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Dear Esteemed Readers, Authors, and Colleagues,

I hope this letter finds you in good health and high spirits. It is my distinct pleasure to address you as the Editor-in-Chief of Integrative Omics and Applied Biotechnology (IIOAB) Journal, a multidisciplinary scientific journal that has always placed a profound emphasis on nurturing the involvement of young scientists and championing the significance of an interdisciplinary approach.

At Integrative Omics and Applied Biotechnology (IIOAB) Journal, we firmly believe in the transformative power of science and innovation, and we recognize that it is the vigor and enthusiasm of young minds that often drive the most groundbreaking discoveries. We actively encourage students, early-career researchers, and scientists to submit their work and engage in meaningful discourse within the pages of our journal. We take pride in providing a platform for these emerging researchers to share their novel ideas and findings with the broader scientific community.

In today's rapidly evolving scientific landscape, it is increasingly evident that the challenges we face require a collaborative and interdisciplinary approach. The most complex problems demand a diverse set of perspectives and expertise. Integrative Omics and Applied Biotechnology (IIOAB) Journal has consistently promoted and celebrated this multidisciplinary ethos. We believe that by crossing traditional disciplinary boundaries, we can unlock new avenues for discovery, innovation, and progress. This philosophy has been at the heart of our journal's mission, and we remain dedicated to publishing research that exemplifies the power of interdisciplinary collaboration.

Our journal continues to serve as a hub for knowledge exchange, providing a platform for researchers from various fields to come together and share their insights, experiences, and research outcomes. The collaborative spirit within our community is truly inspiring, and I am immensely proud of the role that IIOAB journal plays in fostering such partnerships.

As we move forward, I encourage each and every one of you to continue supporting our mission. Whether you are a seasoned researcher, a young scientist embarking on your career, or a reader with a thirst for knowledge, your involvement in our journal is invaluable. By working together and embracing interdisciplinary perspectives, we can address the most pressing challenges facing humanity, from climate change and public health to technological advancements and social issues.

I would like to extend my gratitude to our authors, reviewers, editorial board members, and readers for their unwavering support. Your dedication is what makes IIOAB Journal the thriving scientific community it is today. Together, we will continue to explore the frontiers of knowledge and pioneer new approaches to solving the world's most complex problems.

Thank you for being a part of our journey, and for your commitment to advancing science through the pages of IIOAB Journal.

Yours sincerely,

Vasco Azevedo

Vasco Azevedo, Editor-in-Chief
Integrative Omics and Applied Biotechnology
(IIOAB) Journal

Prof. Vasco Azevedo
Federal University of Minas Gerais
Brazil

Editor-in-Chief

Integrative Omics and Applied Biotechnology (IIOAB) Journal Editorial Board:

ARTICLE

THE COMPOSITION OF NUTRITIOUS BISCUITS OF SWEET POTATO AND TEMPE FLOUR ENRICHED WITH VITAMIN A OF RED PALM OIL

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ABSTRACT

Background: *One of the efforts to tackle the problem of malnutrition among children under five can be done through the processed variety of nutritious food available in the local area.* ***Methods:*** *This paper is based on an experimental research with a completely randomized design that aimed to develop biscuit mixture of sweet potato flour and tempeh (soy bean) flour enriched vitamin A of red palm oil, and to analyze the composition of its nutrients content. Development of biscuit consists of 3 treatments with variations in the composition of sweet potato flour and flour of tempeh. Research activities were carried out in the IKM Laboratory of Faculty of Public Health University of Sumatera Utara, analysis of nutrients carried in the Chem-mix Pratama Laboratory in Jogjakarta and PT Saraswanti Laboratory in Bogor.* ***Results:*** *The results obtained by nutrient composition of biscuit includes protein from 8.84 to 14.48%, fat from 27.70 to 30.64%, carbohydrates 42.70 to 51.53%, calcium from 0.29 to 0.35%, iron from 4.18 to 5.59 mg, zinc from 4.29 to 7.60 mg, beta carotene from 14.93 to 17.28 mg and folic acid 331.12 mcg. As many as 100 g biscuits can contribute protein of 34-55.8% of adequacy for children aged 1-3 years and amounted to 25.3-41.4% of adequacy for children aged 4-6 years.* ***Conclusions:*** *The content of protein, iron, zinc and beta carotene which were relatively high in biscuits, allowing it to be used as an alternative for overcoming the problem of PEM, iron deficiency anemia, zinc deficiency, and vitamin A deficiency in the various communities malnutrition.*

KEY WORDS
biscuit, sweet potato flour, tempeh flour, red palm oil, the composition of nutritional biscuit

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INTRODUCTION

The high rate of the malnutrition problems in the society in Indonesia due to the lack of energy and protein and vitamin A deficiency of the children under five required an assessment in the form of a model of intervention. It seeks to improve the status of energy and protein while meeting the needs of vitamin A and other micronutrients. In 2006, it was found 11% children deficient in vitamins A. Many studies have linked the use of red palm oil for overcoming problems of children nutrition in society who are less vitamin A; among other snack food products made from modified cassava flour (mocaf) with the addition of red palm oil. Thus, red palm oil contains a lot of components in the form of provitamin A carotenoids, which comprises 54.4% of beta-carotene, alpha-carotene 36.2%, 3.3% gamma-carotene, lycopene xantofil 3.8% and 2.2% [1]. Carotenoids that are found in palm oil containing a high bioavailability, so that the provitamin A is easily absorbed by the digestive tract selmucosa [2].

Rice and Burns have made recommendations based on the evaluation of study results in Africa, Asia and Latin America that the red palm oil may be proposed for its use as a fortune in food products to address the problem of vitamin A deficiency in the at-risk populations [3]. The use of red palm oil and synthetic beta carotene in biscuits is equally effective in improving the vitamin A status of primary school children. In addition, red palm oil has the advantage of not containing Tran's fatty acids and rich sources of antioxidants that can serve as an excellent alternative fortificant to overcome vitamin A deficiency [4].

Additionally, sweet potato biscuit which is modified by catfish giving an effect to children under five in increasing intake of energy and protein as well as the improvement of the nutritional status. The sweet potato has a chemical composition which rich in carbohydrates, minerals and vitamins. Vitamin A in the sweet potato formed of provitamin A 7,000-SI / 100 g or two and a half times greater than the average human needs, especially the sweet potato tuber flesh-colored orange. Likewise, for vitamins B1, B6, niacin, and vitamin C are sufficient in number to the sweet potato. Sweet potatoes contain between 2.0 to 6.7% of sugar and amylose of 9.8 to 26%. The high sugar content gives a strong sweet taste, while amylopectin giving properties soft.

Cookies substitutions of soybean (*tempeh* in Indonesian) flour takes effects to the growth of children under five are malnourished. As it is known that tempeh is soybean product enriched by protein which easy to digest. Sweet potato, tempeh and red palm oil are food material that easy to obtain, have properties and nutritional composition that complete each other. So the writer is interested in to develop biscuit by using these material foods. It is a biscuit base that been known as a popular food and preferred by children and adult.

METHODS

An experimental research of biscuit development was conducted in a completely randomized design. It used the material of honey sweet potato and *tempeh*. The materials were purchased in two traditional markets (*Melati* Market and *Tanjung Rejo* Market) in Medan City. Those were then made into flour. Red palm oil was obtained from the oil palm Laboratory Studies Center of Medan City. The test of biscuit production used three (3) steps with the compositions as the following table below:

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Table 1: Composition of Biscuit Production

No.	Ingredient	Content
1.	Sweet potato flour	175 g;125g;75g
2.	Tempeh flour	175 g;125g;75g
3.	Palm oil	150g
4.	Wheat flour	200 g

Research activity was done in IKM Lab of Faculty of Health of North Sumatra University for about six (6) months, and the analysis of nutrients was done by sending the 250 gram of biscuit sample to two different Labs; Chem-mix Pratama Jogjakarta and PT. Saraswanti Bogor. The differences of three biscuits with and without red palm oil can be seen [as shown in Table 1 below]; biscuit C with potato flour composition 75g potatoes and *tempeh* flour 175g compared to the treatment biscuits (A & B) using fewer soybean flour and sweet potato flour. The sample of biscuit C was mixed with sweet potato and tempeh flour substituted by red palm oil. This method tried to offer an alternative food for children in society with many children were in the less nutrition and protein.

RESULT AND DISCUSSION

Based on the trial result development of sweet potatoes biscuits and *tempeh* substituted red palm oil and the organoleptic test with the panelists; students of Faculty of Health of University of North Sumatra Medan, Indonesia, the derived biscuits that have a characteristic brown color, aroma mixture of soybean and palm oil red, sweet and savory, and crisp texture. The three treatments showed the sampled biscuits have a good acceptance or costumers' preference.

The nutrient content of biscuit

Based on the examination results of laboratory that had been conducted at the Laboratory of Primary Chemix Jogjakarta and PT Saraswanti Bogor, obtained nutrient content were shown in [Table 1]. In [Table 1] we, can see the content of nutrients in general are most numerous in biscuits treatment C, namely biscuits with potato flour composition 75g potatoes and *tempeh* flour 175g compared to the treatment biscuits using fewer soybean flour and sweet potato flour more (A and B Treatment). The fiber content of food at the lowest biscuits at 12.42% (biscuits A) and the highest was 16.52% (biscuit C). The analysis also indicates that it contains inulin about 1.2 to 1.30%.

Table 2: Nutrient composition of sweet potato biscuits and tempeh substituted by red palm oil

No.	Nutrition	Sample Code		
		A	B	C
1	Water (%)	4,90	4,76	4,95
2	Protein (%)	8,84	12,48	14,48
3	Fat (%)	27,70	29,74	30,64
4	Carbohydrate (%)	51,53	47,22	42,70
5	Calcium (%)	0,29	0,32	0,35
6	Iron (mg/100g)	4,18	4,90	5,59
7	Zn (mg/100g)	4,29	6,02	7,60
8	Beta Carotene (mg/100g)	14,93	15,92	17,28
9	Vitamin B_{12}(ppb)	Tt	tt	Tt
10	Folic Acid mcg/100g	Tt	331,12	Tt
11	Inulin (%)	1,24	1,20	1,30
12	Dietary Fiber (%)	12,42	14,48	16,52

Water, Protein, Fat and Carbohydrate Ingredients on Biscuits

The content of protein in the biscuit was lower about 8.84% (biscuits A) and the highest was 14.48% (biscuit C). The fat content is contained in the biscuit was lower around 27.70% (biscuits A) and the highest was 30.64% (biscuit C). The carbohydrate content in the biscuit was lower approximately 42.70% (biscuit C) and the highest was 51.53% (biscuits A). The water found in biscuits is 4.76 to 4.95%. The comparison of composition of water, protein, fat and carbohydrates in the three types of biscuits depicted in the graph shown in [Fig. 1].

Based on the result analysis in [Fig. 1], it shows that protein content in biscuit C is highest than others. The protein content of 14.48% is expected to contribute to protein intake for infants and children, school children, pregnant women and nursing mothers. Every chip of biscuit has weight about 10 g, if every toddler consumes 10 chips of biscuit or 100g per day so the biscuit can contribute protein about 8,84-14,5 g or 34-55,8% Dietary Allowances of protein for children aged 1-3 years old and 25,3 – 41,4% Dietary Allowances of protein for children aged 4-6 years old.

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A high protein in biscuit is contributed by *tempeh* flour; known as high protein, it is about 45,05%. Moreover, protein in tempeh is categorized as easy digested, so allowing it to be uses to support the growth process of children more optimal. Therefore, it is expected that biscuit mixed sweet potato and tempeh flour substituted by red palm oil can be one of alternative food for children in society who were less nutrition and protein. Besides has enough good quality protein, it also contains carbohydrate and fat in biscuit.

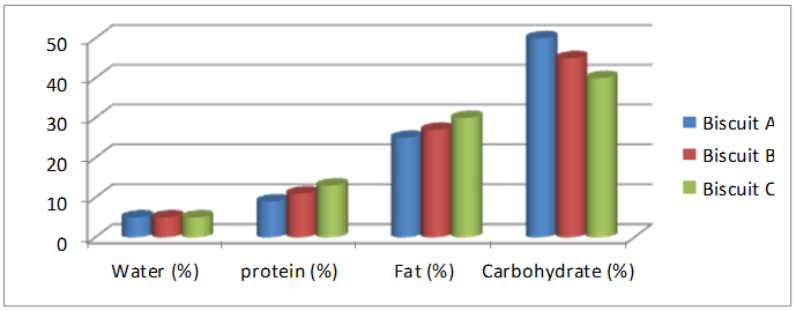

Fig. 1: The composition of water, protein, fat and carbohydrates in the sweet potato biscuits and flour were substituted tempe red palm oil.

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The Content of Mineral and Vitamin in Biscuit

The content of micro nutrition include mineral is calcium (0,29-0,35%), iron (4,18-5,59 mg), zinc (4,29-7,60 mg) and vitamin; beta carotene (14,93-17,28 mg) and folic acid is about 331,12 mcg (biscuit B). Moreover, biscuit also contains around 1, 20-1, 30% of inuline. The composition of mineral and vitamin of the three of biscuit is shown in [Fig. 2] and [Fig.3].

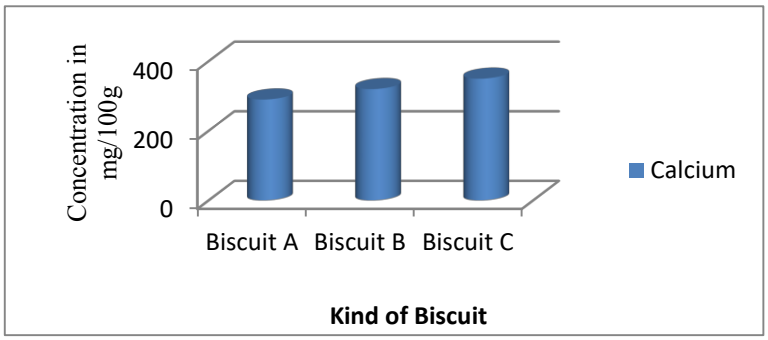

Fig. 2: The content of calcium biscuits

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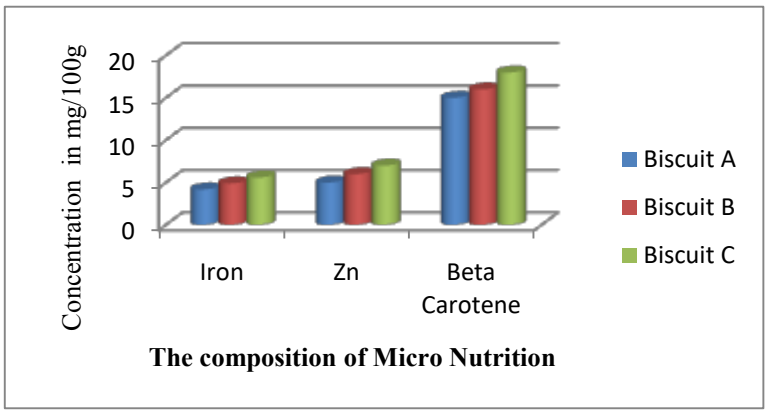

Fig. 3: The content of iron, zinc and beta carotene in biscuits.

