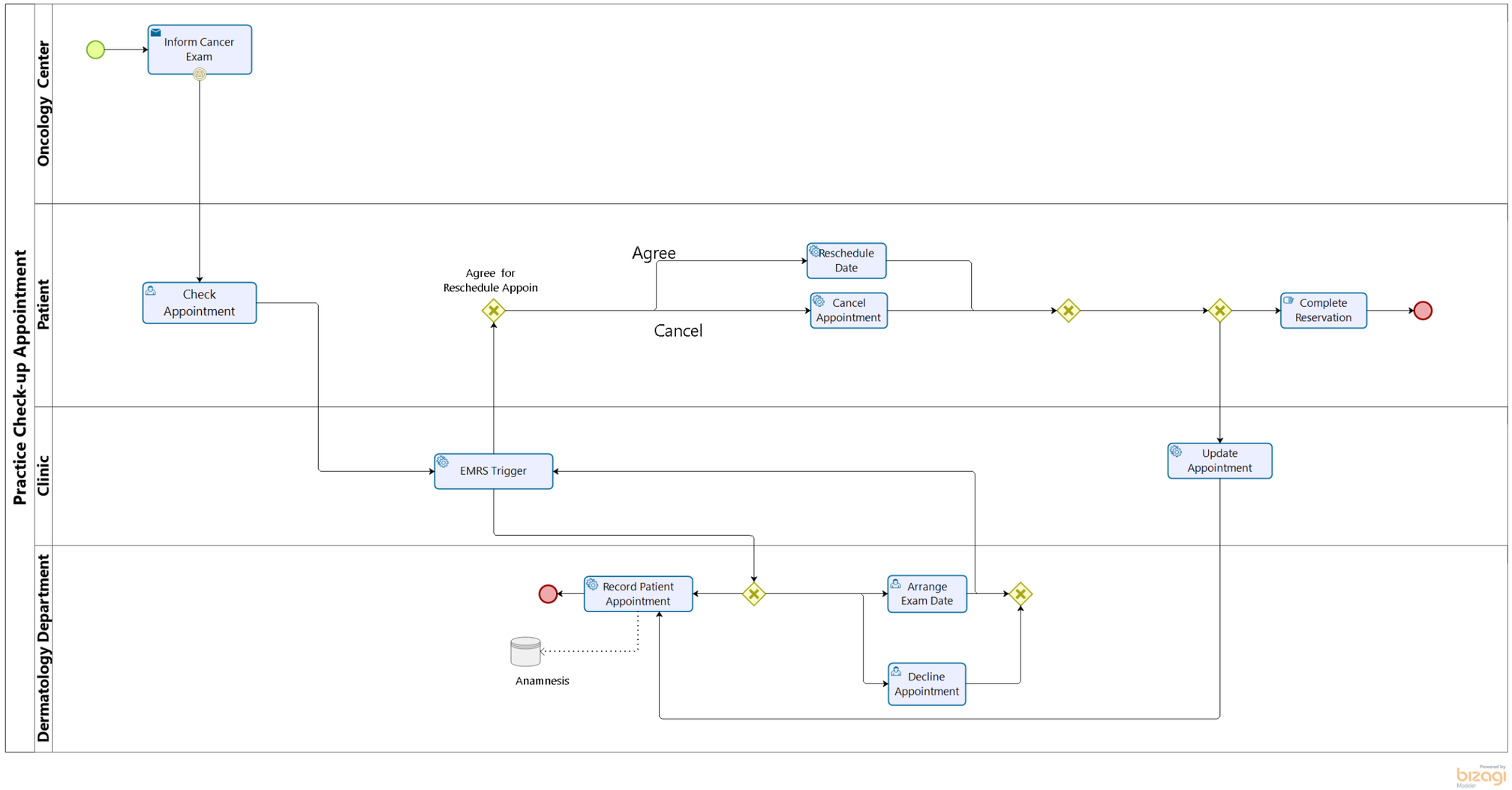


Figure 6-8--Practice Check-up Appointment Process Diagram (TO-BE)

6.6 SKIN CANCER RESOURCE ASSIGNMENT PROCESS (TO-BE)

Optional Remote-Screening operations will be designed in the TO-BE model. One choice is full expert guidance on the operation of the equipment, and the other is semi-independent but requires the patient to consult the doctor for some dermatological problems and technical problems. The Health Center will coordinate Health care resources timely to make early judgments on patients with remote skin cancer screening, and even organize the community about dermoscopy operations introduction and basic screening criteria for skin cancer screening. Over the main responsibility, the health center monitors and reviews existing screening technical and non-technical problems according to the EMRS automated operation, tracking, feedback, and summary until problems are resolved.

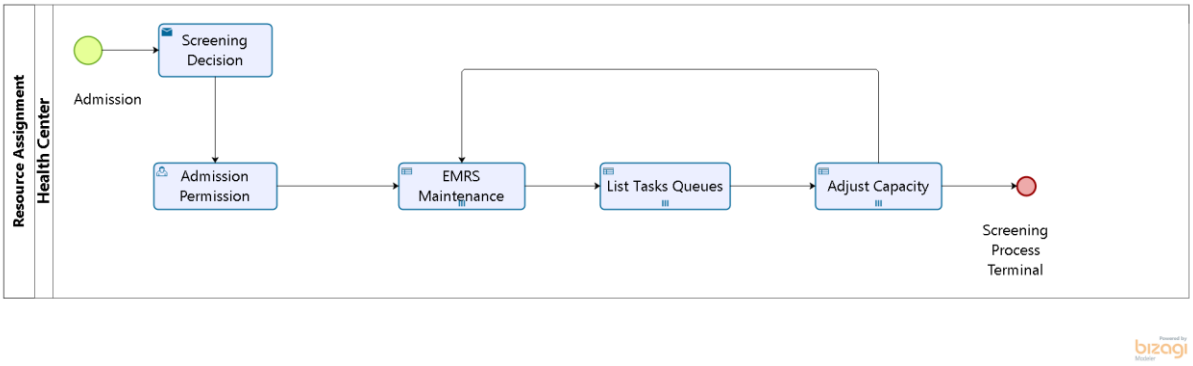


Figure 6-9--Skin Cancer Resource Assignment Process Diagram (TO-BE)

6.7 DATA REQUIREMENT SERVICE PROCESS

Considering the development and utilization of data node technology, the design pattern of the healthcare cloud platform will cause cost differences of the Service layer. With the development of Omni bearing private cloud with high technical demand, long cycle, time cost, and uncountable cost requirements this choice is always off the docket rather than others. Comparatively, Public Cloud has wide availability and high demand satisfaction. Hence, Hybrid cloud models can be determined based on existing resources, technology, and cost considerations. The open skin cancer Image library and open-source algorithm such as HAM10000 can be obtained from the outside without any financial pressure, and medical records of hospitals and cross-department can be shared by private cloud to solve the problem of huge Image memory issue as well.

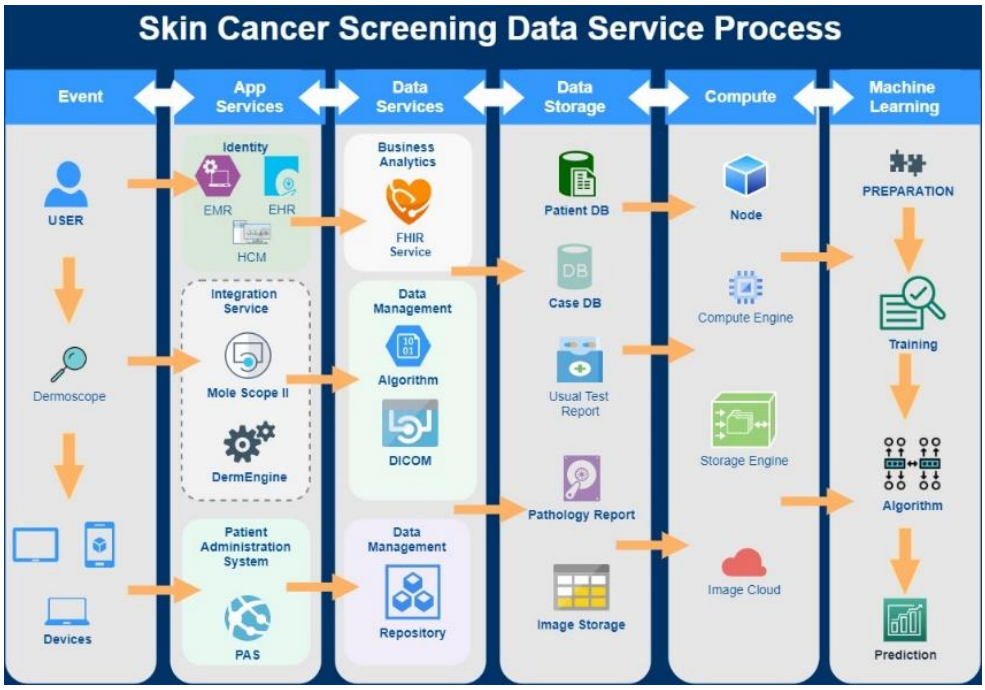


Figure 6-10--Skin Cancer Screening Data Service Process Diagram (TO-BE)

6.8 TO-BE DATA SERVICE FRAMEWORK DESIGN

In Data Service Framework Design, “Health Center Adapter”, “Process Controller, Query Collector”, “Event Management Service”,” Data Analysis Service” and “Security Management Service” are embedded in the main box of the Data Service processing chip.

One example to explain here, the “Event” and “Rules” triggers in the module of “Event Management Service” will enhance concurrent process interaction ability behand of the event response and request status spotlight in the inventory log, as “Process Controller” service is not in deadlock to the demands.

