

EVALUATING THE FEASIBILITY OF  
AUTOMATED DATA CAPTURE AT OREGON  
IMMUNIZATION ALERT

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# EVALUATING THE FEASIBILITY OF AUTOMATED DATA CAPTURE AT OREGON IMMUNIZATION ALERT

## Abstract

**OBJECTIVE:** To determine the feasibility of implementing automated forms processing software to replace manual data entry at Oregon Immunization ALERT.

**METHODS:** Evaluation of two automated forms processing software solutions to determine software interface usability and recognition accuracy along with evaluation of current research to determine current automated forms processing (AFP) utility.

**RESULTS:** While the evaluation of the automated forms processing software did not allow quantifying recognition accuracy, interface usability with *Teleform* was preferred over that of CharacTell FormStorm. Research into timesavings and cost effectiveness suggest that automated forms processing will help realize increased staff productivity and a substantial ROI when based on increased timesavings over manual data entry.

**CONCLUSION:** Further evaluation of AFP software vendors is needed. A longer testing and design phase along with training of both data entry staff and physician office staff will be needed to realize time savings over manual data entry and to ensure a high data quality which will increase software recognition accuracy.

## Introduction

Data entry is defined as entering data into a computer, usually a database or a spreadsheet. Since the use of the punch card to tabulate census data in 1890, government and corporations have used data entry in various forms and in most cases, this task is a manual one.(1) Personnel hired as key operators or data entry technicians have the primary objective of entering data from paper forms into a centralized database. Largely dependent on the key operator's speed and skill level, this manual process can sometimes be tedious, costly, and inefficient. New technologies, such as automated forms processing (AFP), have demonstrated the ability to increase the speed and accuracy of data entry as well as provide a substantial return on investment (ROI).(2-7)

In March 2006, Oregon's Immunization ALERT, a statewide-computerized childhood immunization registry that has existed since 1996, underwent discovery for an information technology (IT) improvement plan.(8) This discovery identified a need for an improved method to capture childhood immunization data that is submitted via paper forms from public and private healthcare providers and then manually entered into the ALERT database. The plan highlighted three major areas that could be addressed with an electronic data capture solution.

- **Legibility issues with provider forms.** Data entry staff report legibility issues with forms, which providers and patients are required to fill out, leading to data inaccuracies.

- **Multiple barcode scanning.** In practice, multiple barcodes are scanned using handheld barcode scanners, which fills up the screen of a custom data entry application created for ALERT. Along with a cumbersome user interface, the handheld scanners sometimes are unable to read the barcode and it becomes difficult for the user to verify if a mistake has been made
- **Turnaround time.** Immunization information is typically received and processed within one month of vaccine administration; however, approximately 22% of the vaccinations administered data is input to ALERT after thirty days

While ALERT currently uses barcode scanning technology, this project's primary goal is to build on the IT improvement plan by evaluating the feasibility of using an AFP application to capture bar-coded patient and vaccine information as well as patient demographic data and vaccination data that is not currently stored in the barcode. A secondary goal of this project is to provide a foundation of information regarding AFP for ALERT that can be used in evaluating data capture software vendors.

## **Background**

### **Data Entry Technology**

Data entry technologies are improving rapidly. Bar-coding, AFP, and radio frequency identification (RFID) are all in use today for data capture in many business, healthcare, and government organizations. ALERT, the primary participant in this project, currently uses barcode technology to assign a unique patient identifier and to capture basic immunization data. Also gaining acceptance in the healthcare community is RFID, a

device that uses a transponder and antenna to transmit data. Despite privacy concerns, VeriChip, the maker of the VeriMed chip, claims that 300 to 400 volunteers in the United States have been implanted with the chip that allows patient data to be accessed once the chip is scanned.(9) RFID is also used in many supply chain data capture processes in businesses throughout the world.

AFP capabilities, which is this project's focus, have been improving rapidly over the last decade and an internet search on "automated forms processing vendors" returned 43 vendors that supply some type of optical character recognition (OCR) or intelligent character recognition (ICR) technology. Technology trade reports have stated multiple benefits from AFP including increased data accuracy, reduction of turnaround times, and cost savings.(10;11) Recent studies have focused on not only the utility of the technology but have also demonstrated accuracy and cost effectiveness when compared with manual data entry.(2;5;7;12-15)

AFP software uses OCR and ICR technologies to convert scanned images, typically data entry forms, into computer usable data. Initially, automated form software was limited to optical mark recognition, such as the green and white Scantron forms that must have the appropriate box marked with a No. 2 pencil, which are still used as test sheets in many U.S. schools. Now, AFP solutions are used in businesses that scan, verify and export data from over a million forms per day as evidenced by a 2006 report by The Association for Work Process Improvement (TAWPI). This project surveyed organizations currently using AFP and approximately 26% of all respondents (100 respondents out of 197



surveyed) stated their organization was scanning greater than 10,000 forms per day and one respondent stated a peak of 1.2 million documents per day. (16)