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Based on a test analysis, the content of calcium biscuit on [Fig. 2], it is found that the content of calcium in biscuit C is the highest one, that is 350 mg and the lowest is in biscuit A; 290 mg, while biscuit B is 320 mg. If it was assumed, toddler consumed 10 chips of biscuit or 100g/day, so they would get 53,8% of calcium and 35% each for children aged 1-3 and 4-6 years old.

The content of iron in biscuit A is about 4,18 mg, biscuit B is 4,90 mg and biscuit C is 5,59 mg. If it was assumed, toddler consumes 100g of biscuit so they would get minimal 59,7% of each iron and 52,3% of Dietary Allowances and maximal 79,9% and 69,9%. Based on the content of zinc in biscuits A,B and C is

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about 4,29mg, 6,02mg and 7,60mg., So it is accounted the contribution of Dietary Allowances of iron is minimally 100,07% (children aged 1-3 years old) and 152,00% (children aged 4-6 years old).

Similarly, with the analysis result of the content of beta-carotene is quite high in biscuit, which is 14,93mg to 17,28mg. Based on the calculation result, if children consume 100g of biscuit, the contribution of vitamin A in biscuit is 37 – 43,2 times of Dietary Allowances of vitamin A for children aged 1-3 years old and 33,2 – 38,4 for children aged 4-6. If a nursing mother consumes 100g of biscuit, it is predicted that vitamin A contribute 17,6 – 20,33 times of Dietary Allowances. It is only for pregnant women should be considered because a high vitamin A may cause a fetal damage.

Marjan et al. suggested that the red palm oil can be used as a source of beta-carotene and antioxidant substances, so its substitution on food products can be a functional high functional antioxidant food alternative in preventing atherosclerosis [5]. According to Zeba et al, red palm oil which is given in Regular small amounts are very effective in lowering the problem of vitamin A deficiency, and may be considered for use as a dietary vitamin A supplement [6].

The composition of folic acid is only detected in biscuit B that is 331,12mcg. If see the number, biscuit A and C also contribute folic acid because it uses the same materials, just the proportion is different. The content of folic acid is 331,12mcg in 100g of biscuit, it means that if it is consumed 100g of biscuit/day so it contributed 2, 21 times of Dietary Allowances of folic acid for children aged 1-3 years old, 1, 7 for children aged 4-6, 0,6 for pregnant women and 0,7 for nursing mother.

The inulin in biscuit is expected to be as prebiotic which has several functions in digestion, such as prevent indigestion and help improve mineral absorption in the gastrointestinal tract. The component of dietary fiber contained in biscuit is also important in help the function of digestion in the process of spending the rest of food is not absorbed in the digestive tract.

The Content of Amino Acid in Biscuits

Based on the result of lab analysis, it showed 18 kinds of the content of amino acid in biscuits; 10 kinds of essential amino acid and 8 kinds of non-essential amino acid. The composition of amino acid in the three biscuits is shown in the [Table 2]. The graphical description of amino acid composition in biscuit is shown in Fig. 4 and 5.

Table 3: The Composition of Amino Acid in the Biscuit of Sweet Potato and Tempeh Flour Substituted by Red Palm Oil

NO	The Composition of Amino Acid (mg/100g)	Sample Code		
		A	B	C
1	Histidin	297,69	422,35	462,78
2	Treonin	584,51	780,29	864,52
3	Prolin	743,94	930,78	1010,99
4	Tyrosine	410,22	555,26	585,63
5	Leusin	955,22	1251,36	1454,18
6	Aspartat acid	1015,03	1334,10	1548,63
7	Lisin HCl	508,44	744,91	944,25
8	Glisin	456,99	603,59	711,94
9	Arginin	605,86	871,80	1016,88
10	Alanin	487,57	636,76	732,53
11	Valin	530,19	704,69	801,01
12	Isoleusin	518,98	688,54	810,96
13	Fenil alanin	703,84	960,69	1005,90
14	Glutamate acid	2716,63	3368,61	3790,82
15	Serin	753,52	971,91	1090,68
16	Metionin	170,23	188,92	250,19
17	Sistin	44,61	60,86	64,29
18	Tryptophan	99,62	129,41	134,26

In [Table 2], the composition of amino acid in biscuit is categorized as complete composition, because it contains all of kind of essential amino acid that needed by body. In [Fig. 4] shows that the content of glutamate acid is the highest composition among another amino acid, then followed with the composition of aspartic acid and leucine.

As it is known that the role of amino acid is very important in supporting the process of growth and development of children especially in toddler year which relatively needs essential amino acid in sufficient quantities so that the growth and development of children is optimal. Toddler year is an important moment includes the process of physical growth especially to prevent stunting and brain growth which is influenced to brain development and the intelligence of children.

[Fig. 5] shows that 10 kinds of essential amino acid in sweet potato biscuit and tempeh flour substituted by red palm oil, leusine is the highest composition, and then continued by ariginine, fenile alanine and the last is tryptophan which is the lowest composition.

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Glutamine is the highest component of amino acid in biscuit. Glutamine of amino acid in baby's food has a role as immunity booster and increasing the length of children [7]. The component of glutamine naturally exists in tempeh flour which has properties in food taste that make delicious.

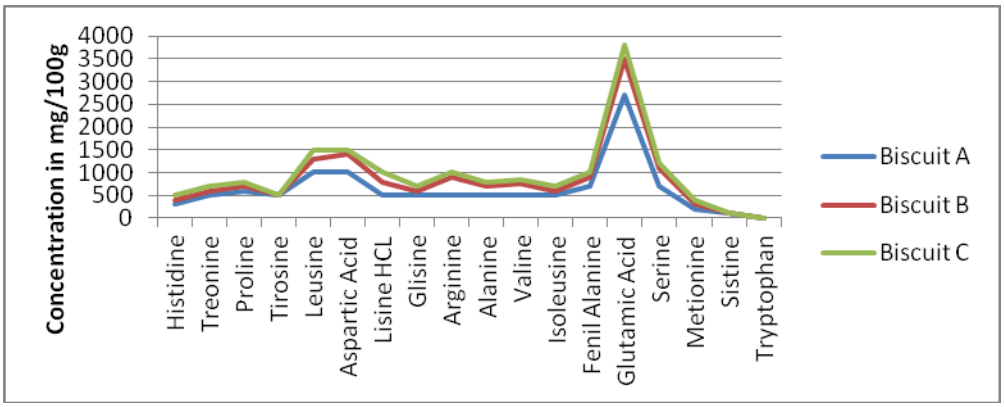

Fig. 4: The Composition of Amino Acid in Sweet Potato Biscuit and Tempeh Flour Substituted by Red Palm Oil.

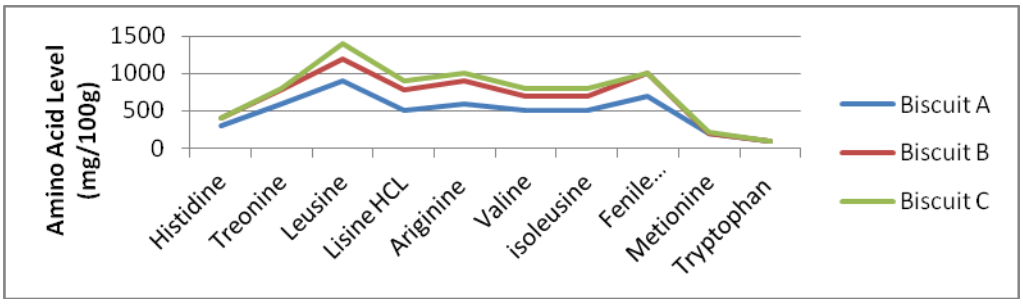

Fig 5: The Composition of Essential Amino Acid in Sweet Potato Biscuit and Tempeh Flour Substituted by Red Palm Oil.

Thus, development of biscuit using sweet potato flour and tempeh flour and substituting red palm oil is expected to continue for the further applied research, especially in overcoming the problem of lack of energy protein (LEP) and the problem of micronutrient deficiencies such as iron anemia, zinc deficiency and a problem of lack of vitamin A on different groups of vulnerable people.

CONCLUSION

Based on the results of research, so it concludes that:

1. Biscuit sweet potato and tempeh flour substituted by red palm oil have better nutrition composition; it has the content about 8,84 – 14,48% of protein, 27,70 – 30,64% of fat, 42,70 – 51,53% of carbohydrate, 0,29 – 0,35% of calcium, 4,18 – 5,59mg of iron, 4,29 – 7,60mg of zinc, 14,93 – 17,28mg of beta carotene, 331,12mcg of folic acid.
2. Biscuit sweet potato and tempeh flour substituted by red palm oil can contribute approximately 34 – 55, 8% of protein of Dietary Allowances for children aged 1-3 years old and 25, 3 – 41, 4% for children aged 4-6 years old.
3. A high protein, iron, zinc and beta carotene in biscuit probably can be used as an alternative way to tackle the problems of lack of energy protein and micronutrient deficiencies such as iron anemia, zinc deficiency and a problem of lack of vitamin A on different groups of vulnerable people.

SUGESTION

The result of this research is expected can be used for an intervening activity in the field concerning with the problems of Lack of Energy Protein (LEP), iron anemia, zinc deficiency and lack of vitamin A.

CONFLICT OF INTEREST

There is no conflict of interest.

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None

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ARTICLE

A CASE REPORT OF THE INTERFACE BETWEEN CA-PPM AND SAP VIA WEB-SERVICES

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ABSTRACT

SOAP web services are a powerful way of sending messages over the internet. CA PPM represents a single platform that enables you to manager your entire innovation life cycle and make more informed strategic investments. SAP's ERP system enables companies to run their business processes, be they accounting, sales, production, human resources or payment, in an integrated environment. This case report demonstrates a real-time integration between CA PPM and SAP via SOAP based web services. This case report describes the interface between CA PPM and SAP via web-services for exchanging data through soap requests and getting a response back from SAP.

KEY WORDS
CA PPM, SAP, SOAP, web-service

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INTRODUCTION

SOAP [1] provides the envelope for sending Web Services messages over the Internet. It is part of the set of standards specified by the W3C. SOAP is an alternative to Representational State Transfer (REST) and JavaScript Object Notation (JSON). The SOAP envelope contains two parts: 1. An optional header providing information on authentication, encoding of data, or how a recipient of a SOAP message should process the message. 2. The body that contains the message. These messages can be defined using the WSDL specification. SOAP commonly uses HTTP, but other protocols such as Simple Mail Transfer Protocol (SMTP) may be used. SOAP can be used to exchange complete documents or to call a remote procedure.

CA PPM [2] represents a single platform that enables you to manage your entire innovation lifecycle and make more informed strategic investments. CA PPM helps you track and prioritize market and customer requirements and make better decisions on how to invest limited resources, so you can optimize your enterprise, IT, service and product portfolio.

In this case study, we shall look at a use case wherein CAPPM will send a SOAP payload to SAP for creating a project definition and a separate SOAP payload to create task level (WBS level) structure of the project in SAP.

The programming interface in CA PPM is known as gel-scripting and it has the capability to query the data from the CA PPM database and send that data over to any third-party endpoint via a SOAP message (in XML format).

There are very few studies demonstrating the communication between CAPPM and SAP via web services. This study demonstrates the real-time integration between CAPPM and SAP via web services.

GEL SCRIPT in CAPPM

The below script sends a project from CAPPM to SAP.

```
<gel:script
xmlns:core="jelly:core",xmlns:file="jelly:com.niku.union.gel.FileTagLibrary"
xmlns:gel="jelly:com.niku.union.gel.GELTagLibrary"  xmlns:nikuq="http://www.niku.com/xog/Query"
   xmlns:soap="jelly:com.niku.union.gel.SOAPTagLibrary"
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"  xmlns:sql="jelly:sql"  xmlns:util="jelly:util"
   xmlns:x="jelly:org.apache.commons.jelly.tags.xml.XMLTagLibrary"
xmlns:xog="http://www.niku.com/xog"  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
   <gel:log>Start this Script</gel:log>
   <!-- Set the endpoint to ServiceNow and set our Authorization for Basic -->
   <core:set
 var="soapEndPoint"
value="https://integration.cert.<yourcompany>.com/XISOAPAdapter/MessageServlet?senderParty=&amp;
senderService=ESERVICES_Q&amp;receiverParty=&amp;receiverService=&amp;interface=si_os_VIB_HOS
T_CIRCUIT&amp;interfaceNamespace=http://EservicesBapi2Webservice.com" />  ☐ specify the WSDL's
end-point here. This was provided by SAP
As demonstrated by Gene. [3]
<core:invokeStatic  var="base64"  className="com.niku.union.utility.Base64"  method="encode">  ☐
readying for Base64 authentication
      <core:arg  type="java.lang.String"  value="soap_test:XXXXXXXX" />  ☐ specify the user-name and
password. This was provided by SAP
   </core:invokeStatic>
   <core:set var="basicAuth" value="Basic ${base64}" />
   <gel:log>basicAuth = ${basicAuth}</gel:log>
```