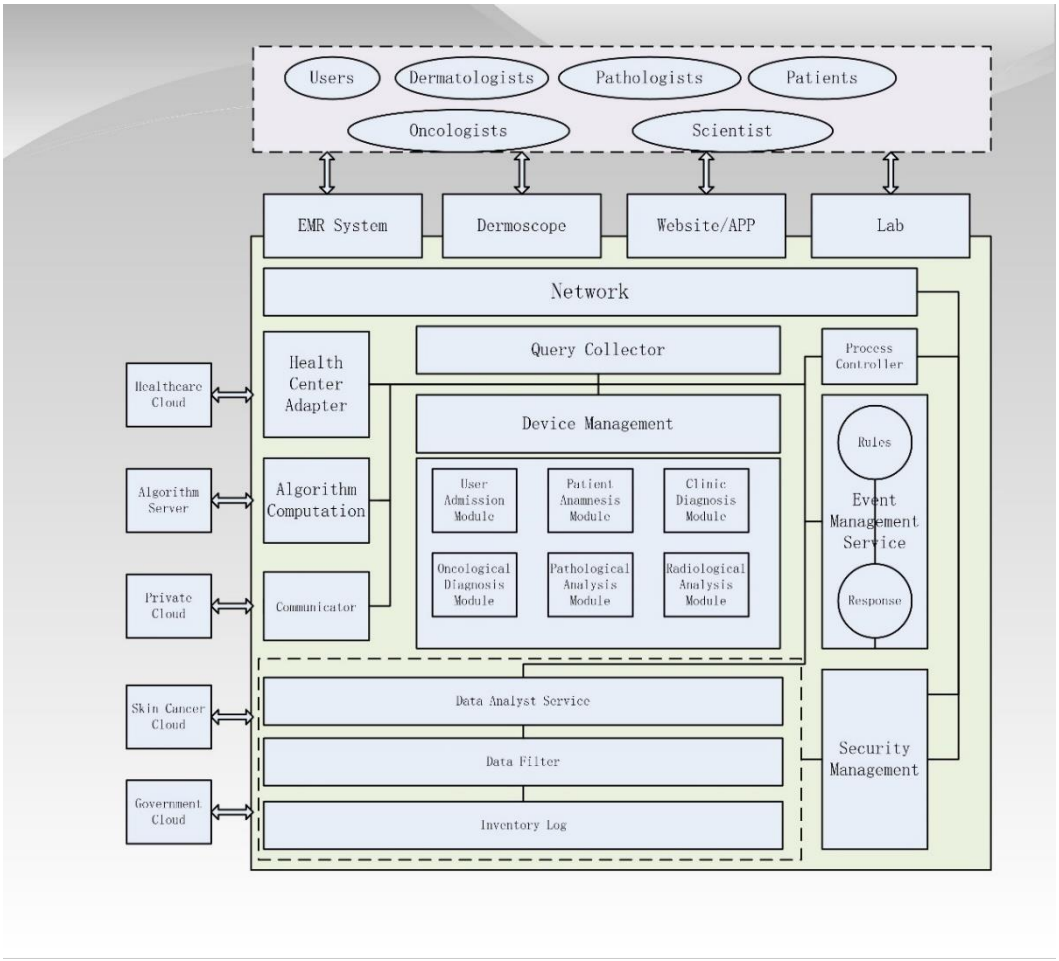


Figure 6-11--Data Service Framework Diagram

7 TO-BE MODEL ANALYSIS

7.1 SIMULATION ANALYSIS

Primary Healthcare level (Line-1) as the resource service commander, appointment trigger capability has arrived to the 98.27% significantly while balancing the GP activities, with the service monitoring operation line 82.86% in the number of instances of appointment request event. To the Secondary level (Line-2) of Healthcare, 48.43% GP work loading without any stressure in average as handling of capacity, however, Tertiary Healthcare (Line 3) would be glad to volume of target appointment events in 81.69%.

Scenario information

Name	What if - AppointmentTriggerBalance-450 (2)
Time unit	Minutes
Duration	030,00:00:00

Resource	Utilization	Total fixed cost
HC-Line1	82.86 %	0
Specilast	67.66 %	0
GP-2	48.43 %	0
HC-Line3	62.85 %	0
HC-Line2	33.58 %	0
GP-3	81.69 %	0
GP-1	98.27 %	0
	Total	0

Figure 7-1--Appointment Trigger Resource Utilization (TO-BE)

Time unit Minutes

Duration 030,00:00:00

Name	Type	Instances completed	Instances started	Min. time	Max. time	Avg. time	Total time	wa
Appointment Service	Process	455	455	2h 42m 23s	26d 46m 7s	6d 18h 44m 44s	3085d 9h 18m 12s	
Physicians are available	Gateway	1,196	1,196					
ExclusiveGateway	Gateway	406	406					
ExclusiveGateway	Gateway	118	118					
Examination Terminal (3)	End event	359						
Adjust Physical Resource	Task	1,471	1,471	18s	2d 5h 27m 4s	1d 1h 55m 59s	1589d 11h 50m 59s	0
Trigger Balance Resource	Task	1,078	1,078	1s	9m 59s	5m	3d 18h 6m 8s	0
Update EMRS	Task	1,078	1,078	5s	6m 59s	4m 26s	3d 7h 56m 42s	0
Estimate Task Priority	Task	1,078	1,078	12m 2s	2d 5h 42m 9s	1d 2h 23m 47s	1185d 15h 32m 6s	0
Request Secondary Clinics	Task	118	118	2m 9s	2h 54m 34s	32m 1s	2d 14h 59m	0
Request Tertiary Services	Task	346	346	1m 19s	3h 22m 11s	36m 12s	8d 16h 49m 17s	0

Figure 7-2--Appointment Trigger Simulation Analysis (TO-BE)

About the average time of fulfilling, 6 days and 18hours for 455 instances completed without any undisposed service respond, means, 8.125 event per hour the average duration of each processing. This series of simulation data is expected to validate as real healthcare system statistics results.

7.2 ISSUES RISK AWARENESS

Risk is an assessment of the randomness, likelihood, and extent of loss of known defects and potential events(Groups, n.d.). Although medical diagnostic treatment and supervision rules have been respectively constraints, including the decision making, strategy implementation, information production and technology delivery, disease screening, intervention analysis, etc. a series of behavior in prioritization assessment with executable assumptions will remind us of the severity of the hazard. The transparency of monitoring risk is embodied in the form of separating mission entities and organizational decision-making functions, which is aimed to prevent the ripple effects of unpredictable factors.

As for risk assessment methods, Event Tree Analysis (ETA) and Fault Tree Analysis (FTA) methods (Marhavilas et al., 2014) are common, presetting the correlation of events and severity of damage in the health system framework assisted in the assessment of risk issues of medical and health models(*Guidelines for Hazard Evaluation Procedures, 3rd Edition*, n.d.). After dividing the task scope, according to the mutually exclusive probability, success, and failure contrast to the event results, the identifiable logic procedure can be measured in sequential inference.

Having the insight of digital technology with technical risks posed by remote services mainly focus on the continuity and security of data delivery, the reliability will rely on coordination between patients and experts. Normative evaluation of the technical behaviors will inevitably condition the accuracy of the overall cancer screening process.

Table 7-1--Major Risk (TO-BE)

Enrollment	Risk	Impact
Self-Examination	1	Self-check and make appointments via mobile phones or devices
Device/APP	2	Cost on installation, and maintenance of medical devices and software. Risks possibly arise from network security and device security
Dermatology	2	Check-up Cost and Scan Cost Permission Authorization Accumulation of Skills and Experience
Biopsy	3	Biopsy Operation Risk, Tumor Definition and Analyzation Cost
Cancer Image Machine Learning	3	Algorithm Development and research cost Data Transformation and Data Management Cost Data Security Risk
Healthcare Hub	3	Identification Deviation Risk Image Analysis Cost Balance Physical Resource Respond for issues solutions Arrange Remote Training

8 VALIDATIONS

This expert interview mainly includes experts in three fields to verify the To-BE model. The first group of experts included Luís d'Orey, director of the operating room of the Instituto Portuguese de Oncology de Lisbon Francisco Gentil E.P.E. (IPO Lisbon), and Cecilia Moura, director of the Dermatology Department (IPO Lisbon), in their understanding of the self-screening process of skin cancer, the risks of task execution and the possibility of introducing remote technology in the future. The second interviewee is Weiwei.Liu, a consultant of Nursing Administration of Royal Adelaide Hospital (RAH) in Australia. As The skin cancer in Australia has always been the highest-risky incidence country of Skin Cancer in the world, with the rate of Age-standardized rate of 33.6 per 100,000 including male and female. But by their undisputed facts references from their rich experience in remote screening, patient care and perfect medical process management system can contribute more worthful information and advice. The third experts Rodrigo Almaraz Barrientos, as Supervisor of Business Process Management from UNIR university and Bolivian Institute for Standardization and Quality (IBNORCA), with more than 10 years of experience in Process Management and ISO Quality System. The last Bharat Hooda who is manager of quality management and network capacity in Siemens Company, with unique opinions and views on the digitization of healthcare processes and service. Each group of experts surveyed and interviewed two or three times, including on-site interviews and email discussions.

Each group of experts' interviews were separately practiced through face-to-face, online or email discussions. After the experts understood the background and objective of the paper and the AS-IS and TO-BE models are presented as well, the four questions are figured out with the answer's basis on their working experience, knowledge, and expertise.

Interview Answers were recorded and transcribed are:

1. What aspects of the TO-BE model do you think can help relieve the pressure of insufficient medical resources?

EP1: In terms of the current screening process, there is no detail data to prove that the current system will break down because it does not consider the opportunity for large numbers of patients to be screened simultaneously. But definitely there is a concern of the resource balance for health care supporters including physicians and nurses, as its clear shortage of professionals for remote screening.

There is some training and awareness about the basics of skin cancer, but doctors' resources are still waiting more attendants to join together.

EP2: It may be difficult to solve the imbalance of medical staff in the short term. For example, people living in rural areas or remote suburbs have to perform examinations by themselves at a distance. Moreover, dermatoscopes are expensive, and we don't know much about the use of dermatoscopes.