All AFP software follows the same basic four step process: scanning, recognition, validation and verification, and export. Scanning is the actual capture of form images. Typically, batches of forms are scanned into an AFP application and either manually or automatically sent to a recognition module. The scanning process relies heavily on the optical scanner. Optical scanners range in price from \$100 to over \$80,000 depending on scan quality and speed of scanning. Scanners that are used for high quality, high volume document imaging have a higher page per minute capability (> 15 ppm) and provide features as dual side scanning, color scanning, and image enhancement.(17) AFP software requires a resolution of 200-300 dots per inch (dpi). Higher resolutions tend to slow the speed of scanning, however, as discovered in this project, *Teleform* required a 400 dpi resolution for successful barcode scanning. Once the form has been scanned into an image, it is then ready for recognition.

Recognition converts the scanned image into computer usable data. OCR and ICR engines, which attempt to recognize numeric and alpha characters by evaluating segments of the image, are used to recognize machine printed standard font characters and hand print characters respectively. The quality of the recognition depends largely on the form design used in the data capture process.

There are two types of forms: structured and unstructured. Unstructured forms are highly variable documents in which the location of the data may change from one form to the next. These types of forms may be used by organizations which capture data but do not control the design of the form. For example, one respondent's form may have the address in the upper left hand corner and the other has the address in the lower right hand corner. These two forms can not be based on the same template for data capture, as with most forms processing scenarios, due to the variable nature of the form design.

Structured forms, however, are constant in their data types and the location of data.

Structured forms with constrained field types, as shown in **Figure 1 - Structured Form Field Types**, will typically increase the accuracy of the recognition.(3;5;17)

**Figure 1 - Structured Form Field Types**

Constrained Print Field (Boxes) :	<input type="text"/>
Constrained Print Field (Combs) :	<input type="text"/>
Choice Field:	<input type="checkbox"/> NO <input type="checkbox"/> Yes
Entry Field:	1 2 3 4 5 6 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>

In addition to the actual presentation of data fields on a form, form design has other aspects that must be considered when evaluating forms for the likelihood of success when using document imaging and data capture. Control of the form design as well as the person completing the form are very important. If the party that is responsible for the data capture has control over the design of the form, it is likely that a form which will be more easily automated will be developed.(17) Also, as noted by Jorgensen & Karlsmose, the quality of data can be greatly increased when the person filling out the form has a

stake in ensuring the data is recognized accurately. (7) This observation points out the importance of ensuring that people completing the forms have a good understanding of the form completion requirements, proper data entry techniques (e.g. uppercase, black ink pen, or within the constrained boxes), and an awareness that the forms being completed will undergo automated data entry that requires care be taken when completing the forms.

As well as form design and control, the quality of the text on the form is a major factor in the recognition accuracy. The color and type of writing implement, handwriting style, and uppercase versus lowercase characters are all factors that can affect the recognition of scanned data. High quality text can result in very high accuracy. Fenster and Jorgensen & Karlslose reported accuracy rates of 99.98% and 99.92% respectively in studies using *Teleform*. Comparatively, manual data entry using a single key operator was reported as 98.76% and 99.89% respectively.(3;7) Each of these studies used a direct comparison of the data on the completed paper forms with the data that had been saved in the target database after verification. While the reported accuracy with AFP is very high, each of these studies verified all data fields present on each form. In real world settings as with ALERT, it is likely that not all fields need verification and accuracy of data entered into the database may be somewhat lower.

Accuracy before data verification was not noted and is dependent on text quality. Spencer states that most AFP software will have a recognition rate between 50-90% depending on the confidence level. (1999) The confidence level determines which characters are reported as unknown or suspect. For example, an 80% confidence level

will show a character as unknown if the engine believes there is more than a 20% chance that it could be another character. If the confidence level is set to 95%, a character will be shown as unknown if the engine believes there is more than a 5% chance that it could be another character. Therefore accuracy, as reported by the software, will likely be higher with an 80% confidence level than a 95% confidence level. These numbers can be somewhat misleading as accuracy statistics that are reported by the software only include “errors that it knows it made, unknown characters, or characters it is not sure about” and does not include characters that are actually recognized incorrectly and substituted with an incorrect character. (17)

Validation and verification is the process used to ensure correct data entry into the database and to ensure that software translation of the image is what was originally entered on the form. Automation of the validation process can occur in several ways before the key operator verifies the form image against what is to be exported to the target database, consequently decreasing the likelihood of incorrect recognition.