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```
<!-- Open a connection to ServiceNow and set our request headers -->
<core:new var="soapUrl" className="java.net.URL">
  <core:arg type="java.lang.String" value="${soapEndPoint}" />
</core:new>
<core:invoke var="connection" on="${soapUrl}" method="openConnection"/>
<core:expr value="${connection.setDoOutput(true)}" />
<core:expr value='${connection.setRequestMethod("POST")}'/>
<core:expr value='${connection.setRequestProperty("Content-type", "text/xml; charset=utf-8")}'/>
<core:expr value='${connection.setRequestProperty("SOAPAction", soapEndPoint)}'/>
<core:expr value='${connection.setRequestProperty("Authorization", basicAuth)}'/> ☐ passing the
Base64 authentication
<core:set var="requestXml">
        <soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:urn="urn:sap-com:document:sap:rfc:functions">
          <soapenv:Header/>
          <soapenv:Body>
                  <urn:Z_BAPI_VIB_HOST_CIRCUIT> ☐ This is the soap body which is defined through
the wsdl. We can get the soap-body from a tool like SOAP UI
                        <CUSTOMER_NO>xWD40</CUSTOMER_NO>
                        <ZBAPIEVCIRC/>
                        <ZBAPIEVHOST/>
                  </urn:Z_BAPI_VIB_HOST_CIRCUIT>
          </soapenv:Body>
        </soapenv:Envelope>
</core:set>
<!-- Write out our getRecords request to ServiceNow -->
<core:invoke var="outputStream" on="${connection}" method="getOutputStream" /> ☐ invoking the
web-service
<core:new var="outputStreamWriter" className="java.io.OutputStreamWriter">
  <core:arg type="java.io.OutputStream" value="${outputStream}" />
</core:new>
<core:expr value="${outputStreamWriter.write(requestXml)}" />    <core:expr
value="${outputStreamWriter.close()}" />
<!-- Read in the response from ServiceNow into a string -->
<core:invoke var="inputStream" on="${connection}" method="getInputStream" /> ☐ getting the
response back
<core:new var="inputStreamReader" className="java.io.InputStreamReader">
    <core:arg type="java.io.InputStream" value="${inputStream}" />
</core:new>
<core:new var="stringBuilder" className="java.lang.StringBuilder" />
<core:set var="data" value="${inputStreamReader.read()}" />
<core:while test="${data != -1}">
<core:invokeStatic var="char" className="java.lang.Character" method="toChars" >
  <core:arg type="int" value="${data}" />
</core:invokeStatic>
<core:invokeStatic var="charString" className="java.lang.String" method="valueOf" >
  <core:arg value="${char}" />
</core:invokeStatic>
  <core:set var="char" value="${java.lang.String.valueOf(java.lang.Character.toChars(data))}"/>
    <core:invoke method="append" on="${stringBuilder}">
      <core:arg value="${charString}" />
    </core:invoke>
    <core:set var="data" value="${inputStreamReader.read()}" />
</core:while>
<!-- Here is a string of the xml reponse payload -->
<gel:log>${stringBuilder.toString()}</gel:log>    <gel:log>End this Script</gel:log>  </gel:script>
```

RESULTS

Below are the results from the SOAP web service call made from CA PPM to SAP. Tests are done with correct and incorrect payload, incorrect password to demonstrate the accuracy of the tests that were performed {Table 1].

Table 1: Test results from the SOAP web service call made from CA PPM to SAP

Step Name	Messages from CA PPM	Comments from Ram
correct pwd correct parameters	Start this Script	Start of the web-service with valid customer data
correct pwd	basicAuth = Basic c29hcF90ZXN0OmhvY2tleTE2	Correct

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correct parameters		Authentication information was provided to the web-service from inside the CA PPM script.
correct pwd correct parameters	<SOAP:Envelope xmlns:SOAP='http://schemas.xmlsoap.org/soap/envelope/'><SOAP:Header/><SOAP:Body><n0:Z_BAPI_VIB_HOST_CIRCUIT.Response xmlns:n0='urn:sap-com:document:sap:rfc:functions' xmlns:prx='urn:sap.com:proxy:SEP:/1SAI/TAS226DF51D1D340203BB9B:740'><HSTCNT>6</HSTCNT><ZBAPIEVCIRC/><ZBAPIEVHOST><item><KUNNR>XWD40</KUNNR><HOST_KEY>0000024753</HOST_KEY><PROD_LINE>S</PROD_LINE><CNCT_PROF>07</CNCT_PROF><CNTRACT_NO>2030079511</CNTRACT_NO><RCUR_BILL>2030079511</RCUR_BILL><CTRT_CURR>USD</CTRT_CURR><GRPINGID>59SF</GRPINGID><LEVEL_TA>HIGH/6</LEVEL_TA><TCP_IP>Y</TCP_IP><CRT_CNT>0024</CRT_CNT><PRIME_LNK>N</PRIME_LNK><SAP_P_LNNO>000000</SAP_P_LNNO><VIB_STAT>IN</VIB_STAT><EID>0000024753</EID><CREATEDATE>2015-05-06</CREATEDATE></item><item><KUNNR>XWD40</KUNNR><HOST_KEY>0000104041</HOST_KEY><PROD_LINE>S</PROD_LINE><CNCT_PROF>07</CNCT_PROF><CNTRACT_NO>2030079511</CNTRACT_NO><RCUR_BILL>2030079511</RCUR_BILL><CTRT_CURR>USD</CTRT_CURR><GRPINGID>5HL9</GRPINGID><LEVEL_TA>HIGH/6</LEVEL_TA><TCP_IP>Y</TCP_IP><CRT_CNT>0027</CRT_CNT><PRIME_LNK>N</PRIME_LNK><SAP_P_LNNO>000000</SAP_P_LNNO><VIB_STAT>IN</VIB_STAT><EID>0000104041</EID><CREATEDATE>2015-05-06</CREATEDATE></item><item><KUNNR>XWD40</KUNNR><HOST_KEY>0000154305</HOST_KEY><PROD_LINE>S</PROD_LINE><CNCT_PROF>07</CNCT_PROF><CNTRACT_NO>2030079511</CNTRACT_NO><RCUR_BILL>2030079511</RCUR_BILL><CTRT_CURR>USD</CTRT_CURR><GRPINGID>CAQ8</GRPINGID><LEVEL_TA>HIGH/6</LEVEL_TA><TCP_IP>Y</TCP_IP><CRT_CNT>0026</CRT_CNT><PRIME_LNK>N</PRIME_LNK><SAP_P_LNNO>000000</SAP_P_LNNO><VIB_STAT>IN</VIB_STAT><EID>0000154305</EID><CREATEDATE>2015-05-06</CREATEDATE></item><item><KUNNR>XWD40</KUNNR><HOST_KEY>0000114233</HOST_KEY><PROD_LINE>S</PROD_LINE><CNCT_PROF>07</CNCT_PROF><CNTRACT_NO>2030079511</CNTRACT_NO><RCUR_BILL>2030079511</RCUR_BILL><CTRT_CURR>USD</CTRT_CURR><GRPINGID>CN41</GRPINGID><LEVEL_TA>HIGH/6</LEVEL_TA><TCP_IP>Y</TCP_IP><CRT_CNT>0029</CRT_CNT><PRIME_LNK>N</PRIME_LNK><SAP_P_LNNO>000000</SAP_P_LNNO><VIB_STAT>IN</VIB_STAT><EID>0000114233</EID><CREATEDATE>2015-05-06</CREATEDATE></item><item><KUNNR>XWD40</KUNNR><HOST_KEY>0000114232</HOST_KEY><PROD_LINE>S</PROD_LINE><CNCT_PROF>07</CNCT_PROF><CNTRACT_NO>2030079511</CNTRACT_NO><RCUR_BILL>2030079511</RCUR_BILL><CTRT_CURR>USD</CTRT_CURR><GRPINGID>CN4F</GRPINGID><LEVEL_TA>HIGH/6</LEVEL_TA><TCP_IP>Y</TCP_IP><CRT_CNT>0033</CRT_CNT><PRIME_LNK>N</PRIME_LNK><SAP_P_LNNO>000000</SAP_P_LNNO><VIB_STAT>IN</VIB_STAT><EID>0000114232</EID><CREATEDATE>2015-05-06</CREATEDATE></item><item><KUNNR>XWD40</KUNNR><HOST_KEY>0000114132</HOST_KEY><PROD_LINE>S</PROD_LINE><CNCT_PROF>07</CNCT_PROF><CNTRACT_NO>2030079511</CNTRACT_NO><RCUR_BILL>2030079511</RCUR_BILL><CTRT_CURR>USD</CTRT_CURR><GRPINGID>CND1</GRPINGID><LEVEL_TA>HIGH/6</LEVEL_TA><TCP_IP>Y</TCP_IP><CRT_CNT>0031</CRT_CNT><PRIME_LNK>N</PRIME_LNK><SAP_P_LNNO>000000</SAP_P_LNNO><VIB_STAT>IN</VIB_STAT><EID>0000114132</EID><CREATEDATE>2015-05-06</CREATEDATE></item></ZBAPIEVHOST></n0:Z_BAPI_VIB_HOST_CIRCUIT.Response></SOAP:Body></SOAP:Envelope>	Call made successfully with the correct data items and the web-service from SAP has sent the response with the customer data.
correct pwd **Incorrect** parameters	Start this Script	Start of the web-service with invalid customer data
correct pwd **Incorrect** parameters	basicAuth = Basic c29hcF90ZXN0OmhvY2tleTE2	Correct Authentication information was provided to the web-service from inside the CA PPM script.
correct pwd	<SOAP:Envelope	Call made

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Incorrect parameters	xmlns:SOAP='http://schemas.xmlsoap.org/soap/envelope/'><SOAP:Header/><SOAP:Body><n0:Z_BAPI_VIB_HOST_CIRCUIT.Response xmlns:n0='urn:sap-com:document:sap:rfc:functions' xmlns:prx='urn:sap.com:proxy:SEP:/1SAI/TAS226DF51D1D340203BB9B:740'><RETURN><TYPE>**E**</TYPE><ID>**Z0**</ID><NUMBER>112</NUMBER><MESSAGE>Invalid Customer</MESSAGE><MESSAGE_V1> Customer</MESSAGE_V1><SYSTEM>SEQ010</SYSTEM></RETURN><ZBAPIEVCIRC/><ZBAPIEVHOST/></n0:Z_BAPI_VIB_HOST_CIRCUIT.Response></SOAP:Body></SOAP:Envelope>	successfully with in- correct data items and the web-service from SAP has sent the response with an error message **EZ0**
wrong pwd	BPM-0704: An error occurred while executing custom script: org.apache.commons.jelly.JellyTagException: null:57:81: <core:invoke> method getInputStream threw exception: Server returned **HTTP response code: 401** for URL: https://integration.cert.sabre.com/XISOAPAdapter/MessageServlet?senderParty=&senderService=ESERVICES_Q&receiverParty=&receiverService=&interface=si_os_VIB_HOST_CIRCUIT&interfaceNamespace=http://sabreEservicesBapi2Webservice.com at org.apache.commons.jelly.tags.core.InvokeTag.doTag(InvokeTag.java:109) at org.apache.commons.jelly.impl.TagScript.run(TagScript.java:247) at org.apache.commons.jelly.impl.ScriptBlock.run(ScriptBlock.java:95) at org.apache.commons.jelly.TagSupport.invokeBody(TagSupport.java:186) at com.niku.union.gel.tags.ScriptTag.doTag(ScriptTag.java:20) at org.apache.commons.jelly.impl.TagScript.run(TagScript.java:247) at com.niku.union.gel.GELScript.run(GELScript.java:57) at com.niku.union.gel.GELController.invoke(GELController.java:74)	Start of the web-service with in-correct credentials. Web-service failed with **401** error indicating that it is an authorization issue.

CONCLUSION

The article is relevant because the documentation on web services in CA PPM is lacking, and is a benefit to CAPPM developers as SAP integration is in demand now.

The syntax of jelly script is one of the more difficult syntaxes to read, and the apache documentation is limited. Therefore, having an example like this denoting the needed attributes for class creation, usage, and calling will be helpful.

CONFLICT OF INTEREST
There is no conflict of interest.

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ARTICLE

STRATEGIES TO CONTROL HEPATITIS B: A POLICY INSIGHT AND EPIDEMIOLOGICAL ANALYSIS FROM THE KINGDOM OF SAUDI ARABIA

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ABSTRACT

Background: *This is a review paper focusing on the policies and strategies to control hepatitis B in the Kingdom of Saudi Arabia. A variety of preventive measures and disease control activities have been performed through the community in primary health care centers, schools and hospitals by the ministry of health and other government sectors for combating hepatitis B virus.* ***Methods****: Sixty suitable literatures and government reports were identified from several literature and public databases out of which only forty were relevant after reading the abstract and finally twenty-six relevant papers from the literature search and one more additional paper from the references were included in the review.* ***Results****: The inclusion of Hepatitis B Vaccine in the Immunization schedule was a very effective preventive measure against hepatitis B virus over the last decades. However, more strategies and policies by the government and the Ministry of Health, as well as effective cooperation with other sectors are needed. Conclusion: Upgrading the existing health care system in the country will prevent the hepatitis B infection, research and community participation will further reduce the cases of hepatitis B in the kingdom of Saudi Arabia.*

KEY WORDS
Hepatitis B, Epidemiology and Policy on Hepatitis B, Strategies to control Hepatitis B.

INTRODUCTION

In general, health issues in developing countries differ from those in developed countries, as they typically cause higher mortality and morbidity rates, and occur in different demographic groups. These differences require different healthcare approaches, for which the causes and the nature of health problems need to be understood in order to provide effective healthcare policies. Health policies could be defined to be those decisions that have been authorized or have been made within a government structure with the intention of having a direct influence on certain behaviors or actions [1]. Policies especially when you come to the health care sector they could either be regulatory or allocative. The aspect of the policies being regulatory means that they regulate all the activities that are being undertaken. When the policy is allocative it means it has the capability of allocating resources to dedicate them to an individual event. Hepatitis B infection is a major public health problem as nearly 240 million individuals are chronically infected worldwide [2]. It has been estimated that 73% of primary liver cancer death worldwide are due to hepatitis B and hepatitis C Virus infection [3].

Hepatitis B is a disease whose cause is an infection resulting from the Hepatitis B virus. The virus has been a serious problem in many countries, and Saudi Arabia is not exceptional as it has also been affected. It is anticipated that 240,000 Saudis are chronically infected with hepatitis B virus, and most of them may still be undiagnosed [4].
The hepatitis virus could be attributed to lead to other infection like cirrhosis, hepatocellular carcinoma, and chronic hepatitis. The spread of the disease is known to rely on risk factors that act for the virus.