EP3: Need more data tracking to learn about the relation between these two subjects.

EP4: I believe this new BPM model helpful for organizations to map the medical resources with existing processes, and then streamline or improve the processes to make them more efficient.

2. Which aspects do you think that the scalability of BPM as a reference to decision-makers will prompt transitional solutions for healthcare solution diversification?

EP1: The new model requires a lot of simulation data to be validated, which is currently lacking in Both Portugal and Europe.

Some doctors prefer to use the current screening model because the procedure is simpler and skin cancer is not a major cancer in Portugal. But each new test means that a lot of experimental data needs to be involved, possibly from appointment systems, referrals, family doctors, oncologists, and even radiologists. At present, the data may be difficult to collect, but it is very helpful.

It's important to educate a lot of people about the risks of skin cancer, and we organize events like this every year on pan-Europe Melanoma. There are some categories on that website that are at high risk for melanoma, airline people, elderly people, outdoor workers, and they all have their own risk. But we want to be able to teach more young people that skin cancer is more than just melanoma and that society needs to do something about it.

What patients worry about biopsy surgery is probably coming from the self-suggestion before surgery, such as pain, scar, infection, and other problems, because those may cause some psychological burden. We need to communicate with them in this aspect before or after screening. In the diagnosis of the patient, we also need the intervention of the psychologist, but it depends on the needs of the patient. Not every patient who learns that they have cancer needs counseling, but we do recommend counseling if they find that they have sad or depressed mood changes. So, family care is indispensable. In conclusion, if critical decisions can be made before the initial diagnosis of skin cancer, it will greatly reduce the incidence of skin cancer spread, because this is not desirable.

EP2: I have trial of using Applications for testing dermatological diseases on mobile phones are, but it is not clear which one is effective and whether patients' privacy will be compromised. Some elderly people around me do not trust these new products and services, so sometimes there are some complaints. I doubt how long it takes for this feedback to reach the decision-makers of skin cancer detection, but the functionality needs to be pointed out.

Another point, any information given by a patient must not be passed to a third party either intentionally or unintentionally. So, it is essential that the highest level of security and digital protection is used when storing patient data in hospital or clinic. For example, hospital/clinics should uphold strict confidentiality procedures to ensure staff member is familiar with the confidentiality content and understands what information should not be shared outside of the working environment.

EP3: Scalability management is an important element to consider when evaluating BPM tools, as they can undoubtedly limit access to patients, especially in the case of mass services.

EP4: This model will help to choose and integrate digital health tools. These digital tools have vast potential to increase our ability for accurately diagnose. Also, enhance the delivery of health care for the individual.

3. What do think the new BPM model can be used as a reference to promote the implementation of remote assisted skin cancer screening?

EP1: Remote skin cancer models have been developed, but new BPM models for which remote skin cancer screening is appropriate for different groups of patients require further collaboration with skin cancer organizations and rational interpretation based on available data.

EP2: It is a fantastic modern method for monitoring skin cancer, especially in the country with ununiform population distribution. It is no doubt that dermatoscopy with proper training can help with diagnosis of skin cancer especially for the residents in remote area. It is essential for government to set up a vital objective when developing digital health in terms of cancer diagnosis/care in remote care. For example, providing adequate training to radiographer/photographer to manage mobile dermatoscopy unit which sends all of the photographs electronically to the city dermatologists and oncologists, who evaluate the images, and give diagnosis.

EP3: The new model is a first step that will go a long way towards enabling remote assistance. Their effectiveness must be continuously evaluated to improve their use.

EP4: It is improvement of healthcare delivery to places where distance become an obstacle. This new BPM model represents a great potential for Skin Cancer screening as visual analysis phase is required.

4. What improvements do you think the new BPM model needs to make in process?

EP1: The description of the whole functional process meets the design of the future digital screening direction. However, once the screening project is implemented, we still need to introduce the supervision and review function to ensure various problems in the screening process, such as personnel communication, technical support, data protection, standard index verification and so on. Particularly in risk assessment, detailed data assessment is required to determine whether personnel and technical costs can be avoided or reduced during effective screening implementation.

EP2: To implement an effective community-based programme in remote area, an issue of staff shortage needs to be solved. Extending nurses' code of conduct may take on some functions of doctors, so that to reduce the cost and to improve the service provision. It is a common use of specialist nurses to help with diagnosis and treatment in remote setting hospital. However, the skin cancer screening protocol should be followed.

EP3: Opportunities for process improvement can be identified in the monitoring of the process in execution. I recommend the application of Lean Six Sigma principles, techniques, and tools for continuous improvement.

EP4: Some automated workflows can be added to make this BPM model more efficient and less time-consuming. Automation in BPM model help patients to make easier to access care. The use of an electronic health record containing the images, the skin phototypes, and demographic characteristics will make easy to understand and time saving.

9 DISCUSSIONS

This dissertation aims on a multi-task solution for skin cancer screening decision making. In premise of balancing medical resources at all levels of health care institutions, clinics, and doctors, introducing task priorities and screening detection objectives by real-time variants launch the screening process to prove the accuracy in full of view with a series of joint consultation and self-examinations behaviors.

The medical resources of community hospitals need to be trained to remotely assist doctors in the use of dermatoscopes, but many patients may still insist on face-to-face screening because they believe it is currently the only way to identify skin cancer. Therefore, we need accurate assessment data on how many people would like or meet the need to use remote screening for skin cancer at first diagnosis as the first screening goal to determine how to intake community healthcare resources to enroll the skin cancer screening project.

The openness of laws and regulations on health data is reflected in the rights and obligations granted to the standardization and operability of data use by the data protection systems. The collection, processing and transfer of data shall have legal basis. The implementation of the data management and supervision is to discussion how to protect personal data in the particularity of data form and the way to deal with data relations on the basis of voluntary and equality principles. It is necessary for public medical institutions to provide multiple options for data application(Raghupathi & Raghupathi, 2014). Otherwise, a compromise will be materialized beyond of misleading the basic principles of data governance when users of one-way data control were deprived their decision-making rights to choose data.

The accuracy of medical data determines the validation on the technical usage and the next steps of processing to doctors and scientists. Whether it is the formulation of dermatoscopes parameter standard, the acquisition of gene database screening factor or the algorithm recognition of sensitivity and specificity in image processing, it is inseparable from the discussion about measurement to biopsy reliability, dermatology accuracy and the reasonability on algorithm application.

In addition, there is a more typical controversy, such as whether the movable range of data should be based on subject confirmation rather than considering individual confirmation consent. In the situation of a new data form is generated in the process of data transformation, there is still no conclusion as it is to discuss the scope of use of the data for further.

Determination of test criteria, skin lesion index, sensitivity and specificity, and diagnostic accuracy of skin lesion index basis on the pathology evaluation, dermoscopy index analysis, identification results and follow-up comparison.

Non-melanoma skin cancer cannot be determined solely by ABCDE principle, inherited genes are individual differences. For example, the main causes of basal cell carcinoma are found to be that transmembrane receptor protein PTCH is related to basal cell nevus syndrome, somatic mutation is related to sporadic skin BCC, and the pathogenic factor of BAP gene has not been determined yet (PDQ Adult Treatment Editorial Board, 2020). Therefore, there are uncertainties and unknowns in local diagnosis using genetic testing. This also creates a technical barrier for the remote realization of genetic testing and dermatoscopy combination.

At present, face-to-face consultation is the main pathway to diagnose skin cancer, while remote expert dermatoscopy screening provides convenience for early targeted prevention and reliable detection of preventing deep skin cancer lesions for special people. The accuracy of remote screening depends on the expert and the patient's dermatoscopy technique, but a pathology report is no substitute for a definitive diagnosis of skin cancer.

The accessibility and equity of personal medical records are activated under the framework of EMRS personal appointment process. Services as dynamic nodes are provided to users with different levels of validity through encryption and decryption security technology. However, in the process of remote personal screening, patients are still restricted by hacker attacks, information loss, interruption of transmission, imperfect data, and many other factors. Patients' participation in remote skin cancer screening is not very intense in that the risk of personal privacy disclosure is not removed.

Indeed, the introduction of different options for new remote skin cancer screening raises the potential to change the relative path of screening. The sustainability and scalability of two diagnostic processes are considered, including one is noted as Person-Centered Integrative Diagnosis (PID)， and the other one accounting with Meta-Centred Clinical Diagnosis involvement.

Currently, the screening methods available to individuals are mainly face-to-face detection, while in the TO-BE, the full-distance screening or semi-distance mixed skin cancer screening will be persistent to expand the treatment scope coverage through expert guidance and community training. That will be subjected to the accountability on chronic diseases including cancers for Primary and Secondary Healthcare Service non-emergency precontrol against risk-resistance.

The current process (As-IS) single mandate with less transparency and permissions, the activities are specified in processing independence without generating a large number of multi-dimensional nodes, yet even did not have cross-level data platform interaction capabilities to release. Therefore, a vertical authorization screening resource balance mechanism is an alternative. According to the simulation data calculation of the model, it can estimate the emergency capacity and risk reduction possibility of the three levels of Primary, Secondary and Tertiary healthcare service under the processing of health and medical resources.

The SDM decision-making framework provides a reference for solving the doctor-patient screening and diagnosis plan for chronic cancer diseases. Dermatologist and scientist compared AI image recognition results, classification in stages under different types of skin cancer screening process to obtain the clues to each sub-type of melanoma and other non-melanoma carcinoma.

10 CONCLUSIONS

The first objective of this dissertation is to figure out the existing main methods and processes of skin cancer screening (AS-IS Model), and then to present a design model for the future (TO-BE Model) as comparative reference. Throughout analyzing the importance of public decision-making, some evidence for source-based screening and remote screening are attempted to track for exploring new skin cancer screening solutions. The models and processes were validated during experts' interviews and discussions.