Validation techniques utilize dictionaries, look-up tables, validation field checks, and acceptable character checks.

Custom dictionaries can be used to contain the allowed values in a field. Fields can be constrained so that the only values allowed in that field are entries that are contained in the dictionary, such as a dictionary with all of the two digit state abbreviations. Look-up tables are used to validate field data by using another field as the verifier. For example, a 5 digit zip code can be used to validate the city and state.(17) Validation fields are used

to constrain or automatically default a field's entry based on another field's value. For example, checking a check box may default certain fields to be required for verification, while if left unchecked, those fields are never displayed to the key operator. The use of these validation techniques is likely where timesavings will occur and may keep data corrections to a minimum during verification, however as noted earlier dependence on the AFP software for data verification rather than human intervention may result in decreased accuracy of exported data.

Verification is the stage in which the key operator verifies the form image against what the software has recognized for each field. After recognition and validation, AFP software can be configured to display as many or as few fields to the key verifier as needed. For some applications, such as clinical research, there may be a need to verify all fields against the form, however other applications may have certain fields that need verification only under certain circumstances or not at all. Fields are then highlighted, with additional highlighting for unrecognized characters, and displayed to the verifier who then ensures that the data is correct before exporting to the target database.

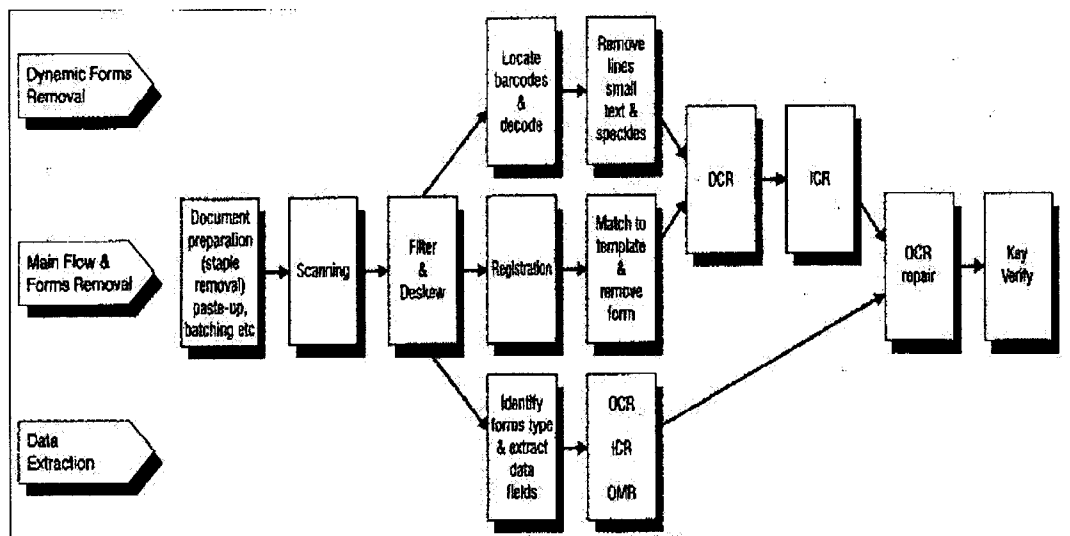
In several studies, the process up to and including the verification stage has been evaluated for timesavings versus manual data entry. Vila reported that the entire process using 313 forms saw an average time savings of 12.8% with *Teleform*.(4) Jorgensen & Karlsrose reported that in a study using 401 forms that manual data entry was 264% of the time that was used for AFP with an 80% confidence level.(7) In a study involving 166 scanned forms and 441 manually entered forms, Guerette et al. reported a total time

savings of 127.3 seconds per form when using AFP. (6) Documented timesavings likely have many factors such as training time, validation methods used, and complexity of forms, however the author was unable to find any studies that offered an opposing opinion when comparing manual data entry with AFP.

Lastly, export is the process of interfacing the data with a target database or application. Depending on the AFP application, either a direct interface with the target database can be configured or the data is exported to a file, such as a comma delimited file (.csv) or xml file, that is then imported to the target database.

Spencer states that all AFP vendors have “developed some proprietary workflow usually based on an underlying database to manage this transaction flow”. This “flow” for AFP software is demonstrated in **Figure 2: AFP Process Diagram.**(17) CharacTell FormStorm and Cardiff *Teleform*, the two AFP software vendors evaluated in this project, follow this same workflow and were chosen based on availability of the software. FormStorm allows a 30-day demonstration version download of the software and *Teleform* is an application that is currently licensed at Oregon Health & Science University which provided greater ease-of-access over other AFP vendors.