Numerous studies have been done in Saudi Arabia, and these studies show that the prevalence of the virus has been reducing with time [5-7]. It has been estimated that this decline in hepatitis prevalence has been happening in the last two decades, and this decrease could be attributed to the reduction in epidemiological factors that are involved in the virus spread and infection. Jeddah region in Saudi Arabia is one area that has been noted to have a high prevalence of the hepatitis B virus by 793 reported cases out 4327 cases in 2016 [8]. HBV has been known to be transferred through semen, blood, and vaginal fluids and some other risk factors include unprotected sex with infected persons, direct contact with the blood of someone who is infected and touching infected open wounds [9]. An infection could also happen at childbirth and managing of HBV infection during pregnancy is difficult due to several peculiar and somewhat controversial aspects [10]. This paper aimed at describing the history, policies, epidemiology and the challenges of Hepatitis B in the Kingdom of Saudi Arabia.

MATERIALS AND METHODS

A literature search was conducted to find the published papers, government reports and other related publications on history, policies and epidemiology related to hepatitis B and the strategies to control the hepatitis B in Kingdom of Saudi Arabia. Google Scholar, PubMed, Saudi Arabia Ministry of Health Database, World Health Organization Database and several other public health databases and websites were used to access the data and peer reviewed scholarly articles. The search was limited to the English language only. The articles were selected by reviewing their titles, abstracts and in some articles the full texts were read. Sixty suitable literatures and government reports were identified from several literatures and public databases out of which forty were relevant after reading the abstract. Twenty six relevant papers were selected from the literature search and one more additional paper from the references was included [Fig.1]. Cross-sectional, Descriptive studies on hepatitis B, review and systematic review on hepatitis B and national & international governmental and non-governmental organization reports on

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hepatitis B were included in the review. Purely interventional, experimental and qualitative studies were excluded.

RESULTS

HBV is a serious disease that threatens human life, and the death rate is very high globally. The risk of developing significant liver disease in individuals infected with HBV lies somewhere between 20% and 40% [4].This viral disease causes significant morbidity and mortality, and imposes a great burden on the country's healthcare system. Thus there is a need for policies formulation and implementation that could attribute to the reduction in the prevalence of HBV in the Kingdom of Saudi Arabia [11]. Policies are important aspects of health care since they can be used to monitor and regulate infection. Policies could be aimed at ensuring that there is no further spread of infection or that the infected cases are regulated. Control is the key factor that drives policy formulation and implementation. Strategies to combat HBV infection include providing treatment to the chronically ill patients, vaccinating susceptible individuals and interrupting the route of transmission [12]. Amongst them, immunization is very sufficient and considered to be the most effective as it prevents individuals from contracting the infection of HBV [13].

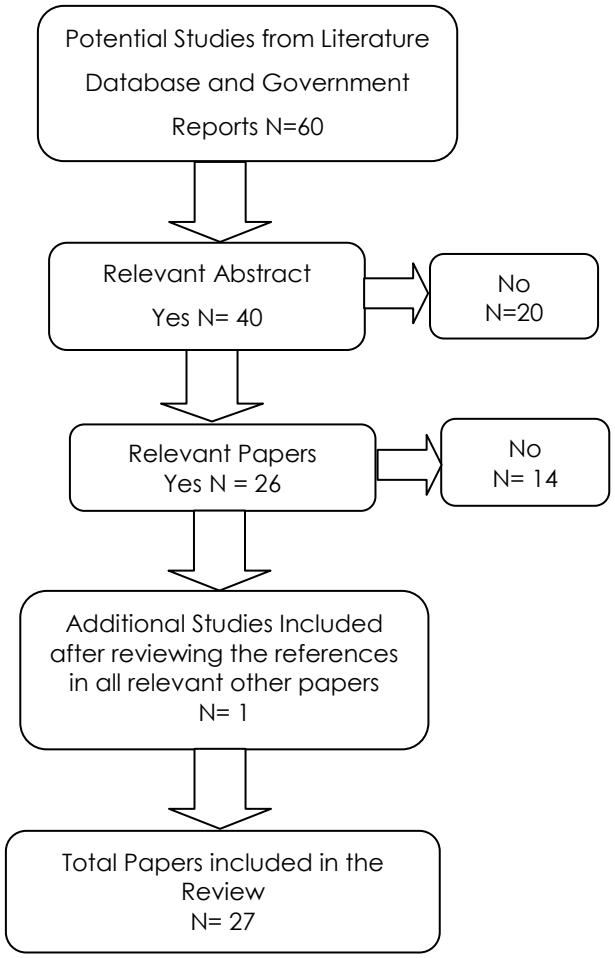

Fig. 1: Process of selection of articles to be included in the review

.....

Improvement of health is often characterized in terms of epidemiological or health transition [14]. Between 1970 and 1980, Saudi Arabia adopted a healthcare approach based on essential health needs and health as a fundamental human right. The approach was conceptualized according to the country's social and economic factors of health in order to encompass the whole population by investing in community programs. Since 1970, the Kingdom of Saudi Arabia has achieved rapid economic growth, an associated expansion of educational attainment and development of primary health care. In the context of developing primary health care services, by the beginning of 1980s, the Saudi Arabian healthcare system had largely prioritized curative healthcare services, with an emphasis on the treatment of the health issues that already existed [15]. In 1990 the Ministry of Health strictly implemented immunization against hepatitis in all infants and all first-grade students. Ten years after vaccination, the rate of Hepatitis B infection fell to less than 1% in the under-20s age group [7]. The rate of Hepatitis B infection is still high in those over the age of 20. Nowadays, indicating the population groups who are bearing the greatest burden of disease is an easy task due to the epidemiological improvement. The recent statistics from Ministry of

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Health , Saudi Arabia reports 32 cases among under 5 year old children, 28 cases among the age group between 5-14 years, 2826 cases among the age group between 15-44 years and 1437 cases among the age group of ≥ 45years [8].

Most vaccinations take place in primary health centers which are now providing both preventive and curative services, referring the cases that require more advanced healthcare to public hospitals (the secondary level of healthcare), while the cases that need more complex levels of healthcare are transferred to central or specialized hospitals (the tertiary level of healthcare).The total number of PHC centers provided by the MOH increased by 14.5%, i.e. from 1,986 centers in 2008 to 2,325 centers in 2016 [8]. The MOH is promoting quality assurance and improvement through the use of standard operating procedures and accreditation of healthcare facilities. Efforts are being made to improve patient safety in both public and private health care facilities. Moreover, maternal and child healthcare, including immunization against major infectious diseases including HBV, has improved over the last two decades. Comprehensive primary healthcare starts with building a community infrastructure of accessible health care centers staffed with well-trained health care workers, based on community involvement, responsive to the community needs, and dedicated to building on community strengths and resilience[16]. In any healthcare program or strategy, the successful implementation of PHC must be guided by the following principles: political commitment, equity, accessibility, affordability availability, effectiveness, efficiency, and integration of promotive, curative, preventive and rehabilitative healthcare services [17]. These are principles that should guide every PHC program in the world towards success. As a result of the constant delivering of integrated and comprehensive healthcare services, the recent statistics of MOH [8] revealed that, the incidence of HBV among Saudi reduced from 15.79 cases /100,000 population in 2012 to 13.63 cases / 100,000 population in 2016. Also, the rate of infant mortality in 2016 was 4.82 cases per thousand live births, compared with 16.2 deaths per thousand births in 2012 while the rate of deaths of children under the age of 5 also reduced to 8.05 cases per thousand live births in 2016 compared with 12.7 deaths per thousand live births during 2012 [18, 8]. The average life expectancy after birth increased to 75 years in 2016, compared with 73.8 years in 2012 and 71 years in 2006 [8,19,20] .

This decreases in mortality and morbidity rates and the increase in life expectancy in Saudi Arabia evident the epidemiological transition. This improvement is a direct effect of the national healthcare development plans, investment in education of medical staff and healthcare accessibility and quality, as well as a political shift towards raising awareness of health as a fundamental human right [21] .Similarly, the causes of illnesses and premature death are being increasingly addressed through intervention, education of the public, community programs and research for prevention of hepatitis B. There has been a remarkable development of the healthcare system for combating HBV, which has been accompanied by an improvement of the quality of healthcare, polices, especially in preventive treatment and curative medicine. Several strategies have been formulated to manage HBV starting by the expanded program of immunization which is stepping forward. There is a drop in the incidence of some vaccination preventable diseases due to the high immunization coverage achieved during this decade. The immunization coverage of Hexa Vaccine which also includes Hepatitis B was 98.5 in 2016 [8]. Immunization has been defined to be one of the most powerful tools that coils be utilized in prevention and control of this menace [22].

According to the rules and regulations that have been clarified in Saudi Arabian hospital, practice is that a HBV vaccine is compulsory in the childhood immunization schedule. The inclusion of the HBV vaccine in childhood vaccination programs is a positive step and a workable idea because most people tend to ignore or forget to immunize their kids or don't even have any reason for doing so. The Saudi government has been taken as an example to be applied in other countries in terms of the intensity of procedures and attention to vaccinations, which are typically mandatory for citizens and residents. A temporary birth certificate for one year duration is issued for the newborn and after one year and the completion of the medical vaccinations; the birth certificate of the newborn is issued [23].

The first dose of hepatitis B vaccine is given at birth, second dose administered at 2nd month, the third dose is needed at 4th month while the forth dose is given at 6 months [8]. At the age of six children can't enroll into schools unless completion of all vaccinations [24]. Not only MOH established a service to remind parents of the deadlines of the basic vaccinations against diseases but also, it performs home visits for providing vaccination for children. Furthermore, another preventive method is the inclusion of hepatitis B testing into the mandatory premarital screening test due to the transmission of diseases from contaminated blood and sexual contact, which consequently lead to the transmission of the disease to newborns. A cross-sectional study done in Jazan, Saudi Arabia by Hussein et al found a statistical correlation between the dental procedure and the hepatitis B infection [25]. Another study in Jazan relieved a positive correlation between the age and the hepatitis B infection [26].

DISCUSSION

Even though the statistics from research work are suggesting that HBV prevalence is reducing, but it remains to be a national menace. It is scientifically proven, that virus keeps changing their definition and form, so it's just a matter of time before the hepatitis virus evolves and causes significant morbidity and mortality. The decreasing prevalence of the HBV infection has been noted in Saudi Arabia. However, high prevalence of the hepatitis B virus recorded in west regions including Jeddah, Makkah and Taif by 793, 580,408 reported cases respectively out 4327 cases in 2016 [8]. It worth investigating the cause of high

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prevalence rates in the above stated regions as many people pass by Jeddah and Taif cities when they visit Makkah for Hajj and Omara gathering. Saudi Arabia hosts large mass gathering events in Makkah attracting more than 3 million people from more than 183 countries annually. These gatherings pose a variety of health risks including infectious diseases, such as seasonal, respiratory, foodborne and other gastro-intestinal illnesses, skin diseases and injuries. To address such risks, Saudi Arabia has put in place an advanced healthcare system infrastructure that includes 177 primary medical clinics and 27 hospitals in the immediate vicinity of the pilgrimage areas [27]. HBV incidence among Saudi was 15.79 cases / 100,000 population during 2016 while it was 7.91cases / 100,000 population among Non-Saudi [8]. This difference may be due to the effectiveness of pre-medical checkup of expatriates which requires absence of infectious diseases such as hepatitis and AIDS before entering the country.
Policy formulation and implementation could be used as a tool for decision making and combating the national menace at the same time. PHC centers should perform general checkup including test for HBV for each patients on regular basis and advise the virus holder to check with the specialist every month for the necessary tests and treatment. Early diagnosis and treatment of the virus is required as the infection takes a very aggressive pathway (hepatitis, or immunodeficiency). On the other hand, treatment of chronic diseases may be necessary to reduce the risk of liver cirrhosis and liver cancer. Examination of the liver of both children at birth and pregnant women is necessary to ensure that they are free from this disease. Implementation of good policies will ensure that everything is running smoothly as expected.

Furthermore, it's required to build more equipped PHC centers to handle such cases. Moreover, accessibility to healthcare services, cost-effectiveness and equity also form an integral part of PHC provision. The improvement of accessibility to healthcare services requires equity in the distribution of healthcare facilities throughout the nation as well as equity of access to health care professionals, including transport to health care providers [28]. A comprehensive surveillance program is needed to provide data on a scientific basis, and enable the relevant authorities to recommend a comprehensive national plan for improving the detection and combating all the cases of infection. Surveillance is a crucial monitoring tool for evidence-based decision making about public healthcare [29].