In the research, we have investigated what factors influence public health decisions - self and public decisions - in determining skin cancer screening. Public decision making provides reference for the possibility of standardized operation and legal guarantee of screening procedures and targets, but many challenges have to be mentioned, whether it is remote skin cancer screening patients' dependence on face-to-face screening and data security vigilance, or digital dermatoscopy, tele-radiology, AI technology support for high resolution imaging faces costs and technical risks. In the existing screening model process, patient self-screening and prevention dominate, so that insufficient screening and imaging data for different sub-skin cancer types collected by public decision making are not adequate to provide digital resources for completely enrolling AI analysis detection.

At this stage, especially within the scope of the existing resources defined engaged, the level of authority is insufficient, and the event processing capability of different levels is predicted according to the model. In data-driven and task-driven modes, both static and dynamic objects will be referential research into practice. Entity attributes are no longer stared at data input and output request, additional attribute with explorable extensibilities and driving capabilities will also occur as part of the dynamic data flow. Process nodes drive tasks. Although the promotion of cloud technology improves the activity and intelligent radiation range of data, the large-scale expansion of module carrying capacity may not adapt to the configuration of between each region and medical center in crossing-layer institutions. Balancing medical resources and cost control is the direction of sustainable medical center digital services to improve disease control. In this way, a deductive map for the algorithm to predict future changes in suspected tumors that will be provided to the next step for machine learning in possibility.

11 LIMITATIONS AND RECOMMENDATIONS FOR FUTURE WORKS

The limitations of telemedicine implementation are constricted by legislations, ethics, health insurance policies and the success rate of innovative technologies that patients have to consider during skin cancer screening. For example, in the Intelligent Business Performance Management (IBPM) era, in the event that personal privacy issues in the data bank are protected under the data security protocol agreement, does the portable equipment or device implanted in the use of the sensor affect the credibility of the implementation of a remote skin cancer diagnosis?

Decision-makers need to provide more evidence on what models to implement for cloud data services, in this model not yet concluded. Different subtypes of skin cancer require a large number of data parameters and professional evaluation as to which time series analysis model to use for analysis due to the different proportions of dermoscopy. With conjunct risk measure models, especially cost-sharing estimation models, to identify medical decisions that affect cost changes due to the introduction of medical insurance and medical technology, assuming that process analysis and state operation priorities have been determined. Attending on data transformation and execution effectiveness brought by cost decision-making will enable the public decision center to propose a factor analysis system for the socialized operation of disease control.

About intelligent medical decision-making system architecture thinking, how to capture the sensitive factors affecting the screening process of the system and reflect them in the intelligent terminal through the algorithm can assist doctors to participate in the cancer image capture quickly and accurately, which is flexible assignment to practice for various reasons. Skin cancer screening scenario simulation conditions are diverse, and it is hoped that more availability data can be obtained through real simulation experiments to provide dynamic data support for data-cloud-driven decision intelligence.

In view of complexity of the skin cancer pathogenesis remains to be further researched through more sophisticated optical device, image recognition algorithm and genetic genealogy data forecast and validation, hope that this model by the dermatology detecting results with different variables and image simulation data, will be expedited to perceive the clues to the rare cancer root in earlier stage of groups.

These risk factors need to be investigated until when is introduced into the model to further explore and predict the incidence of skin cancer in a variety of conditions. More than that as so far, it is necessary to verify which quality factors drive the variation of carrying capacity and conceptional deviation fluctuation besides priority and cost under different decision-making and multi-task in parallelized conditions.

BIBLIOGRAPHY

Adams, W. C. (2015). Conducting Semi-Structured Interviews. In *Handbook of Practical Program Evaluation* (pp. 492–505). John Wiley & Sons, Inc. https://doi.org/10.1002/9781119171386.ch19

Agarwal Gupta, N., & Kabra, M. (2014). Diagnosis and management of Down syndrome. *Indian Journal of Pediatrics*, *81*(6), 560–567. https://doi.org/10.1007/s12098-013-1249-7

Ahmed jan, N., & Masood, S. (2021). Poroma. In *StatPearls*. http://www.ncbi.nlm.nih.gov/pubmed/32809744

Andellini, M., Fernandez Riesgo, S., Morolli, F., Ritrovato, M., Cosoli, P., Petruzzellis, S., & Rosso, N. (2019). *Experimental application of Business Process Management technology to manage clinical pathways: a pediatric kidney transplantation follow up case*. https://doi.org/10.1186/s12911-017-0546-x

Andrews, R., Wynn, M., Vallmuur, K., ter Hofstede, A., Bosley, E., Elcock, M., & Rashford, S. (2019). Leveraging Data Quality to Better Prepare for Process Mining: An Approach Illustrated Through Analysing Road Trauma Pre-Hospital Retrieval and Transport Processes in Queensland. *International Journal of Environmental Research and Public Health*, *16*(7), 1138. https://doi.org/10.3390/ijerph16071138

Avhad, G., Ghuge, P., & Jerajani, H. R. (n.d.). Generalized eruptive syringoma. *Indian Journal of Dermatology*, *60*(2), 214. https://doi.org/10.4103/0019-5154.152586

Barbazza, E., Kringos, D., Kruse, I., Klazinga, N. S., & Tello, J. E. (2019). Creating performance intelligence for primary health care strengthening in Europe. *BMC Health Services Research*. https://doi.org/10.1186/s12913-019-4853-z

Becker, J. C., Stang, A., DeCaprio, J. A., Cerroni, L., Lebbé, C., Veness, M., & Nghiem, P. (2017). Merkel cell carcinoma. *Nature Reviews Disease Primers*, *3*(1), 17077. https://doi.org/10.1038/nrdp.2017.77

Bennett, C. C., & Hauser, K. (2013). Artificial intelligence framework for simulating clinical decision-making: A Markov decision process approach. *Artificial Intelligence in Medicine*. https://doi.org/10.1016/j.artmed.2012.12.003

Bernardes Filho, F., Martins, G., Luchi, G. S., Kac, B. K., Nery, J. A. da C., Azulay-Abulafia, L., & Azulay, D. R. (2014). Multiple lesions by vampire bat bites in a patient in Niterói, Brazil - Case report. *Anais Brasileiros de Dermatologia*, *89*(2), 340–343. https://doi.org/10.1590/abd1806-4841.20142996

Bhambri, A., & Del Rosso, J. Q. (2009). Solitary sclerotic fibroma. *The Journal of Clinical and Aesthetic Dermatology*, *2*(6), 36–38. http://www.ncbi.nlm.nih.gov/pubmed/20729948

Bomhof-Roordink, H., Gärtner, F. R., Stiggelbout, A. M., & Pieterse, A. H. (2019). Key components of shared decision making models: a systematic review. *BMJ Open*, *9*(12), e031763. https://doi.org/10.1136/bmjopen-2019-031763

Buja, A., Toffanin, R., Claus, M., Ricciardi, W., Damiani, G., Baldo, V., & Ebell, M. H. (2018). Developing a new clinical governance framework for chronic diseases in primary care: An umbrella review. *BMJ Open*. https://doi.org/10.1136/bmjopen-2017-020626

Carroll, C. T. (2013). *Six Sigma for Powerful Improvement*. Productivity Press. https://doi.org/10.1201/b14806

Casteleyn, L., Dumez, B., Van Damme, K., & Anwar, W. A. (2013). Ethics and data protection in human biomarker studies in environmental health. *International Journal of Hygiene and Environmental Health*. https://doi.org/10.1016/j.ijheh.2013.03.016

Castori, M., Ruggieri, S., Giannetti, L., Annessi, G., & Zambruno, G. (2008). Schöpf-Schulz-Passarge syndrome: further delineation of the phenotype and genetic considerations. *Acta Dermato-Venereologica*, *88*(6), 607–612. https://doi.org/10.2340/00015555-0547

Trigeminal trophic syndrome simulating rodent ulcer basal cell carcinoma: a new clinico-dermoscopic approach, 92 Anais Brasileiros de Dermatologia 148 (2017). https://doi.org/10.1590/abd1806-4841.20175762

Catalano, R., McConnell, W., Forster, P., McFarland, B., & Thornton, D. (2003). Psychiatric emergency services and the system of care. *Psychiatric Services*. https://doi.org/10.1176/appi.ps.54.3.351

Charifa, A., Volner, K., & Oakley, A. M. (2021). Intraepidermal Carcinoma. In *StatPearls*. http://www.ncbi.nlm.nih.gov/pubmed/29494081

Cheng Low, P. K., & Ang, S. L. (2013). Confucian Ethics, Governance and Corporate Social Responsibility. *International Journal of Business and Management*. https://doi.org/10.5539/ijbm.v8n4p30

Cheung, W. L., Patel, R. R., Leonard, A., Firoz, B., & Meehan, S. A. (2012). Amelanotic melanoma: a detailed morphologic analysis with clinicopathologic correlation of 75 cases. *Journal of Cutaneous Pathology*, *39*(1), 33–39. https://doi.org/10.1111/j.1600-0560.2011.01808.x

Chimenos-Küstner, E., Pascual, M., Blanco, I., & Finestres, F. (n.d.). Hereditary familial polyposis and Gardner's syndrome: contribution of the odonto-stomatology examination in its diagnosis and a case description. *Medicina Oral, Patologia Oral y Cirugia Bucal*, *10*(5), 402–409. http://www.ncbi.nlm.nih.gov/pubmed/16264375

Coskey, R. J., & Pinkus, H. (1976). Trichodiscoma. *International Journal of Dermatology*, *15*(8), 600–601. https://doi.org/10.1111/j.1365-4362.1976.tb04898.x

Costello, C. M., Han, M. Y., Severson, K. J., Maly, C. J., Yonan, Y., Nelson, S. A., Swanson, D. L., & Mangold, A. R. (2021). Dermoscopic characteristics of microcystic adnexal carcinoma, desmoplastic trichoepithelioma, and morpheaform basal cell carcinoma. *International Journal of Dermatology*, *60*(3). https://doi.org/10.1111/ijd.15040