Figure 2 – AFP Process Diagram



### Oregon Immunization ALERT

Oregon Immunization ALERT is a statewide immunization registry that collects vaccination information on Oregon’s children between the ages of 0-18. The registry has been a highly successful effort that currently houses information on over 27 million vaccination records for approximately 1.8 million children. Currently, the registry has 93% of Oregon preschool children registered and vaccination information is submitted, either electronically or by hard copy, from 100% of public providers and 86% of all private providers in the state of Oregon.(8)

The IT improvement plan identified a need for an improved method to capture patient and vaccination data from hard copies submitted via mail or fax. Approximately 130 sites currently send immunization data to ALERT via electronic data exports, however a large number of clinics submit their data using a paper form and barcode system.(8)

ALERT currently has four form types and can be seen along with each form's description of use in **Appendix A: Original ALERT Forms:**

- Blue new enrollee form
- Pink vaccine submission forms
- Green update/additions form
- Barcode label sheets

These forms are submitted by the clinics to ALERT in self-addressed, stamped envelopes via U.S. mail and the ALERT data entry staff manually enters the data into the database by keying the data and scanning the barcodes with handheld scanners. **Appendix B: Manual Data Entry Process** details the purpose of each form and reviews the complete workflow description from the initial form completion at the provider's office to the entry of data into the ALERT database. (8)

This process has worked well for over a decade, but with legislation pending that will expand ALERT to include adult immunization records, there is a need to evaluate data capture technologies to improve the process of data entry.(8) There appears to be a desire to distribute the capture of patient demographic and vaccination information to the physician offices by way of online data entry. The most efficient way of capturing the data may be to give the physician offices the ability to enter information directly into the ALERT database by way of electronic forms or distribution of scanning capabilities. However, many smaller clinics continue to have limited resources such as limited computer availability for data entry, outdated computer systems, dial-up Internet connections, or no Internet connection. While implementing direct data entry with



electronic forms in the physician offices would potentially solve the legibility problem and make data entry close to real time, it would require additional data entry time for clinic staff and may not be widely accepted at this time due to budgetary, personnel, and technology constraints at the physician offices.

Distributing the scanning of forms to the physician's offices would likely improve turnaround time and could show a significant ROI due to a substantial decrease in postage fees, however this would also increase the burden on the physician office staff. This type of data capture distribution would necessitate training for office personnel and possibly hiring of additional office staff, upgraded computers, and improved networking capabilities again making it unlikely to succeed without further evaluation of budgetary and technology constraints.

If this type of distributed data entry were budgeted and mandated by ALERT, there could be resistance from provider's offices to accept the change in workflow. This could potentially cause a decrease in the submission of immunization data to ALERT, thereby defeating a primary goal of the organization which is to obtain 100% participation throughout Oregon. At this time, however, there has not been an evaluation of each provider's office that continues to submit data to ALERT via paper forms and the suspected outcomes are mostly conjecture. Nevertheless, a direct data entry or distributed data capture solution would most likely have the best chance to succeed if offered as an alternative to the current electronic submission or paper submission processes. Therefore, this project will focus on AFP technology that will minimize the

workflow changes at the physician offices and will maintain the data capture responsibilities with the ALERT staff.

## **Planning**

### **AFP Software Selection**

Software applications used in this project were chosen based on ease of access to the software. Cardiff *Teleform* ([www.cardiff-teleform.com](http://www.cardiff-teleform.com)) is an application that Oregon Health & Science University (OHSU) has currently licensed. Since *Teleform* is the application used extensively in the research on AFP advantages over manual data entry, it was an easy decision to use this software to build forms and evaluate the scanning success of the re-designed forms. In addition, an Internet search was performed for AFP vendors and several were contacted to determine if they would allow use of a demonstration version for this project. CharacTell FormStorm allows a 30-day trial version of their software with full capabilities; therefore, FormStorm was used as the second software that would be evaluated by the ALERT data entry staff.

FormStorm and *Teleform* are similar in that they contain modules for scanning, recognition, and verification of paper forms. CharacTell does not have a form builder module; therefore, FormDocs ([www.formdocs.com](http://www.formdocs.com)) was used to generate the scannable forms. *Teleform* does require that the building of scannable forms is performed with their form designer. The forms contain cornerstones for distortion correction and a number in the upper left hand of the form for form identification. The forms used for the

FormStorm application did not contain any form identification or distortion correction markings, however FormStorm does support the ability to use these identifiers.