The current study shows a significant association between the dental procedures and the hepatitis B and this finding is supported by a study conducted in Brazil as a multicentric study by Pereira et al [30]. This study showed the prevalence rate of hepatitis B increases with age and this result is in concurrence with the previous study conducted by in Saudi Arabia by Mehdi et al [31].

CONCLUSION

As Saudi government noted that childhood cases are directly infected due to the emerging of infectious diseases, policies were formulated and implemented effectively. The government's assistance has greatly improved the Saudi healthcare system at a primary, secondary and tertiary level. The policy of having the mandatory HBV vaccine in the immunization program for kids has proven to be more than effective due to reducing number of new infections among children. The population has significantly improved health-wise due to the MOH reforms in healthcare services and substantial attention to PHC, which is vital for every healthcare system. PHC centers have become fully equipped, and are able to perform a variety of advanced treatments. The government is also considering investing more in the research sectors where it will provide the financial means to all the research institutions that are concerned with the virus infection and spread. Financial help will ensure that more research is done to improve the current situation. Government investment in research centers and policy formulation will be a road map for reducing the incidence and prevalence of hepatitis B.

CONFLICT OF INTEREST
There is no conflict of interest.

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FINANCIAL DISCLOSURE
None

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ARTICLE

IMPROVEMENT OF PATIENT PATHWAY IN A BREAST CANCER CENTER

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ABSTRACT

The aim of this paper is to establish the patient flow diagram of a breast cancer center in a private hospital in Turkey and to decrease the current waiting time of patients by applying specific scenarios. With the help of the patient flow diagram and practices applied, the model is to increase the degree of welfare of patients and hospital personnel, to ensure that the resources are efficiently and effectively used, as well as minimizing the financial loss by decreasing the idle time spent in unnecessary queues. The patient flow diagram of the breast cancer center is modeled by means of commercial software ARENA. Discrete event simulations in ARENA are performed by using recorded data to find bottleneck of the system. Patients' queues are chosen as performance criteria. Various scenarios are derived to obtain a significant decrease of waiting time. The results showed that most of the performance criteria gave a significant difference compared to the actual situation whereas some of them are insignificant. Finally, the scenario, which gave the highest improvement, was chosen as the critical improvement scenario for the breast cancer center patient flow system. The increased demand versus insufficient sources caused in healthcare services due to poor quality with long queues during the diagnosis and treatment process, collection of data was the biggest challenge faced during observation. This model can only be used if adapted to processes of other cancer types, other breast cancer centers or any other unit in a hospital. This paper is giving an example of a current and future value stream map showing step by step where the bottlenecks are and how it can be improved and what specific benefits it will bring to the healthcare system specifically to breast center. It will be useful for both academicians and practitioners on how to apply lean to healthcare.

KEY WORDS
Arena, Simulation, Breast Cancer Center, Patient Flow Diagram

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INTRODUCTION

Nowadays due to high population and scarce resources, waiting in queues is inevitable. Queues are seen almost everywhere such as at supermarkets, banks, universities, and hospitals. In this sense, it can be said that queues have become a part of our life. However, waiting in queues is causing unsatisfied customers, which also results in loss of customers. More importantly, queues are resulting in vital consequences. When queues in healthcare are concerned, the degree of illness may increase with the time spent in queues and even may cause death. Therefore, organizations must provide their patients a systematic health service. An effective service includes serving the patients as soon as possible with a higher quality as well as employing enough number of employees. When the optimum numbers are determined, patients will not be waiting in queues too much and costs of unnecessary employees will be decreased. Hospitals are the most distinct places of queuing problems. Most patients are waiting in queues to be examined while others are waiting in queues to have inpatient treatment or to undergo surgery [1]. Another problem foreseen in hospitals is that even though there is a huge queue of patients (most of the time causing confluence) equipment/physician/nurse are kept idle. Because of this, patients are wasting their time in queues as well as resources are not being used efficiently.

Patient flow diagrams are prescriptive diagrams be synchronizing resource, employee and patient to use resources more efficiently (decreasing the waiting time in queues) by showing step by step where patients are supposed to go, the average time of each step, intradepartmental flow time, bottlenecks in the system.

The aim of this paper is to establish the patient flow diagram of a breast cancer centre in a private hospital in Turkey and to decrease the current waiting time of patients by applying specific scenarios. With the help of the patient flow diagram and practices applied, the model is expected to increase the degree of welfare of patients and hospital personnel, to ensure that the resources are efficiently and effectively used, as well as minimizing the financial loss by decreasing the idle time spent in unnecessary queues.

LITERATURE REVIEW

Queuing system

Queues or waiting lines help facilities or businesses provide service in an orderly fashion. As defined by Baht [2] queuing theory embodies the full gamut of such models covering all perceivable systems that incorporate characteristics of a queue.

The history of queuing theory goes back 100 years. Johannsen's "Waiting times and number of calls" (an article published in 1907 and reprinted in Post Office Electrical Engineers Journal, London, October 1910) seems to be the first paper on the subject [2]. On the other hand, Erlang's work "the theory of probabilities and telephone conversations" and the studies done by Molina in 1927 and Fry in 1928 has been motivation for having the practical problem of congestion [2]. In addition Crommelin, Pollaczek, Khintchine, Kolomogorovv and Palm have done research related to this topic [3].

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This system was used only in telecommunication industry until the 1950's; afterwards it was widely spread to other industries. It has been used in designing the traffic flow (including both human beings and cars), scheduling (patients in hospitals, jobs assigned to machines, programs in a computer) and banking sector. Pollaczek, Sysoski, Saaty, Bhat and Taha are academicians who have studied under this major.
Queuing system is defined as customer incoming to the system to receive service, and if not urgent wait in the queue and if waited should leave the system as being served [4]. According to this definition, patients who come to the hospital to be served must leave the hospital after being served.

On the other hand queuing discipline, is explaining whether if the customer should be waiting or not in the queue or if have waited in the queue for a time and then left it without receiving the service [5]. Sundarapandian also added that if the incoming customer were above the service capacity of the system then for sure there would be a queue. If there is a queue, the decision of waiting in the queue is completely the customers desire [5].

Constraints theory

Constraint is an element, which decreases the systems performance. The objective is to use this constraint in the best way in order to reach the highest productivity. Considering a system, first it has to be divided into subsystems and be analyzed. The product, which is going to be produced in this system, will be produced altogether by the subsystems and the slowest subsystem will determine the speed of the system. It does not matter how fast the other subsystems are but the result will not change if the slowest subsystem does not speed up. The slowest subsystem is causing a bottleneck, which is playing a determining role in the speed of the system [6].

Queuing systems applied in healthcare industry

Queuing models are used to receive information on each task in healthcare systems and to figure out the causes of mistakes or errors based on patient care or caring processes. On the other hand, it is also used to improve the general system performance and to estimate the unfavorable tendencies and the consequences of the decisions taken.

Being directly related to human life the healthcare industry is accepted to be different than others and due to it complicacy of its system it is presenting a vital importance to the subject. When the literature is analyzed, more specifically it is seen that between the years 1993 and 2012 there is a cumulative increase in research related to order theory and healthcare industry. Twenty five percent of the research analyzed between these years are related with emergency rooms, twenty-three percent used order theory to analyze the whole hospital generally. Fourteen percent of the research was done on the waiting time of outpatient care and patient satisfaction. Nine percent on operating rooms, seven percent on cardiac surgery, seven percent on patient transportation, another seven percent on assigning beds to inpatients, two percent on accident immediate care, two percent on endoscopy, and the rest two percent of the research was done on the front line assembly area [7]. Research other than these include topics such as queuing theory waiting time, sourcing, systems design, appointment system, system analysis, patient scheduling, resource scheduling and ambulance service.

Varieties of solutions were analyzed for different healthcare organizations including outpatient care centers, hospitals or organizations including both. Quantity oriented research such as, optimizing the number of beds in a hospital or quality oriented research, such as, distributing ambulances for gaining a balanced access were done. Patient waiting time is an important performance criterion for ambulance systems. Bell and Allen in 1992, did research related with multi-server queuing models to be able to reach the predetermined response rate [8]. In healthcare systems on time, access to care became an indicator for a high quality healthcare service. Various researches were done in outpatient clinics, surgical operations, gynecology and newborn unit and mental health units.

Bretthauer et al., has analyzed the blocking of units with a heuristic approach as patients moved from one unit to another and as patients completing their first care in the first unit could not pass to the next due to the inadequate capacity of the second unit [9].

Bailey has mentioned on individual-blocking system by determining two variables, which are determining the effectiveness of the appointment system according to appointment range and the arriving time of the physician [10]. Ho and Lau has mentioned about appointment systems with variable ranges [11].
Waiting time utilization and cost minimization together with longitude of queues are mentioned in healthcare systems analysis.

In a queuing system customers (patients for healthcare systems) minimizing the waiting time and maximizing utilization of server and resources (physician, nurse, beds for healthcare system) are expected. Especially patients leaving the queue without receiving the service has been analyzed to be a very important performance rating parameter in hospital emergency units [12]. Increasing the service capacity which is a traditional method, has a very little effect on reducing the long queues because when patients realize that their waiting time is going to decrease the will increase their speed of incoming to the unit which in fact will result in an increase in the length of the queue once again [13]

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Information on cancer centers