Crane, J. S., Rutt, V., & Oakley, A. M. (2021). Birt Hogg Dube Syndrome. In *StatPearls*. http://www.ncbi.nlm.nih.gov/pubmed/28846260

Cudney, E. A., & Furterer, S. L. (Eds.). (2016). *Design for Six Sigma in Product and Service Development*. CRC Press. https://doi.org/10.1201/b12090

Cueto, M. (2004). The origins of primary health care and selective primary health care. In *American Journal of Public Health*. https://doi.org/10.2105/AJPH.94.11.1864

Dahl, N. A., Sheil, A., Knapke, S., & Geller, J. I. (2016). Gardner Fibroma: Clinical and Histopathologic Implications of Germline APC Mutation Association. *Journal of Pediatric Hematology/Oncology*, *38*(5), e154-7. https://doi.org/10.1097/MPH.0000000000000493

Damij, N., Damij, T., Grad, J., & Jelenc, F. (2008). A methodology for business process improvement and IS development. *Information and Software Technology*. https://doi.org/10.1016/j.infsof.2007.11.004

Dimarogonas, D. V., Frazzoli, E., & Johansson, K. H. (2012). Distributed event-triggered control for multi-agent systems. *IEEE Transactions on Automatic Control*. https://doi.org/10.1109/TAC.2011.2174666

Dinnes, J., Bamber, J., Chuchu, N., Bayliss, S. E., Takwoingi, Y., Davenport, C., Godfrey, K., O'sullivan, C., Matin, R. N., Deeks, J. J., & Williams, H. C. (2018). High-frequency ultrasound for diagnosing skin cancer in adults. In *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.CD013188

Dlamini, Z., Francies, F. Z., Hull, R., & Marima, R. (2020). Artificial intelligence (AI) and big data in cancer and precision oncology. In *Computational and Structural Biotechnology Journal*. https://doi.org/10.1016/j.csbj.2020.08.019

Eddie G. Montgomery, U. of M. U. C. (2014). TALENT MANAGEMENT VULNERABILITY IN GLOBAL HEALTHCARE VALUE CHAINS: A GENERAL SYSTEMS THEORY PERSPECTIVE. *Journal of Business Studies Quarterly*, *Volume 5,*.

Elango, B., Paul, K., Kundu, S. K., & Paudel, S. K. (2010). Organizational Ethics, Individual Ethics, and Ethical Intentions in International Decision-Making. *Journal of Business Ethics*. https://doi.org/10.1007/s10551-010-0524-z

Eleanor Bird, Fox-Skelly, J., Jenner, N., Larbey, R., Weitkamp, E., & Winfield, A. (2020). The ethics of artificial intelligence Issues and initiatives. In *STOA | Panel for the Future of Science and Technology AUTHORS*.

ENCR. (2015). Malignant Melanoma of the Skin (MM) Factsheet. In *European Network of Cancer Registries*.

Esteva, A., Kuprel, B., Novoa, R. A., Ko, J., Swetter, S. M., Blau, H. M., & Thrun, S. (2017). Dermatologist-level classification of skin cancer with deep neural networks. *Nature*. https://doi.org/10.1038/nature21056

Fabiano, N. (2019). Robotics, intelligent systems, ethics and data protection. *PervasiveHealth: Pervasive Computing Technologies for Healthcare*. https://doi.org/10.1145/3309772.3309787

Ferreira, G. S. A., Silva, U. R., Costa, A. L., & Pádua, S. I. D. de D. (2018). The promotion of BPM and lean in the health sector: main results. *Business Process Management Journal*, *24*(2), 400–424. https://doi.org/10.1108/BPMJ-06-2016-0115

Freet, D., Agrawal, R., John, S., & Walker, J. J. (2015). Cloud forensics challenges from a service model standpoint: IaaS, PaaS and SaaS. *7th International ACM Conference on Management of Computational and CollEctive Intelligence in Digital EcoSystems, MEDES 2015*. https://doi.org/10.1145/2857218.2857253

Gay, J. T., Troxell, T., & Gross, G. P. (2021). Muir-Torre Syndrome. In *StatPearls*. https://doi.org/30020643

Genova, K., & Guliashki, V. (2011). Linear integer programming methods and approaches - A survey. *Cybernetics and Information Technologies*.

Gershenwald, J. E., Scolyer, R. A., Hess, K. R., Sondak, V. K., Long, G. V., Ross, M. I., Lazar, A. J., Faries, M. B., Kirkwood, J. M., McArthur, G. A., Haydu, L. E., Eggermont, A. M. M., Flaherty, K. T., Balch, C. M., & Thompson, J. F. (2017). Melanoma staging: Evidence-based changes in the American Joint Committee on Cancer eighth edition cancer staging manual. *CA: A Cancer Journal for Clinicians*, *67*(6), 472–492. https://doi.org/10.3322/caac.21409

Giavina-Bianchi, M., Giavina-Bianchi, P., Sotto, M. N., Rodig, S., Mihm, M., Festa Neto, C., Duncan, L. M., & Kalil, J. (2020). Nodular primary cutaneous melanoma is associated with PD-L1 expression. *European Journal of Dermatology : EJD*, *30*(4), 352–357. https://doi.org/10.1684/ejd.2020.3846

Globle Coalition. (2021). *2O2O Melanoma Skin Cancer Report Stemming the global epidemic*. https://melanomapatients.org.au/wp-content/uploads/2020/04/2020-campaign-report-GC-version-MPA_1.pdf

Goeteyn, M., Geerts, M. L., Kint, A., & De Weert, J. (1994). The Bazex-Dupré-Christol syndrome. *Archives of Dermatology*, *130*(3), 337–342. http://www.ncbi.nlm.nih.gov/pubmed/8129412

Gong, H.-Z., Zheng, H.-Y., & Li, J. (2019). Amelanotic melanoma. *Melanoma Research*, *29*(3), 221–230. https://doi.org/10.1097/CMR.0000000000000571

Goydos, J. S., & Shoen, S. L. (2016). Acral Lentiginous Melanoma. *Cancer Treatment and Research*, *167*, 321–329. https://doi.org/10.1007/978-3-319-22539-5_14

Groups, I. T. M. B.-. (n.d.). *ISO GUIDE 73:2009* (1st ed.). https://www.iso.org/standard/44651.html

Guidelines for Hazard Evaluation Procedures, 3rd Edition. (n.d.).

Gupta, N., Sunwoo, B. Y., & Kotloff, R. M. (2016). Birt-Hogg-Dubé Syndrome. *Clinics in Chest Medicine*, *37*(3), 475–486. https://doi.org/10.1016/j.ccm.2016.04.010

Hafsi, W., Badri, T., & Shah, F. (2021). Apocrine Hidrocystoma. In *StatPearls*. http://www.ncbi.nlm.nih.gov/pubmed/28846245

Hanssen, A. M., & Fryns, J. P. (1995). Cowden syndrome. *Journal of Medical Genetics*, *32*(2), 117–119. https://doi.org/10.1136/jmg.32.2.117

Hashim, P. W., Chen, T., Rigel, D., Bhatia, N., & Kircik, L. H. (2019). Actinic Keratosis: Current Therapies and Insights Into New Treatments. *Journal of Drugs in Dermatology : JDD*, *18*(5), s161-166. http://www.ncbi.nlm.nih.gov/pubmed/31141862

Helfand, M., Mahon, S. M., Eden, K. B., Frame, P. S., & Orleans, C. T. (2001). Screening for skin cancer. *American Journal of Preventive Medicine*. https://doi.org/10.1016/S0749-3797(01)00258-6

Herrera Sánchez, M., Suánez Fernández, R., del Cerro Heredero, M., Rueda Gómez-Calcerrada, M., Vigaray Conde, J., & Sánchez Yus, E. (1998). Sclerotic fibroma. *Dermatology (Basel, Switzerland)*, *196*(4), 429–430. https://doi.org/10.1159/000017939

Hoerbst, A., Hackl, W. O., Blomer, R., & Ammenwerth, E. (2011). The status of IT service management in health care - ITIL ® in selected European countries. *BMC Medical Informatics and Decision Making*. https://doi.org/10.1186/1472-6947-11-76

Hopkins, C., Moyer, A., & Huttenbach, Y. T. (2020). Spiradenoma With Adenoid Cystic Carcinoma-Like Features. *The American Journal of Dermatopathology*, *42*(6), 442–445. https://doi.org/10.1097/DAD.0000000000001594

Hossain, M. S., & Muhammad, G. (2016). Cloud-assisted Industrial Internet of Things (IIoT) - Enabled framework for health monitoring. *Computer Networks*. https://doi.org/10.1016/j.comnet.2016.01.009

I-scoop. (2017). Industry 4.0: the fourth industrial revolution – guide to Industrie 4.0. *I-Scoop*.