### **Form Control and Design**

The ALERT director along with the data entry staff participated in discussions regarding the current data entry process and an evaluation of the re-design of the current ALERT new enrollee, vaccination, and update forms. During this phase, it was also determined that the areas of form utility, application functionality, recognition accuracy, and potential cost savings would be addressed. The stakeholders affected by the aforementioned topics were identified. The first is the physician office staff that must complete the form. Their input was captured by an informal survey upon completion of the re-designed forms but prior to document imaging. The survey does not attempt to assess the form design based on the respondent's knowledge of electronic form scanning or the differences in structured versus unstructured forms. The primary purpose of the survey was to assess ease of use as it relates to the current ALERT forms and is shown in **Appendix F: End User Form Design Usability Survey**. The second stakeholder is the data entry staff. The data entry staff was also surveyed, upon completion of the form but prior to scanning, regarding the readability as they have a stake in ensuring the data quality is high to achieve the highest possible recognition rates. In addition, ALERT data entry staff has a stake in ensuring that the AFP software interface improves their ability to enter data into the ALERT database with greater speed and accuracy. The final stakeholder is the ALERT management that is concerned with the potential cost savings that may be realized by using automated data entry.

ALERT currently controls all aspects of form design, distribution, receipt, and data entry; therefore, the ability to redesign the forms as necessary to increase chances of successful AFP was not a problem. However, since the ALERT staff do not fill out the forms, it was, and will continue to be, necessary to consider any workflow changes that may be caused by form re-design.

### **Form Completion**

The final phase of the project consisted of recruiting two physician offices along with the ALERT data entry staff to complete 20 of each type redesigned forms (20 new enrollee and 20 vaccination forms for both FormStorm and *Teleform*) with fake patient data. Real patient data was not used due to the author and the primary participant being located in different states and the need to pass the completed forms via e-mail and U.S. mail. The completed forms were then returned to ALERT and FormStorm forms were mailed to the author for scanning and *Teleform* forms were given to Dr. Judy Logan, who graciously offered to lead the development, scanning, and verification using *Teleform*.

### **Development**

#### **Form Design**

Initially, it was decided that the blue new enrollee form, pink vaccination forms, and the green update form would be re-designed as a scannable form with as many constrained

print and choice fields as possible with the purpose of keeping the number of unconstrained free text fields to a minimum. In addition, the attempt to consolidate the five total forms into two forms was discussed and the decision was made to move forward with this concept. **Appendix C: Initial Redesigned Forms (Consolidated)** shows the initial mock-ups of the redesigned forms which were completed using a 30-day free evaluation version of FormDocs, a form generation application (licensing cost \$90), which can be downloaded at [www.formdocs.com](http://www.formdocs.com).

The new enrollee form and the patient information portion of the update form were consolidated into one form and the vaccination forms and vaccination information portion of the update form were consolidated into one form. Upon evaluation of the redesigned forms, it was determined that combining the vaccination forms and update form was “too cumbersome, too confusing, too much paper, etc.” and the decision to reproduce the original vaccination forms with additional manufacturer and lot number fields was made.(18) The new enrollee form had minor modifications that included correcting spelling errors, dropping unnecessary fields, and changing the location of several data fields. The requested changes to the CharacTell forms were made and the forms were designed in *Teleform*. The final forms are displayed in **Appendix D: Final Redesigned Forms**.

### **AFP Software Configuration**

The author, who was unfamiliar with AFP software prior to this project, did not have formal training on setup of the FormStorm application but did review the user’s manual

and sample demonstrations provided with the free demonstration version of the software to gain the knowledge required for setup of the application. FormStorm setup consists of scanning a blank form into the application as a template. Areas of the form where data is to be entered are called fields and fields are given characteristics such as a date format, barcode type, city name, etc. The template is then used to “draw” regions over the areas of the form where data will be entered, the type of recognition is defined for the region (e.g. OMR, Barcode, alphanumeric) and the region is connected to a field.

OHSU staff that has previous experience with the setup of the system completed *Teleform* setup. Both applications were configured to read the fields in the re-designed forms based on the field type (e.g. numeric, alphanumeric, date, alpha, etc.) As Vila states, these type of recognition and validation options serve to “minimize the amount of human intervention required to collect data from forms and input those into a database.”(4)

After reading the material for the setup of FormStorm, the author was able to create templates, scan both a new enrollee form and a vaccination form with approximately 80% accuracy<sup>1</sup>, and verify the information within approximately four hours. More detailed information and questions regarding specific application settings was gathered from the vendor and setup questions were addressed that improved recognition and in one case

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<sup>1</sup> It should be noted that an 80% accuracy rate was achieved by the author performing all steps of the AFP process. While an attempt was made to write naturally, initial accuracy was most likely influenced by the author’s knowledge of the necessity of high data quality and well formed, uppercase characters written in black ink. Initial accuracy would possibly have been less had another person completed the forms.

