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# Childhood Immunization Computer System, Pilot Parish Cangahua

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**Summary.** *This article presents the results of process automation childhood immunization which allows carrying information on a data base manager, helping to reduce access time patient data, taking proper control of how it has been developing the child both in weight and size for different medical visits. The health center of parish "Cangahua" located in the Cayambe Canton Pichincha Province operated for many years only typical roles and taken file cabinets information which may be exposed to confusion, lost folder or the creation of charts or repeated cards by the lack of control, this affects the patient and employee working in this area for the time needed to invest in this activity; therefore in order to avoid data redundancy and process to hurry, childhood immunization system was developed so that information gathered in this area of medicine is available and classified. In particular this document specified the development of computer systems is much more efficient and manageable when you have an established procedure, which practice recognize of software development methodologies.*

## Keywords

Stories, Evolving, Immunization, Archivists, Redundancy.

**Resumen.** *Este artículo presenta los resultados de la automatización del proceso de vacunación infantil el cual permite llevar información en un gestor de base de datos, ayudando a reducir el tiempo de acceso a información del paciente, teniendo un control de cómo ha evolucionado el paciente tanto en peso como en talla durante sus diferentes visitas médicas. El centro de salud de la parroquia de "Cangahua" ubicada en el cantón Cayambe provincia de Pichincha funcionaba durante muchos años únicamente con papeles y típica llevada de información en archiveros lo cual puede ser expuesta a confusiones, perdidas de carpetas o a la creación de historias clínicas o carnés repetidos por la falta de control, esto afecta al paciente y*

*al empleado que labora en esta área por el tiempo que necesita invertir en esta actividad, por ello con la finalidad de evitar la redundancia de datos y agilizar el proceso, se desarrolló el sistema de vacunación infantil de forma que se tiene disponible y clasificada la información recolectada en esta área de la medicina. En particular el documento describe que el desarrollo de sistemas informáticos es mucho más eficiente y manejable cuando se tiene un procedimiento establecido, lo cual permite reconocer la práctica de metodologías de desarrollo de software.*

## Palabras Claves

Historias, Evolucionando, Inmunización, Archiveros, Redundancia

## 1. Introducción

Most health centers now offer the service of childhood vaccination which allow for proper controls immunization history, for this reason we should lead information stored in files or any kind of data collector, it contributes to the reduction of time spent on the implementation of this activity; as indicators about vaccination computer system handle is the foundation of Andalusia - Spain has always been at the forefront of the latest changes in the cards that manages and disseminates the World Health Organization which helps us to have a guide point forward. (Andalucía, 2009)

The purpose of creating this system was primarily the need to show real doctors, family and Ministry of Health when required on vaccines that have been provided to patients during their first six years of life, considering that the failure of these substances can generate future disease often fatal.

The collection of relevant information helps in the availability of patient information and allows up processes according to a development methodology.

The main activity is to develop information gathering around the vaccination process, design and analysis of user requirement, development of requirements and finally collected all relevant evidence, checking activities that the time has reduced as the information you have stored securely and reliably, This helps staff to have confidence and want to get more involved in the process; as well as giving the correct monitor each functional system operations constantly checking that performance is the same. (ITMORELIA-CA-PG-002, 2012), (López, 2008), (Sánchez, 2011)

## 2. Materials and Methods

### 2.1 Procedures lift

In the initial analysis of the information data was collected through user stories that were signed by the manager of the vaccination area according to each meeting and observation to be taken of any requirement established, it began with the design of the home page that will characterize the system and displays each operation and function of all methods that allow proper operation, lifting of appropriate processes and documentation, design and structure.

It was possible to analyze and identify the process ID and vaccines in the growth curves had a patient, this is done by considering the notes are at the foot of age range in the, thereby control is achieved that if a patient has a full course no needed for vaccines another age range.

### 2.2 XP methodology

The procedures properly raised help to make software development more orderly and efficient manner following a certain development methodology, in these cases it is advisable to use an agile methodology which allows us to make a proper documentation and adequate development process for projects of this nature.