Iacobelli, J., Harvey, N. T., & Wood, B. A. (2017). Sebaceous lesions of the skin. *Pathology*, *49*(7), 688–697. https://doi.org/10.1016/j.pathol.2017.08.012

Iyer, V., Ganti, B., Hima Vyshnavi, A. M., Krishnan Namboori, P. K., & Iyer, S. (2020). Hybrid quantum computing based early detection of skin cancer. *Journal of Interdisciplinary Mathematics*. https://doi.org/10.1080/09720502.2020.1731948

Jazdi, N. (2014). Cyber physical systems in the context of Industry 4.0. *Proceedings of 2014 IEEE International Conference on Automation, Quality and Testing, Robotics, AQTR 2014*. https://doi.org/10.1109/AQTR.2014.6857843

Jetzek, T., Avital, M., & Bjørn-Andersen, N. (2019). The sustainable value of open government data. *Journal of the Association for Information Systems*. https://doi.org/10.17705/1jais.00549

Ji, X., Yin, Z., Zhang, Y., Wang, M., Zhang, X., Zhang, C., & Wang, D. (2021). Real-time robust forecasting-aided state estimation of power system based on data-driven models. *International Journal of Electrical Power and Energy Systems*. https://doi.org/10.1016/j.ijepes.2020.106412

Jordão, C., de Magalhães, T. C., Cuzzi, T., & Ramos-e-Silva, M. (2015). Cylindroma: an update. *International Journal of Dermatology*, *54*(3), 275–278. https://doi.org/10.1111/ijd.12600

Jovanovic, P., Mihajlovic, M., Djordjevic-Jocic, J., Vlajkovic, S., Cekic, S., & Stefanovic, V. (2013). Ocular melanoma: an overview of the current status. *International Journal of Clinical and Experimental Pathology*, *6*(7), 1230–1244. https://doi.org/10.1007/s11912-012-0244-x

Kazakov, D. V. (2016). Brooke-Spiegler Syndrome and Phenotypic Variants: An Update. *Head and Neck Pathology*, *10*(2), 125–130. https://doi.org/10.1007/s12105-016-0705-x

Kermany, D. S., Goldbaum, M., Cai, W., Valentim, C. C. S., Liang, H., Baxter, S. L., McKeown, A., Yang, G., Wu, X., Yan, F., Dong, J., Prasadha, M. K., Pei, J., Ting, M., Zhu, J., Li, C., Hewett, S., Dong, J., Ziyar, I., … Zhang, K. (2018). Identifying Medical Diagnoses and Treatable Diseases by Image-Based Deep Learning. *Cell*. https://doi.org/10.1016/j.cell.2018.02.010

Khan, F. A., Ali, A., Abbas, H., & Haldar, N. A. H. (2014). A cloud-based healthcare framework for security and patients' data privacy using wireless body area networks. *Procedia Computer Science*. https://doi.org/10.1016/j.procs.2014.07.058

Kibbi, N., Worley, B., Owen, J. L., Kelm, R. C., Bichakjian, C. K., Chandra, S., Demirci, H., Kim, J., Nehal, K. S., Thomas, J. R., Poon, E., & Alam, M. (2020). Sebaceous carcinoma: controversies and their evidence for clinical practice. *Archives of Dermatological Research*, *312*(1), 25–31. https://doi.org/10.1007/s00403-019-01971-4

Kim, K. S., & Weinberg, P. E. (1981). Dermoid tumor. *Surgical Neurology*, *15*(5), 375–376. https://doi.org/10.1016/0090-3019(81)90175-0

Landry, M., & Winkelmann, R. K. (1972). Multiple clear-cell acanthoma and ichthyosis. *Archives of Dermatology*, *105*(3), 371–383. http://www.ncbi.nlm.nih.gov/pubmed/4334961

Laver, N. V, McLaughlin, M. E., & Duker, J. S. (2010). Ocular melanoma. *Archives of Pathology & Laboratory Medicine*, *134*(12), 1778–1784. https://doi.org/10.5858/2009-0441-RAR.1

Lee, J., Bagheri, B., & Kao, H. A. (2015). A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems. *Manufacturing Letters*. https://doi.org/10.1016/j.mfglet.2014.12.001

Leshob, A., Bourgouin, A., & Renard, L. (2018). Towards a Process Analysis Approach to Adopt Robotic Process Automation. *Proceedings - 2018 IEEE 15th International Conference on e-Business Engineering, ICEBE 2018*. https://doi.org/10.1109/ICEBE.2018.00018

Liang, J. (2019). Qualitative research methods: collecting evidence, crafting analysis, communicating impact (2 nd Edition). *Communication Research and Practice*, *5*(4), 408–409. https://doi.org/10.1080/22041451.2019.1688620

Longo, C., & Pellacani, G. (2016). Melanomas. *Dermatologic Clinics*, *34*(4), 411–419. https://doi.org/10.1016/j.det.2016.05.004

LONGO, C., PELLACANI, G., TOMASI, A., MANDEL, V. D., & PONTI, G. (2016). Fibroepithelioma of Pinkus: Solitary tumor or sign of a complex gastrointestinal syndrome. *Molecular and Clinical Oncology*, *4*(5), 797–800. https://doi.org/10.3892/mco.2016.794

Low, L. L., Ab Rahim, F. I., Johari, M. Z., Abdullah, Z., Abdul Aziz, S. H., Suhaimi, N. A., Jaafar, N., Mohd Hanafiah, A. N., Kong, Y. L., Mahmud, S. H., Zulkepli, M. Z., Perialathan, K., Muharam, N., Zainudin, N. H., Mohd Zin, Z., Mohd Roslan, N., Aris, T., & Murad, S. (2019). Assessing receptiveness to change among primary healthcare providers by adopting the consolidated framework for implementation research (CFIR). *BMC Health Services Research*. https://doi.org/10.1186/s12913-019-4312-x

Lucas, A. S., Chung, E., Marchetti, M. A., & Marghoob, A. A. (2016). A guide for dermatology nurses to assist in the early detection of skin cancer. *Journal of Nursing Education and Practice*. https://doi.org/10.5430/jnep.v6n10p71

Lunenburg, F. C. (2012). Organizational Structure: Mintzberg's Framework. *International Journal for Scholarly, Academic, Intellectual Diversity*.

Maguire-Eisen, M. (2013). Skin cancer: A growing health problem for children. *Seminars in Oncology Nursing*. https://doi.org/10.1016/j.soncn.2013.06.006

Mahbod, A., Schaefer, G., Wang, C., Ecker, R., & Ellinge, I. (2019). Skin Lesion Classification Using Hybrid Deep Neural Networks. *ICASSP, IEEE International Conference on Acoustics, Speech and Signal Processing - Proceedings*. https://doi.org/10.1109/ICASSP.2019.8683352

Maher, E. E., & Vidal, C. I. (2015). Trichilemmoma. *Cutis*, *96*(2), 81, 104–106. http://www.ncbi.nlm.nih.gov/pubmed/26367753

Marhavilas, P., Koulouriotis, D., & Mitrakas, C. (2014). FAULT AND EVENT-TREE TECHNIQUES IN OCCUPATIONAL HEALTH-SAFETY SYSTEMS - PART I: INTEGRATED RISK-EVALUATION SCHEME. *Environmental Engineering and Management Journal*, *13*(8), 2097–2108. https://doi.org/10.30638/eemj.2014.232

Martin, N., Martinez-Millana, A., Valdivieso, B., & Fernández-Llatas, C. (2019a). Interactive Data Cleaning for Process Mining: A Case Study of an Outpatient Clinic's Appointment System. *Undefined*, *362 LNBIP*, 532–544. https://doi.org/10.1007/978-3-030-37453-2_43

Martin, N., Martinez-Millana, A., Valdivieso, B., & Fernández-Llatas, C. (2019b). *Interactive Data Cleaning for Process Mining: A Case Study of an Outpatient Clinic's Appointment System* (pp. 532–544). https://doi.org/10.1007/978-3-030-37453-2_43

MEGAHED. (1999). Polypoid basal cell carcinoma: a new clinicopathological variant. *British Journal of Dermatology*, *140*(4), 701–703. https://doi.org/10.1046/j.1365-2133.1999.02774.x

Moe, M. M. (2019). Comparative Study of Test-Driven Development TDD, Behavior-Driven Development BDD and Acceptance Test–Driven Development ATDD. *International Journal of Trend in Scientific Research and Development*, *Volume-3*(Issue-4), 231–234. https://doi.org/10.31142/ijtsrd23698

Mohiuddin, W., Laun, J., & Cruse, W. (2018). Brooke-Spiegler Syndrome. *Eplasty*, *18*, ic14. http://www.ncbi.nlm.nih.gov/pubmed/30093932

Muthukumaran, D., Umapathy, K., & Omkumar, S. (2021). Health Cloud—Health Care as a Service. In *Lecture Notes in Networks and Systems*. https://doi.org/10.1007/978-981-16-0666-3_39

Navarrete-Dechent, C., Bajaj, S., Marghoob, A., Gonzalez, S., & Munoz, D. (2016). Multiple familial trichoepithelioma: confirmation via dermoscop. *Dermatology Practical & Conceptual*, *6*(3). https://doi.org/10.5826/dpc.0603a10

Nicolson, N. G., & Han, D. (2019). Desmoplastic melanoma. *Journal of Surgical Oncology*, *119*(2), 208–215. https://doi.org/10.1002/jso.25317

North, J. P., Lo, J., & Landers, M. (2012). Poromatosis in pregnancy: a case of 8 eruptive poromas in the third trimester. *Cutis*, *89*(2), 81–83. http://www.ncbi.nlm.nih.gov/pubmed/22474731

Occidental, M., Shapiro, R., & Jour, G. (2020). Lentigo maligna melanoma in situ with neurotropism. *Journal of Cutaneous Pathology*, *47*(12), 1155–1158. https://doi.org/10.1111/cup.13778

Olla, D., & Neumeister, M. W. (2021). Mucosal Melanoma. *Clinics in Plastic Surgery*, *48*(4), 707–711. https://doi.org/10.1016/j.cps.2021.05.010

Owen, J. L., Kibbi, N., Worley, B., Kelm, R. C., Wang, J. V, Barker, C. A., Behshad, R., Bichakjian, C. K., Bolotin, D., Bordeaux, J. S., Bradshaw, S. H., Cartee, T. V, Chandra, S., Cho, N. L., Choi, J. N., Council, M. L., Demirci, H., Eisen, D. B., Esmaeli, B., … Alam, M. (2019). Sebaceous carcinoma: evidence-based clinical practice guidelines. *The Lancet Oncology*, *20*(12), e699–e714. https://doi.org/10.1016/S1470-2045(19)30673-4

Parekh, V., & Seykora, J. T. (2017). Cutaneous Squamous Cell Carcinoma. *Clinics in Laboratory Medicine*, *37*(3), 503–525. https://doi.org/10.1016/j.cll.2017.06.003

Parren, L. J. M. T., & Frank, J. (2011). Hereditary tumour syndromes featuring basal cell carcinomas. *British Journal of Dermatology*, *165*(1), 30–34. https://doi.org/10.1111/j.1365-2133.2011.10334.x

PDQ Adult Treatment Editorial Board. (2020). Skin Cancer Treatment (PDQ®). In *National Cancer Institute (US)*.