resolved a software bug that was preventing the reading of multiple barcodes on one form.(19;20)

## **Evaluation**

### **Form Usability**

Once application setup was complete and the re-designed forms completed with fake patient data, the forms were returned, along with the usability surveys, to the author and Oregon Health & Science University (OHSU) staff to begin the evaluation of the application scanning and verification. Ten forms were returned and each of the eight questions on all surveys was completed. The questions were based on a five response Likert scale rated one to five starting with one being assigned to “strongly disagree” and five being assigned to “strongly agree”. Results were mixed regarding how well organized the forms were and if the forms were more difficult to fill out than the current forms. Seventy percent of the responses agreed that the forms were well organized and were at least as easy to fill out as the current alert forms. Fifteen percent disagreed and thought that the forms were more difficult and that the information on the forms was not clearly defined and fifteen percent of the responses were neutral. Also provided was a comment section. One user commented that the forms “could be better organized”. Another user commented that adding the manufacturer and lot number boxes to the vaccination forms would increase their work and they “probably wouldn’t complete it”. Further discussion regarding the form design and how to design the forms for maximum scannability while minimizing workflow changes for the physician office staff would be

needed prior to implementing an AFP solution. Survey responses are seen in **Table 1:**

**Form Evaluation Survey Responses.**

**Table 1: Form Evaluation Survey Responses**

	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>	<b>Strongly Agree</b>	<b>Average</b>
The required information is clearly defined.	0	2	0	6	2	7.6
The forms are well organized.	0	2	1	6	1	7.2
Response areas are easily recognized	0	2	1	6	1	7.2
I was not confused about where to enter requested information on the forms.	0	1	2	5	2	7.6
The purpose of the forms is clearly defined.	0	0	2	6	2	8
I believe that a patient's family member could fill out the enrollee form correctly and easily	0	1	3	4	2	7.4
The barcode areas are easily recognized.	0	1	1	6	2	7.8
The forms are more difficult to fill out than the original ALERT forms.	0	5	2	0	3	6.2

**Form Scanning and Verification**

Once the forms were prepared (staples removed, edges straightened, etc.) a demonstration and short training session on the FormStorm application was held with ALERT staff.

Scanning, recognition, verification and export were reviewed. Initially, the scanning of the completed forms was going to be performed by the ALERT staff, however due to



time constraints, the author took the responsibility of scanning the form images into the required tagged image file format (TIFF). Initial recognition was very poor when using a low-end desktop scanner (Brother MFL-Pro Suite MFC-420CN) which does not provide image enhancement, however once a high quality flatbed scanner was used, recognition was improved. Once the images were scanned using a Fujitsu FI-4220C2 model flatbed scanner (approximately \$1200), which scanned one page in approximately 3 seconds, the 39 form images (one form was ripped causing it to be unscannable) were sent to ALERT staff.

ALERT data capture staff then went through the process of recognition, verification and export. For 39 forms, verification took approximately 1.5 hours and ALERT staff stated some disappointment with the results of the recognition. The majority of questions that arose from the FormStorm evaluation dealt with application configuration capabilities. ALERT staff stated that the interface was somewhat cumbersome and preferred another vendor's interface to that of CharacTell. Under normal circumstances, ALERT reports that new enrollee forms take approximately one minute for data entry and the vaccination forms take approximately 15 seconds for data entry, therefore 20 new enrollee forms and 20 vaccination form would take approximately 25 minutes. It should be noted however, that the evaluation of this application was not intended to be assimilated into normal workflow in this short period. It is to be expected that a period of adjustment is needed prior to integration of AFP software into the daily workflow to realize time savings.(5)

Export of data was done to a comma delimited file (.csv) rather than a database. Some AFP applications allow a direct interface to many database formats, (e.g. SQL, Oracle, ODBC) however FormStorm only allows export to xml or .csv format, which is uploaded to the target database programmatically.

*Teleform* followed the same process, however OHSU staff performed the scanning, using a relatively inexpensive scanner (approximately \$650) which has batch scanning capability. Recognition and verification was completed and the details reported back to the author and ALERT. A high rate of recognition errors occurred due to identifying several fields as the incorrect datatype. For example, a field that contains all numeric characters identified as an alpha field. The number of recognition errors before or after scanning was not quantified for either application due to setup problems and data quality issues, such as setting fields to the wrong type and incorrect placement of barcodes, which would likely not occur as often with further training on setup of the application and a longer design and testing phase. Even though recognition rates weren't quantified, ALERT staff stated that the recognition with *Teleform* appeared to be better than recognition with FormStorm .(21)

## **Discussion**

This project's primary objective was to evaluate the feasibility of using automated data entry at ALERT and to provide a foundation of information for choosing an AFP vendor. While the recognition rates of the two AFP applications that were evaluated was not able

to be quantified, research indicates that with substantial testing and design, adequate end-user training, and the use of multiple validation techniques, accuracy rates can be at least as high as those of manual data entry. Consideration of timesavings is necessary when determining whether or not automated data entry is right for an organization. In this project, the time for validation and verification using automated entry was more than three times what it would take to manually enter data, however research indicates that with a period of training and adjustment, there can be substantial time savings over manual data entry.