The steps followed in the development of this computer system are those of the methodology Programing Xtreme (XP) which helps us to keep a proper order to develop all kinds of business processes, These begin with research and business analysis, that's to say familiar with that will develop, the second is the documentation and survey process, third step we design and development and

as a final step we implement and test the developed system. (Artega, 2012).

### 2.3 Development tools

For the implementation of the system will be uploaded on the server apache Tomcat 7.0 web applications which allow us to have hosted our web publishing system and the user, for mapping tables to objects in the IDE eclipse, it is done by java persistence API (JPA) using java database connection (JDBC). (Andalucía, 2009).

The application server that is more suited to this project is Apache Tomcat, which more than one application server is a web container that allows you to publish your pages to the user and this in turn have communication with our server database. (Alvarez, 2012), (Eloy, 2013).

The database is handled in this system is Postgresql, today is one of the most used market managers as far as free software is concerned, He is a manager that allows many clients and provides the service ACID (Atomicity, Concurrency, Integrity and Availability) of data, This allows users to have orderly, relevant, safe and reliable information at all times. (Martinez, 2010).

Intermediate classes called JavaBeans, which allow manipulation of entities from the view of the programmer, this helps to keep a proper management of properties and methods have in our business layer and view.

To display the reports that are presented to users according to the required needs the Jasper reporting tool Ireport 5.0 engine is used, this helps us to improve the presentation in different formats like PDF, Excel, XML, among others, which gives us statistical tables in a document if you want to export or print. (JasperSoft Community, 2014).

The view or presentation layer handles with JSF(Java ServerFaces) framework and library PrimeFaces 3.5, this is the latest stable version has been handled, which helps to give a friendly and easy presentation to the user, best known bookstores used with: java database connection connector (JDBC), JSTL which is a component within the specification Java 2 Enterprise Edition (J2EE), This is nothing more than a simple set of libraries that encapsulate the functionality used in JSP pages, one of the main disadvantages of this library is fully charged all the time to show information to the user, this gives us problems if wanting the information is dynamically presented as do datatables PrimeFaces, so you should use this library with caution, knowing well that if I show this library

information is because I don't need dynamic data. (González, 2014), (Joyanez, 2010), (Primefaces, 2014).

### 2.4 Description of computer system

The system called SIVIC childhood immunization helps to have more control of vaccines notices missing, pending or delayed vaccines, next scheduled date of application of a particular vaccine, creation of patients, basic and necessary inventory control, keeping daily records of the vaccines, ease of creating meat entering a patient, patient search more easily and quickly, booking appointments, view patient list has to vaccinate a certain date, visualize growth curves and weight of a patient.

For reports have statistics which allows us to see the growth or decline of applied vaccines, children with a certain vaccine, children vaccinated at an age range table, vaccines given in certain years, queries made on specific dates or date range, export pdf to some reports, selecting a vaccine that patients have been applied, to choose a patient who has had consultations with their respective dates, Patients with missing vaccines to date with the specifications of the dates were scheduled appointment, among others.

In public health centers have an inventory where they have the amount they have in stock and vaccine decreases by each application to perform a given patient, Card movements are created for each vaccine to enter them into the system with all its details and initial values, the system allows a clear visual feedback on how they are inventory movements of each vaccine, and can be clearly visualized as stock is taken, other functions offered by the system are warning messages when you are applying the vaccine and the stock is already reaching its minimum value, this will help the user to be aware of not running without of vaccines and so pay attention to good citizenship.

For the technical side the childhood immunization information system allows the complete control of the system, this makes administrator who can enter from any medical center that select and make changes, this allows information more available and timely.

### 3. Results



Figure 1: Log on childhood immunization information system.

The front childhood immunization system is presented as shown in Figure 1.