Perez-Castillo, R., Ruiz, F., Piattini, M., & Ebert, C. (2019). Enterprise Architecture. *IEEE Software*. https://doi.org/10.1109/MS.2019.2909329

Pérez, L. L., & Bashline, B. (2019). Skin Cancer: Prevention. *FP Essentials*. https://doi.org/10.1093/innovait_inr230

Phan, R., Augusto, V., Martin, D., & Sarazin, M. (2019). Clinical Pathway Analysis Using Process Mining and Discrete-Event Simulation: an Application to Incisional Hernia. *2019 Winter Simulation Conference (WSC)*, 1172–1183. https://doi.org/10.1109/WSC40007.2019.9004944

Phillips, C. B., Pearce, C. M., Hall, S., Travaglia, J., De Lusignan, S., Love, T., & Kljakovic, M. (2010). Can clinical governance deliver quality improvement in Australian general practice and primary care? A systematic review of the evidence. In *Medical Journal of Australia*. https://doi.org/10.5694/j.1326-5377.2010.tb04071.x

Pyne, J. H., Myint, E., Barr, E. M., Clark, S. P., David, M., Na, R., & Hou, R. (2017). Superficial basal cell carcinoma: A comparison of superficial only subtype with superficial combined with other subtypes by age, sex and anatomic site in 3150 cases. *Journal of Cutaneous Pathology*, *44*(8), 677–683. https://doi.org/10.1111/cup.12959

Rabbie, R., Ferguson, P., Molina-Aguilar, C., Adams, D. J., & Robles-Espinoza, C. D. (2019). Melanoma subtypes: genomic profiles, prognostic molecular markers and therapeutic possibilities. *The Journal of Pathology*, *247*(5), 539–551. https://doi.org/10.1002/path.5213

Radu, O., & Pantanowitz, L. (2013). Kaposi Sarcoma. *Archives of Pathology & Laboratory Medicine*, *137*(2), 289–294. https://doi.org/10.5858/arpa.2012-0101-RS

Raghupathi, W., & Raghupathi, V. (2014). Big data analytics in healthcare: promise and potential. *Health Information Science and Systems*, *2*(1), 3. https://doi.org/10.1186/2047-2501-2-3

Rahman, J., Tahir, M., Arekemase, H., Murtazaliev, S., & Sonawane, S. (2020). Desmoplastic Trichoepithelioma: Histopathologic and Immunohistochemical Criteria for Differentiation of a Rare Benign Hair Follicle Tumor From Other Cutaneous Adnexal Tumors. *Cureus*. https://doi.org/10.7759/cureus.9703

Rich, C., Singleton, J. K., & Wadhwa, S. S. (2018). *Sustainability for healthcare management*. Routledge. https://doi.org/10.4324/9781315276878

Rieck, J., Zimmermann, J., & Gather, T. (2012). Mixed-integer linear programming for resource leveling problems. *European Journal of Operational Research*. https://doi.org/10.1016/j.ejor.2012.03.003

Robbins, H., & Monro, S. (1951). A Stochastic Approximation Method. *The Annals of Mathematical Statistics*. https://doi.org/10.1214/aoms/1177729586

Romao, M., Costa, J., & Costa, C. J. (2019). Robotic process automation: A case study in the banking industry. *Iberian Conference on Information Systems and Technologies, CISTI*. https://doi.org/10.23919/CISTI.2019.8760733

Rose, K. H. (2013). A Guide to the Project Management Body of Knowledge (PMBOK® Guide)-Fifth Edition. *Project Management Journal*. https://doi.org/10.1002/pmj.21345

Rosemann, M., & Vom Brocke, J. (2015). The six core elements of business process management. In *Handbook on Business Process Management 1: Introduction, Methods, and Information Systems*. https://doi.org/10.1007/978-3-642-45100-3_5

Ruben, R. Ben, Vinodh, S., & Asokan, P. (2018). Lean Six Sigma with environmental focus: review and framework. *The International Journal of Advanced Manufacturing Technology*, *94*(9–12), 4023–4037. https://doi.org/10.1007/s00170-017-1148-6

Sattler, E. C., & Steinlein, O. K. (1993). Birt-Hogg-Dubé Syndrome. In *GeneReviews®*. http://www.ncbi.nlm.nih.gov/pubmed/20301695

Schaller, J., Rytina, E., Rütten, A., Hendricks, C., Ha, T., & Requena, L. (2010). Sweat duct proliferation associated with aggregates of elastic tissue and atrophodermia vermiculata: a simulator of microcystic adnexal carcinoma. Report of two cases. *Journal of Cutaneous Pathology*, *37*(9), 1002–1009. https://doi.org/10.1111/j.1600-0560.2010.01527.x

Schwartz, R. A. (1994). Keratoacanthoma. *Journal of the American Academy of Dermatology*, *30*(1), 1–19. https://doi.org/10.1016/S0190-9622(94)70001-X

Scope, A., Wang, S. Q., & Rabinovitz, H. S. (2012). Lentigo maligna melanoma. In *Atlas of Dermoscopy* (pp. 223–229). Informa Healthcare. https://doi.org/10.3109/9781841847627.027

Scully, K., Bargman, H., & Assaad, D. (1984). Solitary fibrofolliculoma. *Journal of the American Academy of Dermatology*, *11*(2 Pt 2), 361–363. https://doi.org/10.1016/s0190-9622(84)70173-3

Shellenberger, R., Nabhan, M., & Kakaraparthi, S. (2016). Melanoma screening: A plan for improving early detection. In *Annals of Medicine*. https://doi.org/10.3109/07853890.2016.1145795

Siegel, J. A., Korgavkar, K., & Weinstock, M. A. (2017). Current perspective on actinic keratosis: a review. *The British Journal of Dermatology*, *177*(2), 350–358. https://doi.org/10.1111/bjd.14852

Situm, M., Buljan, M., Kolić, M., & Vučić, M. (2014). Melanoma--clinical, dermatoscopical, and histopathological morphological characteristics. *Acta Dermatovenerologica Croatica : ADC*, *22*(1), 1–12. http://www.ncbi.nlm.nih.gov/pubmed/24813835

Skorin, L., & Bauer, S. A. (2020). Trichoepithelioma. *The Journal of the American Osteopathic Association*. https://doi.org/10.7556/jaoa.2020.103

Starink, T. M. (1997). Eccrine syringofibroadenoma: Multiple lesions representing a new cutaneous marker of the Schöpf syndrome, and solitary nonhereditary tumors. *Journal of the American Academy of Dermatology*, *36*(4), 569–576. https://doi.org/10.1016/S0190-9622(97)70245-7

Stinchcombe, A. L. (2000). Social structure and organizations. *Advances in Strategic Management*. https://doi.org/10.1016/S0956-5221(03)00039-3

Sun, R., Shi, D., Zhang, Y., Li, R., & Li, R. (2021). Data-driven technology in event-based vision. In *Complexity*. https://doi.org/10.1155/2021/6689337

Szel, M., Berniak-Wo, J., & Lipí nski, C. (2021). *BPM Support for Patient-Centred Clinical Pathways in Chronic Diseases*. https://doi.org/10.3390/s21217383

Tanbeer, S. K., & Sykes, E. R. (2021). MyHealthPortal – A web-based e-Healthcare web portal for out-of-hospital patient care. *Digital Health*. https://doi.org/10.1177/2055207621989194

Tanese, K. (2019). Diagnosis and Management of Basal Cell Carcinoma. *Current Treatment Options in Oncology*, *20*(2), 13. https://doi.org/10.1007/s11864-019-0610-0

Teli, B., Thrishuli, P. B., Santhosh, R., Amar, D. N., & Rajpurohit, S. (2015). Giant solitary trichoepithelioma. *South Asian Journal of Cancer*, *04*(01), 041–044. https://doi.org/10.4103/2278-330X.149951

Tellechea, O., Cardoso, J. C., Reis, J. P., Ramos, L., Gameiro, A. R., Coutinho, I., & Baptista, A. P. (n.d.). Benign follicular tumors. *Anais Brasileiros de Dermatologia*, *90*(6), 780–796; quiz 797–798. https://doi.org/10.1590/abd1806-4841.20154114

Thomas, L., & Puig, S. (2017). Dermoscopy, digital dermoscopy and other diagnostic tools in the early detection of melanoma and follow-up of high-risk skin cancer patients. *Acta Dermato-Venereologica*. https://doi.org/10.2340/00015555-2719

Thompson, L. D. (2012). Pilomatricoma. *Ear, Nose, & Throat Journal*, *91*(1), 18–20. https://doi.org/10.1177/014556131209100106

Ting, D. S. W., Peng, L., Varadarajan, A. V., Keane, P. A., Burlina, P. M., Chiang, M. F., Schmetterer, L., Pasquale, L. R., Bressler, N. M., Webster, D. R., Abramoff, M., & Wong, T. Y. (2019). Deep learning in ophthalmology: The technical and clinical considerations. In *Progress in Retinal and Eye Research*. https://doi.org/10.1016/j.preteyeres.2019.04.003

Trakatelli, M., Barkitzi, K., Apap, C., Majewski, S., De Vries, E., Coebergh, J. W., Apalla, Z., Ioannides, D., Kalabalikis, D., Kalokasidis, K., Kitsou, A., Siskou, S., Traianou, A., Sotiriadis, D., Moreno-Ramirez, D., Ferrandiz, L., Ruiz-De-Casas, A., Micallef, R., Ranki, A., … Crawford, L. (2016). Skin cancer risk in outdoor workers: A European multicenter case-control study. *Journal of the European Academy of Dermatology and Venereology*. https://doi.org/10.1111/jdv.13603