Timesavings and increased productivity are factors that can determine whether an AFP solution is more cost effective than manual data entry. For most organizations, cost may be the biggest hurdle to overcome when selecting an AFP vendor. Initial investment in this type of technology can be substantial. Along with initial software costs, an organization may incur the cost of a scanner (likely two scanners due to the need for a back up scanner), upgrades to existing PCs, and servers that will store the scanned images. Evaluation of ROI with centralized automated data entry must consider potential increases in staff productivity and increases in turnaround time over manual data entry because there are no decreases in paper form costs.

Costs associated with three AFP vendors were researched based on ALERT's current volume of forms and the number of data entry staff they currently have on payroll. At peak volume, ALERT can receive approximately 12,000 forms per week and currently employed are four full time data entry staff at a total yearly salary of approximately

\$105,600 (average of \$13.75/hr). Using a reproduction of Vila's MS Excel spreadsheet, as seen in **Appendix E: ROI Calculator**, cost effectiveness based on initial costs of software and hardware, personnel costs, time savings using automated data entry, time in years that the software will be used, and the number of forms scanned annually can be determined.(4) Assumptions are that there are approximately 250 working days a year due to holidays, sick leave and vacation and fifty minutes of every hour are spent performing data entry. If the initial cost of AFP related software and hardware is \$40,000 and a time savings of 15 seconds per form can be gained using automated data entry, the technology becomes cost effective if 48,485 forms are scanned a year. With ALERT's volume, realization of this number of forms could happen in as little as two months. Even gaining only a five-second timesavings per form, automated data entry becomes cost effective once 145,455 forms are scanned. At an average of 6,000 forms per week, realization of cost savings happens in a little over 6 months.

In all likelihood, initial costs for AFP software, two production quality scanners, and a storage server for scanned images will be between \$25,000 and \$60,000 depending on the vendor. CharacTell was the least expensive of the vendors and the initial licensing fee which included one scanning module, one recognition module, five verification modules and a module for storage and indexing of imaged forms would cost approximately \$14,000. Teleform is priced at approximately \$5,000 per module and with the same configuration as above, the cost would be approximately \$40,000. Neither of these estimates includes the costs for training, which varies widely depending on the number of people trained and the length of training. A third vendor, Datacap, quoted the price for

one software license, storage server, a test system and training at \$57,000. Along with software costs, there is a need for a production quality scanner. With the volume of forms that ALERT currently has, there is a need for a scanner that has a 10-ppm scanning capability and includes image enhancement. Most scanners of this quality range between \$900 - \$1200 dollars. Depending on the final system configuration, image storage needs, and software training needs, initial costs are likely to vary widely between vendors.

## **Conclusion**

The implementation of an automated data entry system is a daunting task. There are challenges relating to form design and usability as well as workflow and process changes. AFP technology has been shown to improve turnaround time without sacrificing accuracy and ROI has been demonstrated in many instances. Along with cost, an evaluation of AFP vendors should consist of questions that determine if the software will meet the needs of the organization. Questions regarding the amount of training needed, development requirements prior to performing at full functionality for the organization, types of hardware needed, and system scalability are all important topics to discuss with AFP software vendors. Should ALERT decide to continue with the process of implementing an AFP solution, this project has shown that a significant testing and development time allotment will be needed along with additional training for data entry staff and physician office staff to ensure the best possible recognition rates and data quality. One significant challenge will be balancing the potential for additional work for physician office staff while continuing to move toward a goal of 100% clinic

participation. It does appear, however, that potential for increased productivity and cost savings could make automated data entry a reasonable choice for Oregon Immunization ALERT.