Due to the increase in the number of cancer patients, the need of cancer centers are increasing cumulatively. Therefore, the number of cancer centers must increase as well as the current centers must be improved in order to serve better in the world and of course in Turkey. Patient waiting times are increasing, as demand is high when looked from the patients' perspective. When analyzed from the service provider perspective, improved processes would result in higher patient flow as well as higher profit. Unfortunately, it is quite hard to improve the cancer center processes due to high patient numbers, multi-stage service care, uncertain daily demand and uncertain patient floe diagrams.

Modelling by simulation

Simulation is taking a real system as a base and designing a model of this system and analyzing the behavior of the system or is the total of all the strategies applied to improve the system. Simulation started to be properly used in the 1990's. Good animations, ease of use, high speed of computers, and ease of application of other packages made simulation a standard tool in many organizations [14].

Using simulation in cancer centers

The first objective of healthcare services is to provide health but the demand is uncertain and variable. Therefore, using simulation model, without harming or occupying any resource, possible changes can be made and analyzed.

In 2009, Santibanez has analyzed an ambulatory care unit (ACU) of the British Columbia Cancer Agency (BCCA) in Vancouver. In this research, any change done on the physical infrastructure, planning politics and assignment of capacity, which is effecting the patient waiting time, overtime in the clinic and sourcing were analyzed. It was found that changing or improving more than one variable would give the best result, in which, patient waiting time decreased by 70%, need for physical area (size of care room, number of rooms, infrastructure, physician working area, and patient waiting area) has decreased by 25% [15].
Changing the laboratory and pharmacy locations and making changes in the planning procedures has justified 30% increase in rate of patient checking out with the application of simulation [16].
In another research done in Louisville, six different scenarios were formed and compared with current situation. Some of the scenarios were as adding two specialized nurses such as specific breast nurses for the breast cancer center.[17]

The aim of this paper is to establish the patient flow diagram of a breast cancer center in a private hospital in Turkey and to decrease the current waiting time of patients by applying specific scenarios. With the help of the patient flow diagram and practices applied, the model is expected to increase the degree of welfare of patients and hospital personnel, to ensure that the resources are efficiently and effectively used, as well as minimizing the financial loss by decreasing the idle time spent in unnecessary queues it has been decided to analyze breast cancer centers in Turkey as breast cancer is the most common cancer type faced in Turkey nowadays. Simulation will be used as the first step of the study to figure out the main problem of the centers.

METHODS

The literature review and observation showed that patients are mostly suffering from waiting in the queue. So the aim of this paper as mentioned before is to minimize the waiting process and improve healthcare services in breast cancer centers in Turkey. In this study, as the state variables are differentiating in some points (patient entering the hospital or patients after being served) discrete event simulation has been used.

In order to detail the process, expert opinion was taken. Therefore breast surgeon, radiologist, pathologist; pathology technician, radiology technician and desk nurse were interviewed in the chosen private university hospital. Both open and close-ended question were asked during the interview. With the help of these questions, the process of the system and the physician schedule was learned in detail. In addition to this observation was also done. For this, the researchers were present at different departments in the hospital. Time spent in each machine, and time of examination were measured by a stopwatch and collected. Collection of information took place between 10 March 2014 and 08 April 2014, in a one-month observation period.

ARENA simulation program was used to draw the patient flow diagram and after analyzing the data distribution, it was added to the diagram, which was formed by the simulation program ARENA.
The case study was decided to be done in a private university hospital in Istanbul Turkey. The hospital is giving service between 08:00 until 17:00. However, starting from 16:50 no patient registration is done. In addition to this even though the hour of work is finished if there is a patient in a machine or in a physician's room being examined, the extra time spent is accepted as overtime. The workday finishes when the last patient is discharged from the clinic.

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Between 12:00-12:59, the hospital has lunch break and apart from the operations room and emergency room the rest of the departments are not working during the lunch break. There is only one breast surgeon in this hospital. Every hour five patient is visiting the general surgery department. Patients visiting the breast surgeon are 25% of the total patients visiting the general surgeons.

Patients are visiting the hospital via appointments taken from internet or telephone. After patient enters the hospital, they have to make registration and then be examined by the surgeon. This is a manual examination done in the surgeon room. During this time, surgeons listen to history of patients. After the manual examination if the surgeon decides that there is nothing going wrong the patient is discharged. In other cases patient is sent to the radiology unit for imaging processes. Patients' age is important at this point, being above or below age forty makes sense. Patients below age forty are only asked to have ultrasound examination. For patients at age forty or above only ultrasound or both ultrasound and mammography may be requested. [Fig. 1] is showing the present system of the private university breast cancer center.

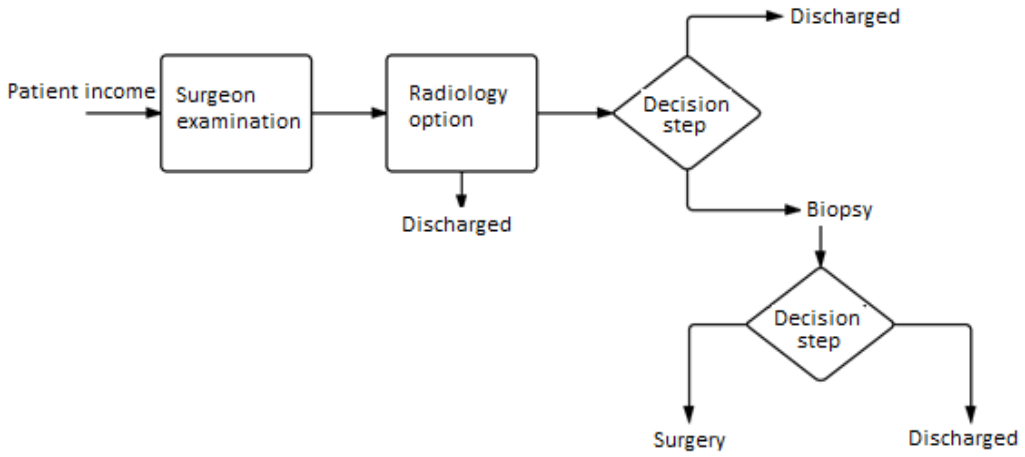

Fig. 1: Present system of breast cancer centre

The patient first has to be registered at the radiology department and manual examination is done by the radiologist. The ultrasound is done by the physician by the mammography is taken by the technician. The results of the ultrasound and mammography are not printed and given to the patient immediately but are directly seen at the computer screen of the surgeon. The surgeon loudly examines the results of the ultrasound and/or mammography and saves the voice as a voice message. Then the reporter transfers the voice message in a written document and prints it. For both of the results the patient is called one day after the examination is done to pick up the results. If there is no need for biopsy the patient is discharged. If biopsy is requested, it is done immediately and after the biopsy operation, the patient is sent home. The piece taken from biopsy is sent to the pathology department. The results from the pathology department finalizes in three to four days. Patient comes to the hospital to take the results, if not ready this action is repeated. After all the results are ready, the breast surgeon analyses them and decides whether MRI is needed. MRI is an imaging system taken by a technician. MRI results are ready in 24 hours. At the end the breast surgeon decides whether if the patient needs operation or not by examining the MRI results or pathology results or both. If operation is not needed the patient is discharged with a decision of close follow-up.

Finally, the model is operated and the time of queues and patient time spent in each unit is determined. For system improvement, more than one scenario is developed and analyzed afterwards. Each patient flow diagram for each unit is shown in supplement figure A1 to A10 in detail.

RESULTS

Data was collected in a one-month period between 10 March 2014 and 08 April 2014. As explained before the observed hospital is giving service between 08:00 until 17:00. However, starting from 16:50 no patient registration is done. In addition to this even though the hour of work is finished if there is a patient in a machine or in a physician's room being examined, the extra time spent is accepted as overtime. The workday finishes when the last patient is discharged from the clinic. Between 12:00-12:59, the hospital has lunch break and apart from the operations room and emergency room the rest of the departments are not working during the lunch break.

Appointments are arranged in a range of one hour for each appointment. Excel Easy Fit determines the distribution of the collected data. The distribution was found to be Poisson distribution (λ=40 patient per

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day). After determining the distribution by Excel Easy Fit it was statistically tested and proved that Poisson distribution is best fitting the data distribution.

There are four general surgeons employed in this hospital and 25% of the patients visiting surgeons belong to breast surgery. 0.2% of the patients visiting the breast surgeon are having biopsy and 0.07% is having a surgical operation.

The patient flow diagrams are shown in Appendix from figure A1 to A10 at the end of the paper.
The system was calculated ten times (number of replications) in thirty days (replication length). Patient flow was also observed in the system. The processes in the system were either observed or referred to an expert opinion. The following table [Table1] is giving information on the distribution parameters (in minutes) for each task in the process.

Table 1: Distribution types for healthcare process in breast cancer centre

Task	Used Resource	Distribution Type	Distribution Parameters
Hospital Registration	Desk Staff	Constant Dist.	2 (min)
Physical examination	Breast Surgeon	Normal Dist.	15-20 (min)
Radiology registration	Radiologist desk staff	Normal Dist.	2-3 (min)
Physical examination	Radiologist	Constant Dist.	1 (min)
Breast Ultrasound	Radiologist	Normal Dist.	14-16 (min)
Mammography	Technician	Normal Dist.	15-20 (min)
Ultrasound reporting	Radiologist	Normal Dist.	1,8-2,2 (min)
Mammography reporting	Radiologist	Normal Dist.	1,8-2,2 (min)
Reporting	Reporter	Constant Dist.	4 (min)
Consultation	Breast Surgeon and Radiologist	Normal Dist.	5-8 (min)
Biopsy	Radiologist	Normal Dist.	20-25 (min)
Breast MRI	Technician	Normal Dist.	20-30 (min)
MRI Evaluation	Radiologist	Constant Dist.	3 (min)
MRI Reporting	Radiologist	Constant Dist.	2 (min)
Pathology	Technician and pathologist	Normal Dist.	3-4 (min)
Outcome evaluation	Breast Surgeon	Normal Dist.	4,8-5,2 (min)
Examination after MRI	Breast Surgeon	Normal Dist.	4-6 (min)
Surgical operation	Breast Surgeon	Normal Dist.	1-1,5 (hrs)
Other processes	Breast Surgeon	Normal Dist.	20-25 (min)
Breast Surgeon other consultation	Breast Surgeon and other doctor	Normal Dist.	5-8 (min)
Radiology other registration	Radiologist desk staff	Normal Dist.	2-3 (min)
Radiology other processes	Radiologist	Normal Dist.	5-8 (min)
Radiology other consultation	Radiologist and other doctor	Constant Dist.	10 (min)
Radiology other ultrasound	Radiologist	Normal Dist.	14-16 (min)
Radiology other processes	Technician	Normal Dist.	15-20 (min)

Visits to the surgeons have been determined to be Poisson distribution. As breast patients visiting the surgeons are a sample of the patient population it is accepted that they are also fitting the Poisson distribution. Addition to fitting the Poisson distribution there may still be patients visiting surgeons in other specific hours. Visiting distribution is developed by ARENA program.

Patient registration process has a standard value and takes two minutes. This process is done by Decision module and can have two or more alternatives and each alternatives percentage is added to the system.
In order not to reject the patients, visiting the hospital at lunch break a Hold module is used and patients set to wait until the break is over. In this study, human flow is analyzed. In addition to this in order to be able to receive blood tests and radiological examination workflows must be also considered together with human flows. For this reason, workflow is paralleled added to human flow and is determined to have both of them at the same time. The Separate module is used for this situation. Batch module is used to pair two

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entities. As an example batch module is pairing the patients report outcomes and patient next visit to the hospital. By this module, when report outcomes are not ready the patient goes back home, but if report outcomes are ready then the system continuous with the next step in the flow chart. Record module is keeping records of the time spent between the requested modules. At the point where patients care is finished the Dispose module is the module used to discharge the patients from the system.
After all the data are transferred to the program, the program is operated ten times in thirty days. The length of the queues can be obtained as well as by placing assign and record modules to intervals, which are requested to be measured, are also possible.