Vabres, P., Lacombe, D., Rabinowitz, L. G., Aubert, G., Anderson, C. E., Taieb, A., Bonafé, J. L., & Hors-Cayla, M. C. (1995). The gene for Bazex-Dupré-Christol syndrome maps to chromosome Xq. *The Journal of Investigative Dermatology*, *105*(1), 87–91. https://doi.org/10.1111/1523-1747.ep12313359

van der Aalst, W. M. P., Netjes, M., & Reijers, H. A. (2007). *Supporting the Full BPM Life-Cycle Using Process Mining and Intelligent Redesign* (pp. 100–132). https://doi.org/10.4018/978-1-59904-289-3.ch004

Vieira, J., Pinto, C., Afonso, M., do Bom Sucesso, M., Lopes, P., Pinheiro, M., Veiga, I., Henrique, R., & Teixeira, M. R. (2015). Identification of previously unrecognized FAP in children with Gardner fibroma. *European Journal of Human Genetics : EJHG*, *23*(5), 715–718. https://doi.org/10.1038/ejhg.2014.144

Von Rosing, M., White, S. A., Cummins, F., & De Man, H. (2014). Business process model and notation-BPMN. In *The Complete Business Process Handbook: Body of Knowledge from Process Modeling to BPM*. https://doi.org/10.1016/B978-0-12-799959-3.00021-5

Wagner, G., Back, W., & Sachse, M. M. (2021). Clear cell acanthoma. *Journal Der Deutschen Dermatologischen Gesellschaft = Journal of the German Society of Dermatology : JDDG*, *19*(1), 31–36. https://doi.org/10.1111/ddg.14270

Waldmann, A., Nolte, S., Weinstock, M. A., Breitbart, E. W., Eisemann, N., Geller, A. C., Greinert, R., Volkmer, B., & Katalinic, A. (2012). Skin cancer screening participation and impact on melanoma

incidence in Germany-an observational study on incidence trends in regions with and without population-based screening. *British Journal of Cancer*. https://doi.org/10.1038/bjc.2012.22

Welch, J. P., Wells, R. S., & Kerr, C. B. (1968). Ancell-Spiegler cylindromas (turban tumours) and Brooke-Fordyce Trichoepitheliomas: evidence for a single genetic entity. *Journal of Medical Genetics*, *5*(1), 29–35. https://doi.org/10.1136/jmg.5.1.29

Wick, M. R., & Swanson, P. E. (1986). Primary Adenoid Cystic Carcinoma of the Skin. *The American Journal of Dermatopathology*, *8*(1), 2–13. https://doi.org/10.1097/00000372-198602000-00002

Wohlmuth, C., & Wohlmuth-Wieser, I. (2019). Vulvar malignancies: an interdisciplinary perspective. *Journal Der Deutschen Dermatologischen Gesellschaft = Journal of the German Society of Dermatology : JDDG*, *17*(12), 1257–1276. https://doi.org/10.1111/ddg.13995

Wollina, U. (2019). Recent advances in managing and understanding seborrheic keratosis. *F1000Research*, *8*. https://doi.org/10.12688/f1000research.18983.1

Wood, S., Nguyen, D., Hutton, K., & Dickson, W. (n.d.). Pilomatricomas in Turner syndrome. *Pediatric Dermatology*, *25*(4), 449–451. https://doi.org/10.1111/j.1525-1470.2008.00732.x

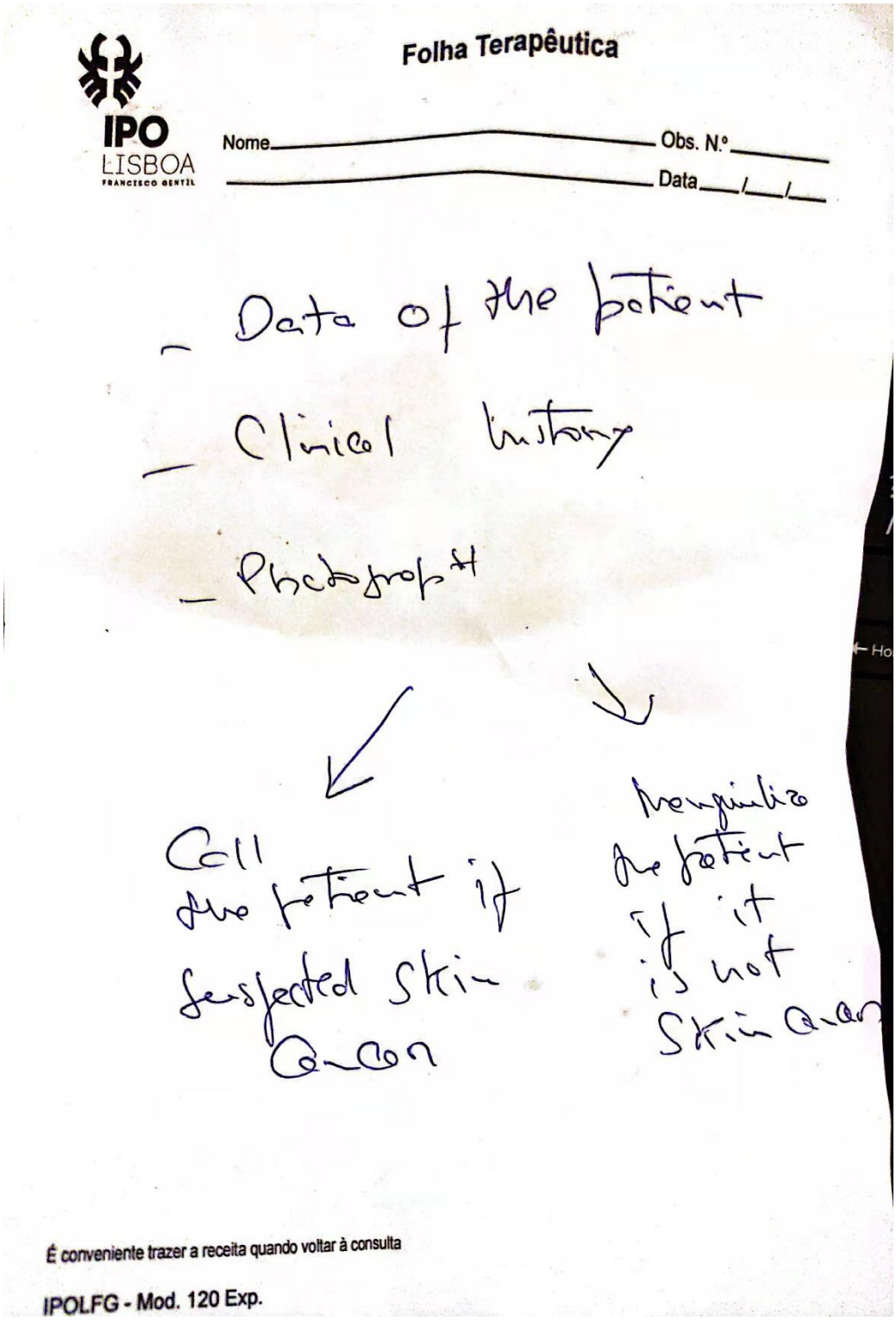
Xu, A., Patel, V., Sutton, L., & Orengo, I. (2018). Infiltrative basal cell carcinoma mimicking tinea corporis. *Dermatology Online Journal*, *24*(3). http://www.ncbi.nlm.nih.gov/pubmed/29634889

Young, A. L., Kellermayer, R., Szigeti, R., Tészás, A., Azmi, S., & Celebi, J. T. (2006). CYLD mutations underlie Brooke-Spiegler, familial cylindromatosis, and multiple familial trichoepithelioma syndromes. *Clinical Genetics*, *70*(3), 246–249. https://doi.org/10.1111/j.1399-0004.2006.00667.x

Zionts, S. (1979). A survey of multiple criteria integer programming methods. *Annals of Discrete Mathematics*. https://doi.org/10.1016/S0167-5060(08)70360-1

ANNEXES

ANNEXES-1 IPO SELF-EXAMINATION PROCESS



Folha Terapêutica

IPO LISBOA FRANCISCO GENTIL

Nome_____ Obs. N.º_____

_____ Data___/___/___

- Data of the patient
- Clinical history
- Photograph

Call the patient if suspected skin cancer

Reassure the patient if it is not skin cancer

É conveniente trazer a receita quando voltar à consulta

IPOLFG - Mod. 120 Exp.

ANNEXES-2 SAMPLE OF E-REFERRAL DATA FORM

This is an example clinical document, data is for demonstration purposes only

e-Referral
17 Aug 2012

Frank **HARDING** DoB 4 Oct 1949 (64y) SEX Male IHI 8003 6086 6670 1594

Somac 40mg capsule: hard, 30 capsules	1 tablet once daily
Astrix 100mg capsule: hard, 30 capsules	1 tablet once daily

Medical History

Medical History - Procedures

Date Time	Procedure	Comments
01 Jan 1999 16:33+1000	Diabetes insipidus	
25 Jan 1998 09:30+1000	Primary uncemented total knee replacement	Cementless
15 Jan 1990 09:30+1000	Replacement of cardiac pacemaker	

Adverse Reactions

Substance/Agent	Manifestation
Phenoxymethylpenicillin	• Nausea • Diarrhea

Diagnostic Investigations

This section may contain the following subsections Pathology Test Result, Imaging Examination Result and Requested Service(s).

Pathology Test Result (Diagnostic Investigations > **Pathology Test Result**)

Pathology Test Result(s)

Test Result DateTime	Test Result Name	Diagnostic Service	Overall Test Result Status	Clinical Information Provided	Pathological Diagnosis	Pathology Test Conclusion	Test Comment	Image / File

THANK YOU!