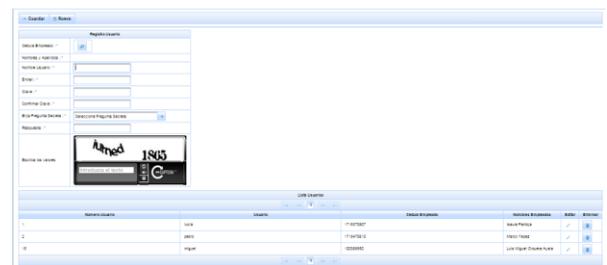


Figure 2: Register of user's access to the computer system of child vaccination.

Allows user registration system depending on the role and assign the administrator, you can see the part that belongs.

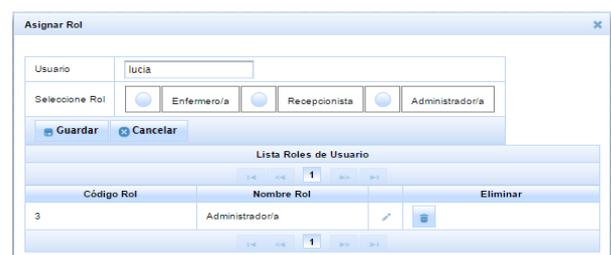


Figure 3: Role's appropriation to a user.

In the form of figure 3, shows how role assignment to a particular user, the same may have permissions to specific functions depending on the role.

Figure 4: Patient's Registry.

The patient registry allows the patient to collect additional information for future functions such as vaccination, query or application of vaccines per year, in this section shows the card creation option to save a patient, this point isn't mandatory but facilitates the employee if you register the card with the patient.

Id	Nombre	Stock	Acción
16	Neumoco 23 (Polisacárido)	10	[+]
17	Imovigulina HB	5	[+]
18	Meningococo B.C	10	[+]
19	Influenza (FLU)	10	[+]

MOVIMIENTOS HAREX						
Estadística Actual	Fecha movimiento	Descripción Movimiento	Fecha Inventario	Estado	Saldo	Existencia Actual
98.0	2014-05-04	INVENTARIO			0.0	0.0
98.0	2014-10-20	Vacuina ganá		0	1	58
98.0	2014-10-20	Vacuina ganá		0	1	58
98.0	2014-10-20	Vacuina ganá		0	1	57
98.0	2014-10-20	Vacuina Funa (a ganá)		0	1	58

VALOR ACTUAL EN STOCK: 98.0

Figure 5: Entry and income inventory formulary of movements.

The system allows the entry of inventory also displays a dialog with the movements it has had on the implementation of each vaccine to a patient, this allows us to visualize what the current stock of a particular vaccine, to thereby avoid lack of supplies at the medical center.

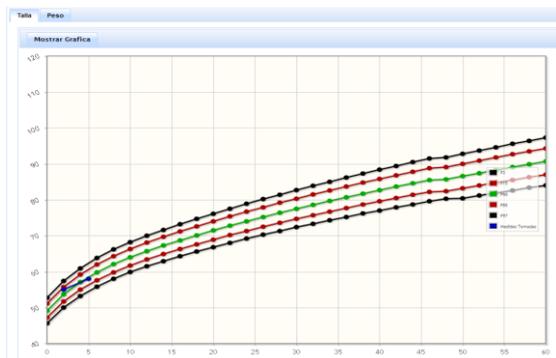


Figure 6: Control growth curve vaccination card.

It must analyze the results of the blue curve depending on the color curve, in which it is located, we will take into account the following table with their respective indications:



Good	Much danger	warning sign
The child (a) is growing well.	You should eat at least 5 times a day and go to the health center.	The child (a) may be sick (a) needs special care.

Chart 1: Summary table of control growth curves their meanings and alert.

With this information the family and doctor can know what is happening with your child and professional can diagnose the health of the patient.