Nine performance criteria were selected. These nine criteria are (1)discharged patients from first surgeon examination, (2)MRI and USG report extra waiting time, (3)patient coming to radiology department but not having biopsy operation and being discharged, (4) discharged patient after all examinations are done but without having a surgical operation, (5)biopsy process, (6)surgeon physical examination, (7)second step physical examination (radiologist physical examination), (8) surgeon and radiologist consultation, and (9) breast surgeon outcome assessment. The current situation performance measurement is shown below in [Table 2].

Table 2: Current situation performance measurement

Perf. Crit.	Ave.	Half Credible Intervals	Min. Ave.	Max. Ave.	Min. Value	Max. Value
1	1,647	0,37	0,87	2,35	0,28	20,83
2	0,66	0,48	0,00	6,54	0,00	99,67
3	30,15	1,93	27,55	36,78	24,61	141,41
4	123,71	3,71	117,91	136,01	102,16	190,53
5	0,25	0,13	0,058	0,78	0,00	1,15
6	1,26	0,32	0,68	1,95	0,00	21,65
7	0,41	0,45	0,09	2,17	0,00	20,65
8	4,13	2,26	1,34	11,04	0,00	115,75
9	2,35	0,75	0,80	4,82	0,00	8,43

According to the performance criteria mentioned above, average time spent until discharge is that patient being discharged after just being examined by the surgeon take 1.6hrs. The minimum waiting time of a patient after entering the hospital is 0.28 hrs or in other words 17 minutes, maximum waiting time of patient until being discharged is 20.83 hrs. Averagely a patient is discharged with a delay of average minimum 0.88 hrs. (53 min.) and maximum average rate is 2.4 hrs.

Normally the outcome of MRI and USG are being prepared in one day after the examination, but the average delay of it reaching the patient is 0.66hrs (40min.). As the report delivery minimum delay is 0 hrs, maximum waiting time is 99 hrs. (4 days). Averagely it is minimum zero hrs. and maximum average delay is 6.5 hrs.

Patient going to radiology department but no need to have biopsy operation is discharged starting from his/her entrance to the hospital in 30.2 hrs. (1.3 days). Minimum waiting time of patient is 24.6 hrs. and maximum waiting time is 141 hrs. (5.9 days). Averagely waiting time is minimum 27.6 hrs. (1.2 days), and maximum average is 36.8hrs (1.5days) until the patient is discharged from the radiology department.
For patients after having a biopsy operation but no need to have surgical operation are discharged with an average of 123.7 hrs. (5.1days). Minimum time to be discharged is 102 hrs. (4 days), maximum time to be discharged is 190 hrs. (7.9 days). Averagely min 118 hrs. (5 days) and maximum average is 136 hrs. (5.7 days) for the patient to be discharged.

Alternative scenario's for system improvement

After forming the model for the current situation, the system is recommending different scenarios for the improvement of various performance criteria.

Scenario 1

The latest time for accepting patients has been changed from 16:50 to 16:00. Correspondingly, important changes have been seen in many ranges and queues. With this change, even though not much difference was seen with the surgeon first examination average time, the maximum waiting time (20.8303 hrs.) has been decreased and became the lowest time (5.2685 hrs.). Waiting time for MRI and USG reports has dropped by 10% when compared to the current situation. All these differences were tested with ANOVA test to make sure they were significant. This test had 95% confidence level. When $p<0.05$, it means that two scenarios are significant. Therefore, instead of comparing the current situation and scenario, the p

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values, which are less than 0.05, have been taken into consideration for determining the criteria. ANOVA test for Scenario 1 is significant and queues of performance criteria 1, 5 and 6 have shown improvement.

Scenario 2

In the second scenario, resource numbers were changed to see how it affects patient queues. Number of radiologist has been increased from 1 to 4, and technician number has been increased from 7 to 8. Queues of performance criteria 1, 2, 3, 5, 6, 8 and 9 have shown improvement as the waiting time of patients has decreased. However, when ANOVA test was calculated the only improvement was seen in the queue of the fifth performance criteria.

Scenario 3

In the third scenario once again resource number differences has been tested. However, this time the number of breast surgeon has been increased from 1 to 2 breast surgeon. With this increase queues at 1, 2, 3, 4, 6, 8, and 9 performance criteria has shown improvement. However, not all of them were statistically significant. The statistically significant ones were 1, 3, 6 and 8 performance criteria queues.

Scenario 4

In this scenario, a different type of resource has been changed. This time the number of USG machines has been increased from 1 to 2, and its effect was checked. With this additional machine queues at performance criteria 1, 2, 3, 4, 5, 6, 7, and 8 (almost all) has showed improvement. Statistically significant ones were found to be the queues of 5 and 7 performance criteria.

CONCLUSIONS AND RECOMMENDATIONS

Even though the rate of having cancer in Turkey is increasing progressively, studies done for improving the process of patients waiting time is limited. Especially there is no single research done for forming patient flow diagrams, simulating them and determining the bottlenecks in order to improve the process of Breast Cancer Centers. In this respect, this paper is the primary research done in Turkey. This study was applied to a private university hospital in Istanbul at its breast cancer center. The patient flow process has been analyzed. Besides, various alternative scenarios were formed for improving the flow of patients through the center. As the model is too complicated, various acceptances were made. This study is the basis of patient flow diagram formation in breast cancer centers.

In this paper after the present system was analyzed, it was figured out that there is a build-up and workload density at the radiologists and at the breast surgeons. For decreasing the build-up and ensuring improvement four different scenarios were formed. Some of these scenarios included changing the number of resources used in the system and some of them intended to change the end of patient admission time. However, the improvement was not only based on decreasing the queue length but was expected to be statistically significant at the same time. For this reason, ANOVA significance test was applied.

In the first scenario, the latest patient admission time was changed from 16:50 to 16:00. By this way not only the work load of doctors were decreased but also patients coming to the hospital and waiting unnecessarily, and any idle time was tried to be prevented. In this case, the patients with no cancer suspicion who visit the breast surgeon mistakenly will be discharged earlier from the physical examination. On the other hand, a patient with its MRI and/or USG done earlier will spend less time in the physical examination room of the breast surgeon and the decision whether or not to have biopsy will be given in less time.

In the second scenario, the number of radiologists and radiology technician has been increased by 1. Therefore, only a patient who needs biopsy will have her/his biopsy in less time and as well by waiting less in the queue.

In the third scenario, the number of breast surgeons has been increased from one surgeon to two breast surgeons. By this way, the number of patient waiting in the queue in the present system has decreased with the new scenario. Patients with no cancer suspicion, visiting the breast surgeon mistakenly will be discharged from the physical examination earlier than before. Patients with their MRI and/or USG done before who also do not need biopsy will be discharged from the hospital earlier and that they will not wait unnecessarily as they do not need any treatment. In addition, these patients will not be waiting for days for the consultation of the surgeon and the radiologist, and will be discharged earlier from the physical examination of the breast surgeon. In the present state when the radiologist is idle the breast surgeon is either in physical examination or in a surgical operation. Because of this, a patient is forced to wait for the breast surgeon and radiologist consultation, which in reality takes only 5 minutes.
In the fourth and last scenario by adding one more USG machine to the system, the radiologist will do his/her physical examination and biopsy in less time.

Taking into account all of these scenarios, it is possible to reduce the workload of both breast surgeon and radiologist in the third scenario.

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As the data is not recorded in Turkey cancer centers and as alternative improvement scenarios are unlimited, this study is open to improvement in various subjects. For further recommendations, improvement in hospital process, improving more than one resource at the same time, cancelling lunch break are some other practicable scenarios.

This study is only considering the mentioned private university hospital, as other cancer patient flow processes show differences, this patient flow diagram cannot be generalized and used directly to any center. This model can only be used if adapted to processes of other cancer types, other breast cancer centers or any other unit in a hospital.

CONFLICT OF INTEREST

None

ACKNOWLEDGEMENTS

None

FINANCIAL DISCLOSURE

None

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Supplement Figures A1-A10: The development of patient flow diagrams

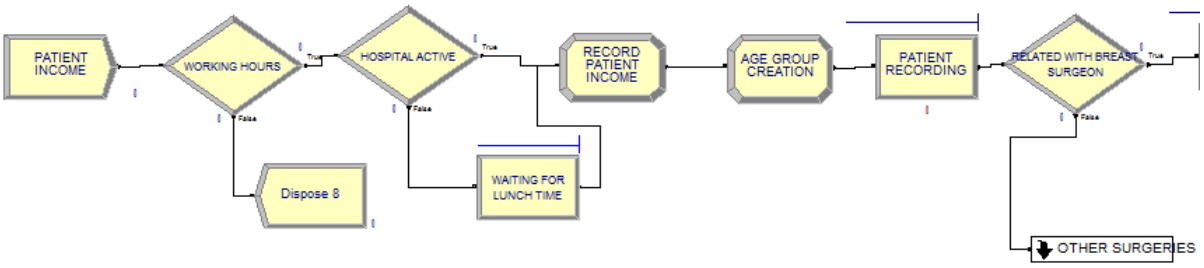

Fig. A1: Patient visiting surgeon

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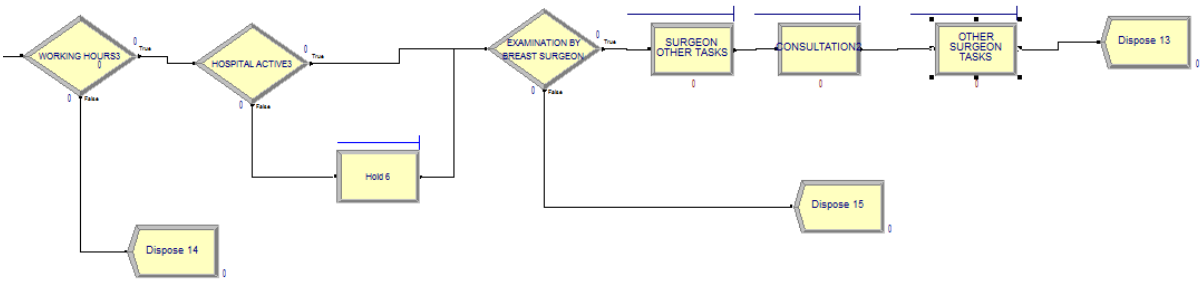

Fig. A2: Surgeon other tasks

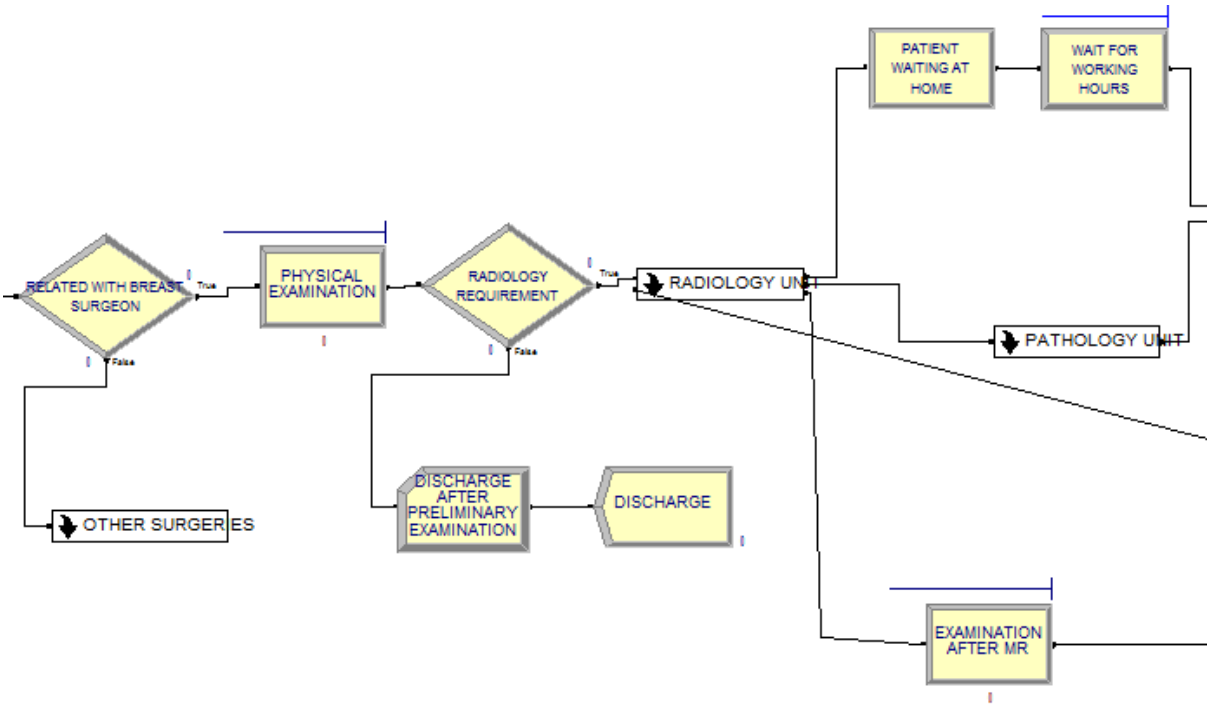

Fig. A3: Process between surgeon and pathology

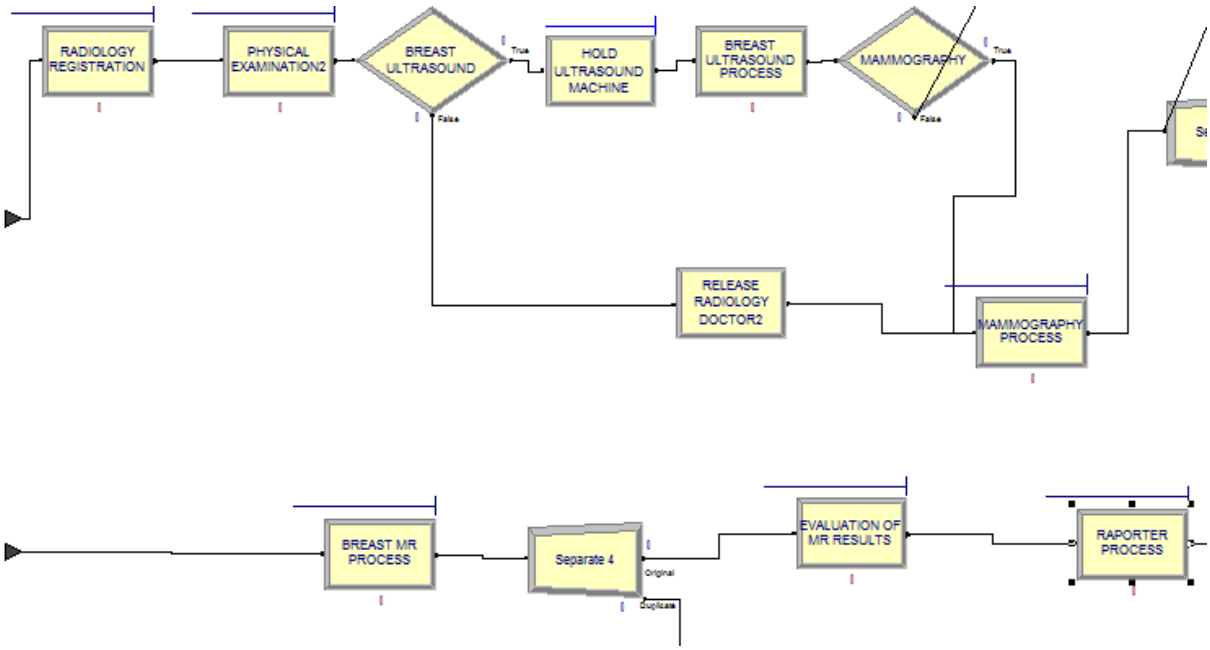

Fig. A4: Radiology Process 1

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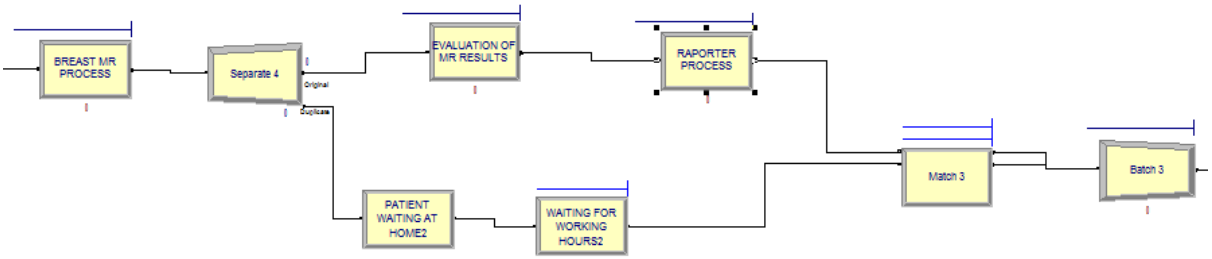

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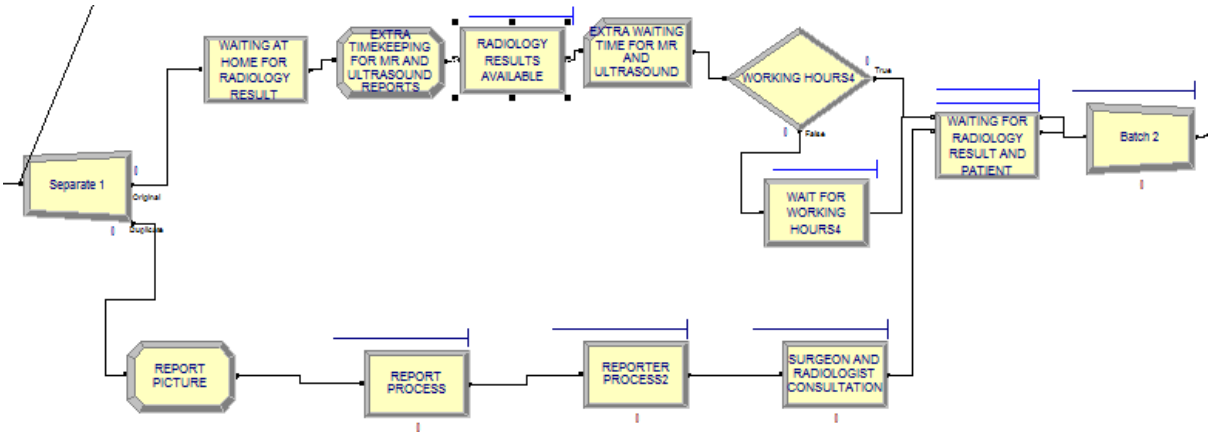

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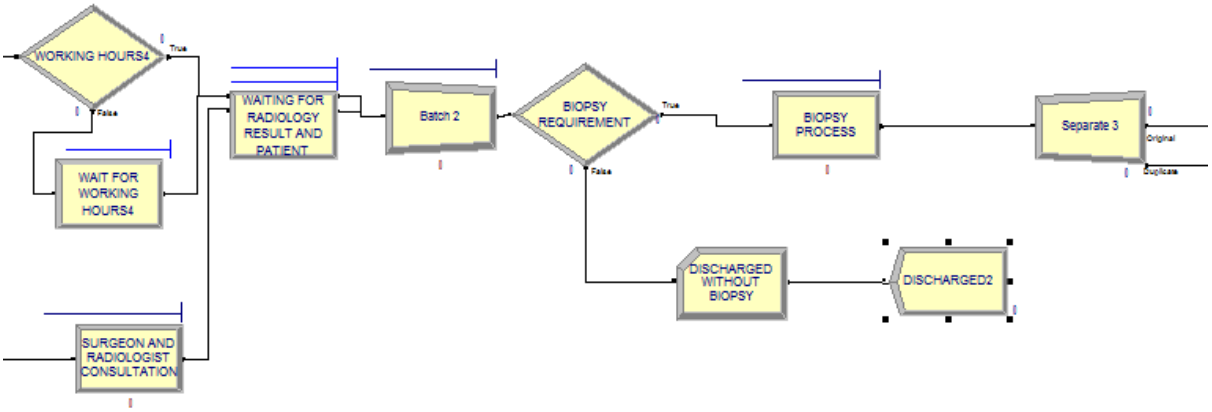

Fig. A7: Radiology process 4.

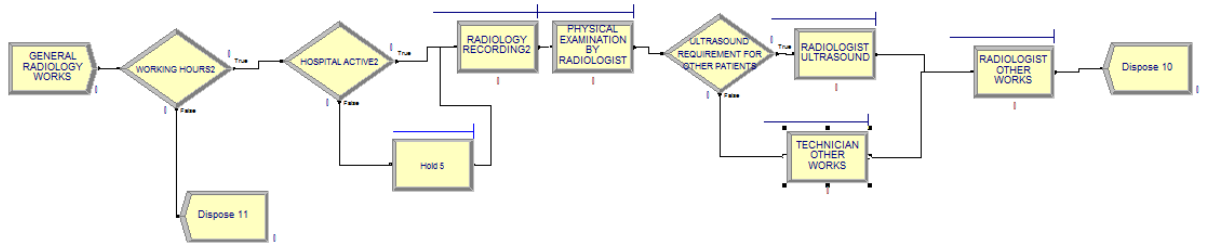

Fig. A8: Radiology other tasks

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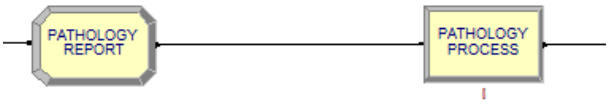

Fig. A9: Pathology tasks.

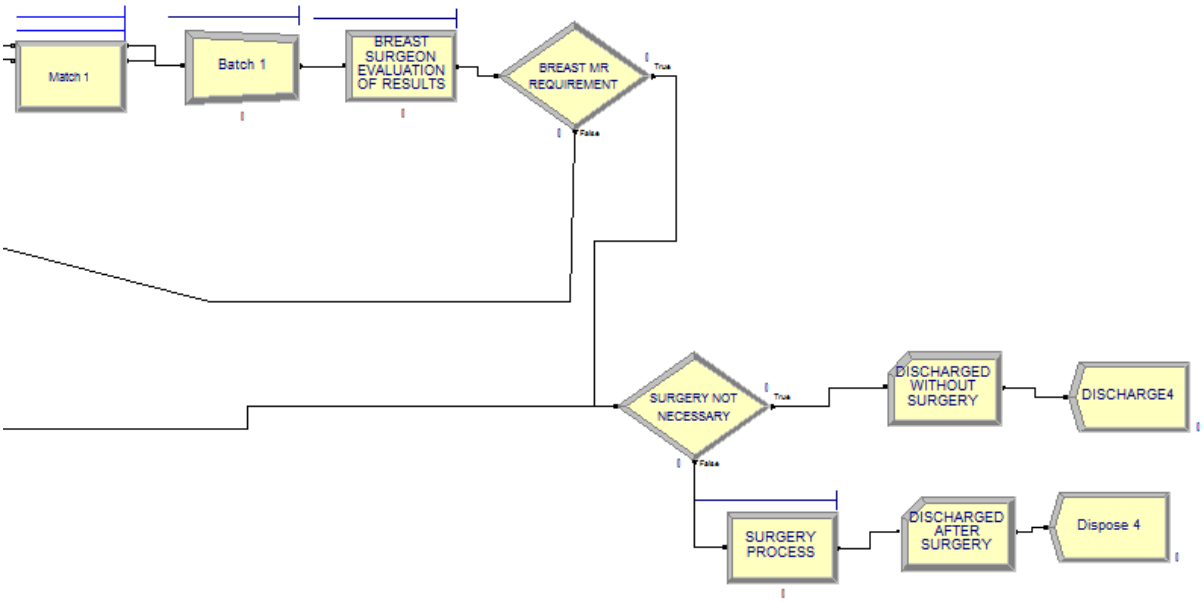

Fig. A10: Process after pathology

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ARTICLE

AN INHERITED APPROACH OF IOT BASED SMART APPLICATION FOR THE INTERACTIVE HEALTHCARE MONITORING SYSTEM

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ABSTRACT

The proposed idea deals with the inherited features of socio-technical approaches in healthcare domain for continuous online Patient-Physician monitoring by using the IoT (Internet of Things) based Multi-Agent systems. It comprises the integrated environment such as IoT health body sensors, Internet and NFC (Near field Communication) enabled mobile system with the specific Android based GUI application from the patient and physician side communication, secular multi agent data transfer communication mechanism. Particularly this system is focused for reducing the lacking and difficulties of patient and physician interaction during the emergency period. Through this IoT based approach, the patient can easily interact with the physician and also the physician can suggest the prescription by visual interaction and measuring the basic ontological tests. This method also well adapted, while the patient or physician in roaming. The system also has a backup of the related information about the patient in the encrypted format and the same will be notified and retrieved automatically from the physician server. So the patient and physician will be in continuous monitoring for 24 X 7 using this integrated approach.

KEY WORDS

IoT (Internet of Things), Multi Agent Systems, Body sensor, Ontological tests, Encryption

INTRODUCTION

The integration of IoT in health care is an important path to solve the medical health problems and also leads to enhance the quality of life and health service level. This is very much essential in nowadays, to reduce the difficulties of immediate contact with the physician for the emergency problem. In this internet era, with the maturation of technology and promotion of application demand , many people have been attracted towards the IoT in health care sectors. All the existing IoT based health care system are concentrated on making the design of human body sensor and collection of human psychological data rather than providing the health care service for user mobility. In order to overcome these difficulties, We designed the IoT based health care system as 'human-centred', because it uses to analyse the data starting from the human body IoT health care sensor to the physician office with the integration of secure multi agent communication system. This is an entirely different approach in terms of providing human centric health care services through IoT. The proposed system is making the users to obtain the service and convenience brought by mobile medical treatment while the users are under highly mobile conditions in the physical world. So we believe that, this system makes an inevitable trend for development of IoT based health care system.