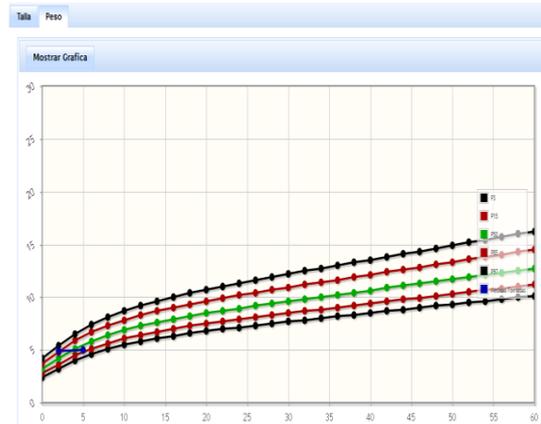


Figure 7: Weight Control in the growth curve.

The data required for the curve of growth (height) or weight measurement and analysis in which the patient is are height, weight and age, these data are obtained by taking vital signs in different medical queries.

Código	P3	P15	P50	P85	P97	Editar
123	2.40	2.80	3.20	3.70	4.20	[E]
124	3.20	3.60	4.20	4.80	5.40	[E]
125	4.00	4.50	5.10	5.80	6.50	[E]
126	4.80	5.10	5.80	6.70	7.40	[E]
127	5.10	5.60	6.40	7.30	8.10	[E]
128	5.50	6.10	6.90	7.80	8.70	[E]

Figure 8: Control growth curve vaccination card.

The points reflect depend on the patient's gender and type of measure will, that is to say size or weight and varying points according to these two characteristics such as height of children is slightly higher than girls and so does the points of the curve weight.

Figure 9: Search patients and options that can be performed.

This form of Figure 4, allows us to search for a particular patient by different ways either by history number, ID or names and surnames; besides once selected we can see all patients or only those who have license and register a query or proceed to vaccinate the selected patient.

Figure 10: vaccination's Card.

It may represent the card with the history of vaccines that have the patient at different ages as well as can be observed or place the date of the next appointment which will be reflected in an appointment calendar on different dates of the month, This part is checked whether a vaccine can't be applied since it depends on if you have or previously administered vaccines this lets us know when trying to book appointment for the next vaccine, options vaccines will be activated only in accordance with the age of the patient with this misapplication of vaccines is avoided. Any comments you have of the current vaccine from the patient should be noted at the bottom of the form in the comments box that is saved when making any vaccination.

Figure 11: Register of medical consultations per patient.

In the form of figure 11, can enter all the necessary information vital signs, these data are critical to later show the respective curves height and weight per patient.

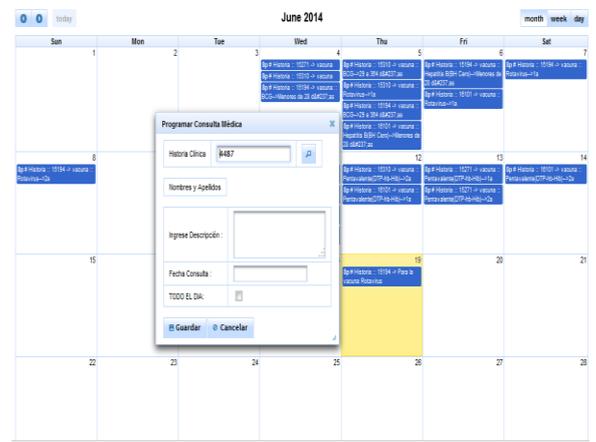


Figure 12: Medical appointments previously booked.

The dates are booked in the menu, reservations or appointments or in the form of figure 10 at time of booking or archive the next patient visit, with this responsible for reviewing can see how many appointments have on the day depending on the month, another way to enter a future query is giving the same calendar date clicking requiring consultation or medical appointment and entering the data needed to store this date and details of the consultation.

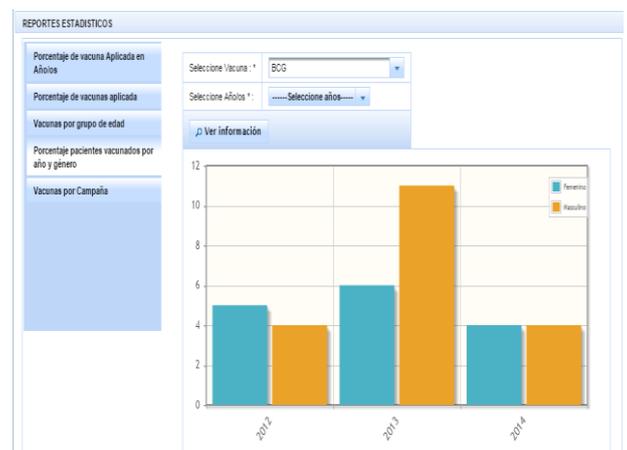


Figure 13: Statistical number of children vaccinated.

The number of patients who have been administered different vaccines among children contained in the present computer system vaccination is taken, for that you have a query that returns me the list of patients applied different vaccines that belong to the card, and depending on this proceed with the statistical chart equivalent percentages applied to all patients those vaccines. The system has many other statistical charts representing different information be patient consultations or vaccines at different dates or years.

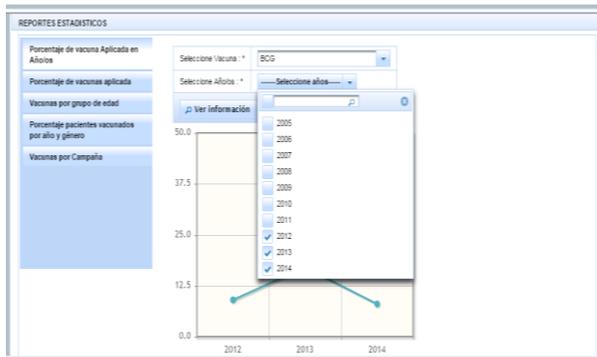


Figure 14: Statistics by year's selection.

Selecting the years of which needs the information, proceed to plot the data corresponding to those dates, it helps to have specific information may be one or more years depending on the need, requirement and an analysis of how it has been changing either increase or decrease in each of the years, so you can make a diagnosis and any change to improve the various shortcomings that have under observation of statistical graph.

menores de 1 año												
Nombre y apellidos	Sexo	Nacionalidad	Auto-identificación	BCG	Hepatitis B(Hb-Car)	Rotavirus	Pentavalente(PP-4b-Hb)	Antipoliomielítica Oral(OPV)	Neumococo Conjugado			
				Menores de 30 días	28 a 364 días	Menores de 30 días	1a	2a	3a	1a	2a	3a
Israel Fortango	M	Ecuatoriano	Indígena	-	-	-	-	-	X	-	-	-
Nayer Tazapata	F	Ecuatoriano	Indígena	-	-	-	-	X	X	-	-	-
Nairo Talera Pacheco	M	Ecuatoriano	Indígena	-	-	-	-	X	-	-	-	-
Total:				0	0	0	0	1	3	0	0	0

Figure 15: Sheet of daily log vaccine.

You can have a general observation of daily record of immunization, depending on a specific date this is because every day there are a fairly large number of patients who are registered with a vaccine are those applied by campaign or not, Which is required to register the patient as vaccine dose was given, also It be analyzed to a patient per day will be applied one or more vaccines depending on the case where you are or diagnose the professional area.



Figure 16: Informe de manual de usuario.

You can remember that when you need some additional information about system operation you have the option to help where we place the manual that clearly indicates why and how a particular form of system functions in simple steps and clear, besides you have a backup of a proper functioning of the initial system requirements.

## 4. Conclusions

Management documentation known as the necessary information of the whole process of Child vaccination from "Cangahua" Parish for the development of computer system called SIVIC (Computer System Childhood Immunization) was collected.

The development of computer systems is much more efficient and manageable when you have a good-established entity which it's making the software procedure.

Knowing how all processes and documents kept in the stories of childhood immunization are made, allowed better attach the computer system to the reality of these processes.