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LITERATURE SURVEY

In recent years, a lot researches is going in the field of machine to machine learning (M2M), Internet of things for the effective utilization in various sectors like health care, transportation, tourism and smart environments. It also witnessed that a lot of challenges and synchronization problem occurs in the communication between the devices, sensors and distributed network environments [1,2,3,4]. In case of the health care system, still many IoT technologies are used for designing the IoT based body sensors and the collection of human related psychological data. There is a lacking found in integrating the information about patient, analysis of the behavioural information and symptoms related to the various diseases. Meanwhile, there is a security issue arises between the communication and storage of patient privacy information. The autonomous nature of IoT aggravates these privacy threats [5].

According to the survey, most of the health system is severely overburdened. Because it is constantly challenged by the need to make difficult decisions about competing priorities. For adapting to this current scenario, many barriers have been raised to mHealth implementation globally. The highest is conflicting health system priorities (52%) and the lowest is underdeveloped infrastructure (26%). All identified barriers, however, should be reviewed when considering the many factors that can slow down mHealth adoption. Since mHealth currently lacks a strong evidence base to verify its impact on health outcomes and health systems [6]. Meanwhile, many researchers are doing their research to meet the challenges of bringing the revolution is required for providing end-to-end processing and connectivity solutions for IoT-driven healthcare solutions, working toward establishing standards for these solutions and accelerating innovation for organizations eager to realize the benefits of the IoT in healthcare[7]. Integrating IoT is the one way to promote the active participation of elderly in the design and implementation of their healthcare would be to learn from the field of design and adapt models, concepts and methods relevant to participation for use in a healthcare setting. [8]

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PROPOSED PATIENT-PHYSICIAN MONITORING SYSTEM ARCHITECTURE

In our proposed architecture, the physician would monitor a patient 24x7 and look for deep symptoms and anomalous in nature. We made it possible with the integration of emerging technologies of IoT. This system establishes a secure communication between the patient and physician to stay connected at all necessary times; even it also adapted in the of roaming. The proposed architecture, mainly comprises of three major modules such as Patient System(PaS), Physician System(PhS), Physician Office Server(PoS), Secular Communication System.

Patient system

Patient System (PaS) is nothing but an internet and NFC enabled mobile phone with GUI interaction. It is serving as a PDA device. It acts as mediator between the devices connected to the body sensor and the physician system communication.The primary function of the Patient System will receive the statics reading of Blood pressure, Glucose levels, pulse, hormone levels, temperature and any abnormal symptoms in the patient's body and communicate the data to the Physician System(PhS) via Physician office Server(PoS). We specifically designed the special Android based GUI Application for the interaction purpose of the patient and the physician through the IoT technologies. The Android based GUI Application as shown in the [Fig.1] includes the facilities like hospital location, initial precaution steps for Asthma, Diabetes diseases, body sensor interaction, etc. The list of IoT based health sensor interaction with this GUI application is shown in the [Fig.2]. It would make the patient and physician to have a clear study about the problem occurs in the patient's body.

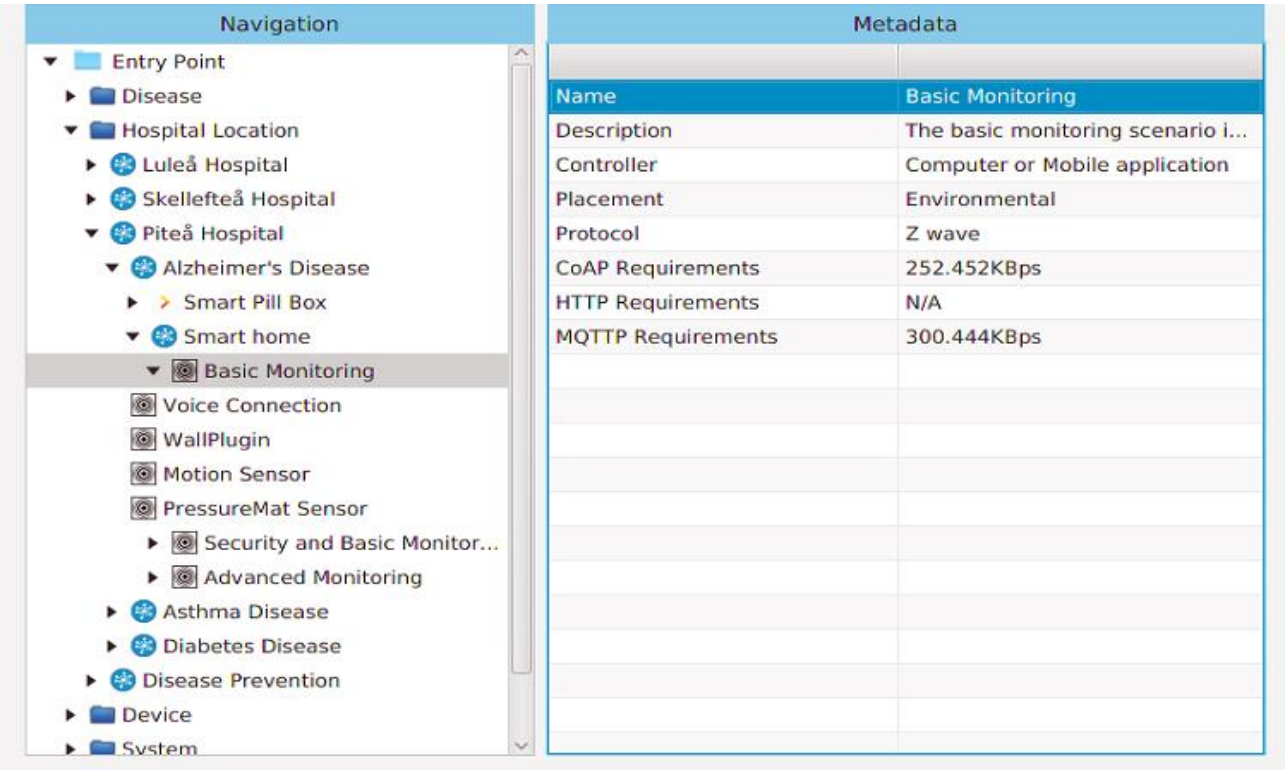

Fig.1: Patient System(PaS) user interface application

This it based GUI application enables the patient to communicate with the physician by doing the following steps

1. Turn on internet enabled PDA to receive an incoming stream of data from the attached IoT health sensors from the patient's body.
2. Comparing the data with the predefined threshold value for low blood pressure, High blood pressure, Glucose level, body temperature and make a decision of abnormality of the system. The proposed patient –Physician Monitoring algorithm shown below to enable the GUI application to monitor continuously about the status of the body and keep communicating to the Physician System(PhS).
3. It establishes the authenticated secure communication to the user prescribed physician by using the password management system authentication. This connection is also adaptable either the patient and the physician in roaming or travelling.
4. Finally, turn off incoming servicing requests from the Patient System(PaS) if it is not required.

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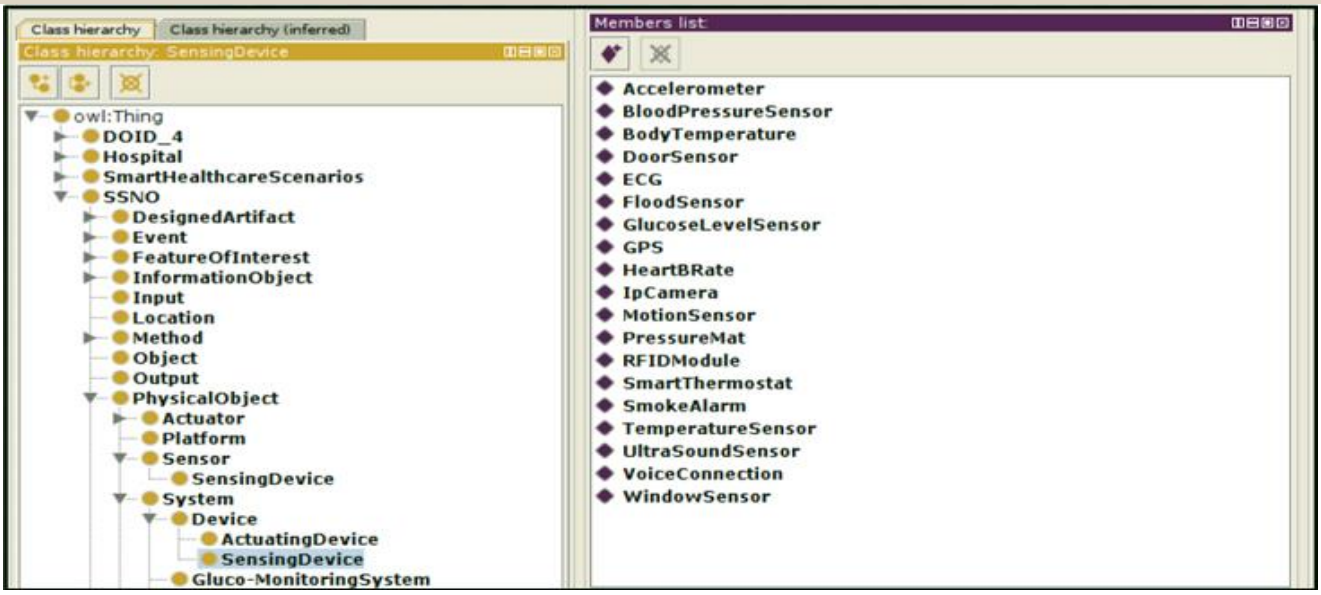

Fig.2: List of IoT based healthcare sensors

Algorithm for patient -physician monitoring

The proposed healthcare system ideally engages its patient on an integrated platform. Basically, the patient server would continuously carry out the following loop

declare
k:int (frequency of reading)
status(a_i) =0 (every variable initialize value)
status(a_j) =0 (every variable initialize value)
do : compute predicate values $Pa_i(t)$ & $Pa_j(t)$ where t is the time instance
{
compare predicate values $Pa_i(t) \geq$ threshold(β) where $i \leq 1 \leq n$
compare predicate values ($Pa_j(t) \geq$ threshold(γ) where $i \leq 1 \leq n$
do: if
{
true → send (physician, status (Pa_i), status(Pa_j), corr(Pa_i,Pa_j));
receive (physician, push(Pa_i,Pa_j) → store (physician, list($\sum Pa_i$,Pa_j)
search (patient, list(a_i,a_j) : k)
receive(physician, instruction /prescription) to follow
}
else
false →skip the physician

According to this integrated algorithm, the patient PDA device collects the information periodically through the IoT health sensors which have been attached to the patient's body. The above algorithm explaining the computation of the Blood Pressure test. It computes and compares the predicate values $P(a_i,a_j)$ of the Blood Pressure like High BP & Low BP for the predefined threshold values like $Pa_i(t) \geq$ threshold(β) & $Pa_j(t) \geq$ threshold(γ) for the physician observation. In addition to that, the proposed GUI application would attempt to discover the several past predicate values of the patient for better diagnostics. The proposed system has been designed to store the relevant status of the patient by using the secure storage management system in the Physician office Server(PoS) for future reference and diagnostics. The relevant information of the patient would be stored in the encrypted form as a Patient Entity profile which has been shown in [Fig.3]

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Patient Linkage Profile

Name: Edwin

SSN: XXX-XX-XXXX //encrypted

Primary Physician: (encrypted string) Dr. P. Ruffana //encrypted

Primary Physician's Record Pointer: yy-yy-yy-yy-yy-yy //encrypted

Nearest Outpatient Clinic:

Nearest Hospital: File handler XYZ //encrypted

Allergic to: List() // encrypted

Current Medication: List() //encrypted

Major observations: List() //encrypted

Patient's Lawyer: Name, Phone, File pointer

Relative/friend in case of emergency: Name, Number

Fig.3: Patient entity profile

Physician System (PhS) and Physician Office Server (PoS)

Physician System (pHs) is an internet and NFC enabled mobile phone device which is integrated the IoT based Android GUI Application from the physician end. This Physician system(PhS) communicates the Patient System(PaS) through Physician Office Server(PoS), which would offer the continuous monitoring and observation to the patient. Normally, the Physician office Server located in the physician office would offer the data security and relevant statics details of the concerned patient. It used to store all the patient related information in the secure storage system as an encrypted format by keeping away from the malicious attacker. Sometimes, the Physician System (PhS) would suggest specific specialist such as cardiologists, endocrinologists, neurosurgeon, allergists to resolve the further anamolies of the patient. The functionalities of the Physician System(PhS) and Physician Office Server(PoS) is shown in the [Fig.4]

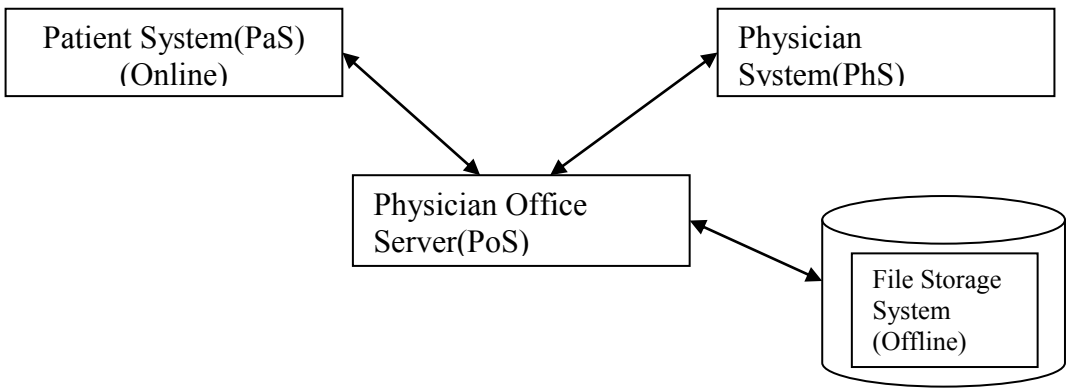

Fig.4: Functionalities of physician system and physician office server

The Patient System(PhS) also designed such a way to share the metadata to the patient in relations to the symptoms and relationship across the various human diseases. Each disease and its related information are comprised with metadata along with Disease ID (DOID) and the same to be maintained in the Physician Office Server(PoS). The metadata format of the various diseases is shown in [Fig.5]. This would help the patient to get more awareness and exposure about the seriousness of the particular disease. It will help in all the way to protect them and lead them away from from the serious infections & conditions.

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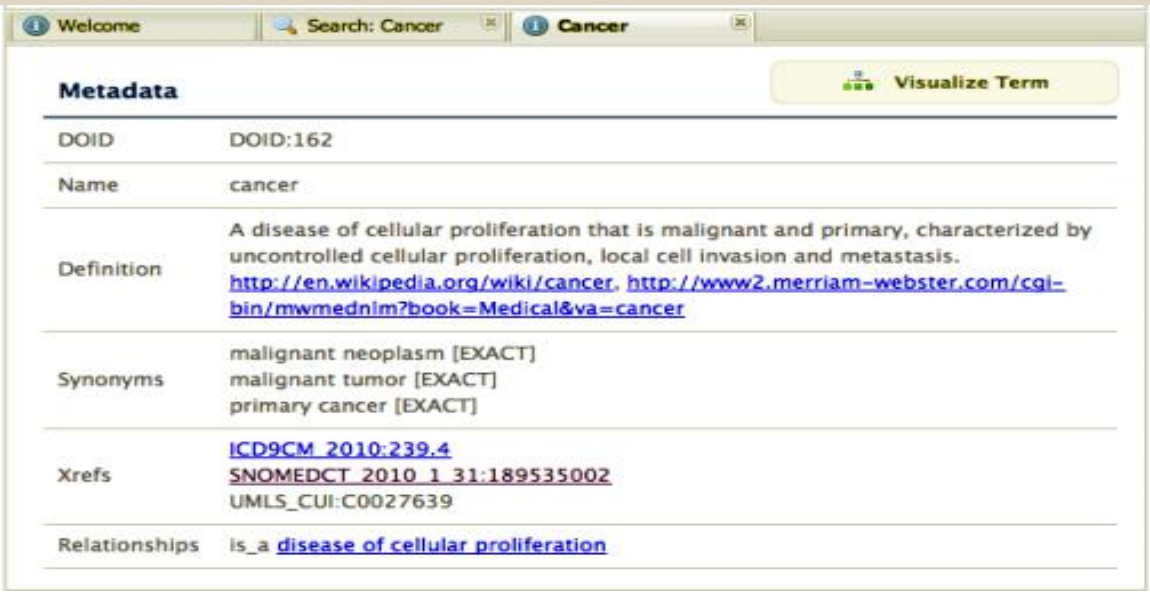

Fig.5: Typical disease metadata

Secure multi agent communication system

The proposed architecture is integrated with the secure Multi Agent Communication System for the purpose of establishing a secure communication between the Patient and Physician System. We are using the Multi agent system for the purpose of continuous interaction and making the decision in contact with another agent system that is located in widely spread geographical regions. This would help the patient and physician interaction during the time of travelling or roaming in somewhere else. But the challenging part, we faced is the managing and engaging of all the systems in terms of coordination, cooperation and negotiation of communication. In this proposed system, it provides the password management system to the service agent and the secure agent for the purpose of encryption and decryption. The burden of the user device is reduced because of this encryption and decryption process done by the multi agent system. The service agent of the communication system serves as an applicant agent for acting as an interface between the Android platform GUI Application and networks. The secure agent played the role like crypto agent, to encrypt and decrypt data and send it back to the service agent. The secure agent uses the AES algorithm for generating a new key every time with the key size of 124Kbytes for the purpose of encryption and decryption process. There is an inbuilt provision assigned to the secure agent for keeping the generated key in the secure storage place. This will helps the patient-physician monitoring and interaction goes in the secured manner. The framework of the secure multi agent communication system is shown in the [Fig.6]

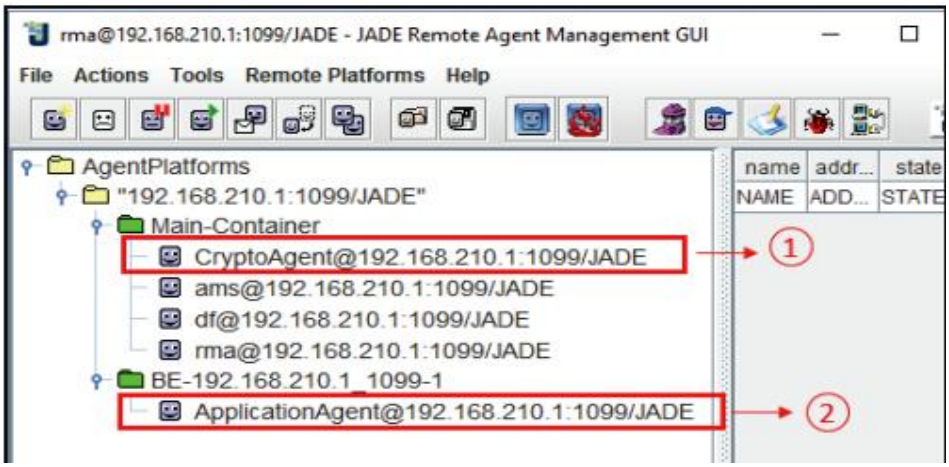

Fig.6: Secured multi agent communication management system

Each agent system would use the data forwarding techniques while the patient or physician is roaming. In this data forwarding technique, each agent has given autonomy in terms of processing capability and communicates to the nearest or neighbouring Access Point Nodes for forwarding the data closer to the Physician office Server(PoS). This type of secure multi agent communication system will lead to use existing resources effectively in terms of flexible distributed computing architecture. It leads to easier

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coordination, asynchronous computing and reduced communication costs for the patient-physician interaction by giving autonomy of each involving agent for making the process.

CONCLUSION

The proposed IoT based integrated architecture has been designed to provide the multi agent based communication starting from the body sensors of the patient to the physician's office. It enables both the patient and the physician see the presence of each other in a synchronous channel for various activities like online monitoring, assigning medication dosages, observing the current status of the patient. Meanwhile, it ensures the data security and patient privacy through the secure communication and data forwarding techniques. In addition to that, this system is very much adaptable for the continuous patient-physician interaction in roaming. In the future, we would like to extend the application with the context of overcoming interoperability problems among the agents and the integration of big data analytics for handling huge volume of medical data.

CONFLICT OF INTEREST
None

ACKNOWLEDGEMENTS
None

FINANCIAL DISCLOSURE
None

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