Upon study vaccine administration process, the system allows us to more easily examine the missing vaccines, administered and not applied in patients who are registered in the system; this helps to better control the fulfillment of the vaccine, thus preventing diseases that can be prevented by the responsible administration.

The management methodology XP (Extreme Programing), allowed the user will review progress according to time of development.

The database manager PostgreSQL allows more easily carry and safety information generated daily in the health center and through the various reports can see the progress that has on record.

The use of framework JSF (JavaServer Faces) helps greatly because it's intended to facilitate the creation and development of interfaces for Web-based applications.

Primefaces version 3.5 provides several components of development for the programmer and more friendly and intuitive user interface.

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## References

- Alvarez, A. (08 de Julio de 2012). El servidor, tipos y sus usos. Obtenido de <http://www.slideshare.net/anthony1991aj/tipos-de-servidores-y-sus-usos>
- Andalucía, J. (2009). *Marco de Desarrollo de la Junta de Andalucía*. Andalucía: Andalucía.
- Andalucía, J. d. (2009). *Marco de Desarrollo de la Junta de Andalucía Referencias JPA*. Obtenido de <http://www.juntadeandalucia.es/servicios/madeja/contenido/recurso/176>
- Artega, A. M. (2012). *Metodología XP*. Obtenido de <https://sites.google.com/site/xpmetodologia/>
- Eloy, A. E. (2013). *Programación en castellano*. Obtenido de [http://www.programacion.com/articulo/tomcat\\_-\\_introduccion\\_134](http://www.programacion.com/articulo/tomcat_-_introduccion_134)
- González, G. (2014). *Introducción a JSTL*. Recuperado el 23 de 10 de 2014, de [http://java.ciberaula.com/articulo/introduccion\\_jstl](http://java.ciberaula.com/articulo/introduccion_jstl)

ITMORELIA-CA-PG-002. (2012). *Procedimientos para control de Registro de calidad (Referencia a la norma ISO 9001:2008 4.2.4)*. Morelia.

JasperSoft Community. (2014). *JasperSoft Community*. Obtenido de <https://community.jaspersoft.com/project/ireport-designer>

Joyanez, L. Z. (2010). *Programación C, C++ java y UML*. Madrid: Madrid/McGraw-Hill.

López, P. (2008). *Guías para la Inmunización del niño en Colombia. Capítulo de vacunas - Asociación Colombiana de Infectología*. Bogotá: Sociedad Colombiana de pediatría.

Martinez, R. (02 de 10 de 2010). *PostgreSQL - es*. Obtenido de <http://www.postgresql.org/es/>

Mercurio, E. (11 de septiembre de 2013). *Ecuador cuenta con altas coberturas de vacunación*. Obtenido de <http://www.elmercurio.com.ec/319568-ecuador-cuenta-con-altas-coberturas-de-vacunacion.html>

Primefaces. (12 de 02 de 2014). *PrimeFaces ultimate JSF component Suite*. Obtenido de <http://www.primefaces.org/>

Sánchez, R. O. (2011). *Evaluación de los cuidados que brindan las madres de familia a los niños menores de 5 años al presentar reacciones adversas post-vacunación*. Carchi-Tulcán.

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### Author - Lucía Reinoso

Student of "Técnica del Norte" University Applied Sciences Faculty, School of Engineering in Computer Systems, which during his student life framed conducting research in medicine and procedures, and became very interested in researching new software development tools, and the need for an important area of medicine "VACCINATION".

One of the main reasons for this is to see the need for adequate control of the information generated in various processes not only vaccination but also other relevant points to this public work is essential in child development, the whole citizenship.

The development of the thesis with its scientific article helped shape me as a professional and person, knowing one of the most important areas: technology and medicine, two worlds that can't be separated.

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It is an ethical person, rather than a human being professional is framed in the ongoing investigation with all the technological advances that arises today.

It is a multidisciplinary professional criteria, working with groups of professionals in many areas, which helped with primordial ideas in development, design and functionality of the system, Computer childhood immunization.