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Pink Vaccination Forms - 3 forms with different VFC eligibility types based on clinic type (Private, Public, FQHC)

Date vaccine given:			← Please use only for vaccines given on date shown.
Mm	dd	yyyy	
Vaccine eligibility: (must check one)			Bar code label here
<input type="checkbox"/> Medicaid/OHP			Bar code label here
<input type="checkbox"/> Amer. Indian/ Alaskan Native			Bar code label here
<input type="checkbox"/> No Insurance			Bar code label here
<input type="checkbox"/> Underinsured			Bar code label here
<input type="checkbox"/> Fully Insured			Bar code label here
<input type="checkbox"/> History Only (Shots previously given)			Bar code label here
Private FQ Bar Code Sites ONLY			DHS 8000B (12/03)

Date vaccine given:			PLEASE USE ONLY FOR VACCINES GIVEN ON DATE SHOWN	
m	d	yyyy	Place barcode label here	
VFC eligibility: (must check one)			Place barcode label here	
<input type="checkbox"/> Medicaid/OHP			Place barcode label here	
<input type="checkbox"/> Amer. Indian/ Alaskan Native			Place barcode label here	
<input type="checkbox"/> No Insurance			Place barcode label here	
<input type="checkbox"/> Not VFC eligible			Place barcode label here	
<input type="checkbox"/> History Only (Shots previously given)			Place barcode label here	
			DHS 8000 (12/03)	

Date vaccine given:			← Please use only for vaccines given on date shown.
Mm	dd	yyyy	
Vaccine eligibility: (must check one)			Bar code label here
<input type="checkbox"/> Medicaid/OHP			Bar code label here
<input type="checkbox"/> Amer. Indian/ Alaskan Native			Bar code label here
<input type="checkbox"/> No Insurance			Bar code label here
<input type="checkbox"/> Underinsured			Bar code label here
<input type="checkbox"/> Copay unaffordable			Bar code label here
<input type="checkbox"/> Billable (Fully Insured)			Bar code label here
<input type="checkbox"/> Locally Owned			Bar code label here
<input type="checkbox"/> Other			Bar code label here
<input type="checkbox"/> Unknown			Bar code label here
<input type="checkbox"/> History Only (Shots previously given)			Bar code label here
Public Bar Code Sites ONLY			DHS 8000A (12/03)



Green update/addition form

**Oregon Immunization ALERT – Update/Addition Form**

Use to update, add, or correct patient information already submitted to ALERT

**CLINIC INFORMATION (required):**

↓ Clinic or Attending Provider Stamp ↓

Date of Update: \_\_\_\_\_

Staff Providing Update: \_\_\_\_\_

Staff Phone Number: \_\_\_\_\_

**PATIENT INFORMATION (required):**

Child's Name: \_\_\_\_\_ Date of Birth: \_\_\_\_/\_\_\_\_/\_\_\_\_

Current ALERT Barcode Number: OR-\_\_\_\_-\_\_\_\_-\_\_\_\_ (assigned by **your** clinic)

**OR**

Current Electronic Transfer ID Number: \_\_\_\_\_ (assigned by **your** clinic for e-transfer records)

**DEMOGRAPHIC CHANGES, ADDITIONS, AND/OR CORRECTIONS (e.g., name change, address, phone number):**

Example: Name was John Doe, now John Smith

*Note: You cannot change or correct information submitted by a clinic/source other than your own.*

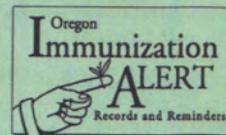
**IMMUNIZATION CHANGES, ADDITIONS AND/OR CORRECTIONS (Use only for missing or incorrect immunizations; for new immunizations, use pink form or e-transfer. Please attach any relevant immunization documentation):**

Example: DTaP shot submitted by my clinic for 3/10/02 was really given 3/1/02

*Note: You cannot change or correct information submitted by a clinic/source other than your own.*

**TO CONTACT ALERT:**

Phone: 800-980-9431 (Statewide)  
971-673-0275 (Portland Metro)  
FAX: 971-673-0276  
Email: OHD.ALERT@state.or.us



**PLEASE PRINT IN BLACK INK**

# Barcode Label Sheet

Oregon  
Immunization  
**ALERT**

Name: Fantasia Smith  
DOB: 2-22-00

Chart #:

OR-009-801-156

Enrollee Name \_\_\_\_\_  
Labels DOB \_\_\_\_\_

Name \_\_\_\_\_  
DOB \_\_\_\_\_  
OR-009-801-156

Hep B-1  
OR-009-801-156 008-1

Hep B-2  
OR-009-801-156 008-2

Hep B-3  
OR-009-801-156 008-3

DTaP-1  
OR-009-801-156 020-1

DTaP-2  
OR-009-801-156 020-2

DTaP-3  
OR-009-801-156 020-3

DTaP-4  
OR-009-801-156 020-4

DTaP-5  
OR-009-801-156 020-5

Pediarix  
DTaP-HepB-IPV  
OR-009-801-156 110-0

Pediarix  
DTaP-HepB-IPV  
OR-009-801-156 110-0

Pediarix  
DTaP-HepB-IPV  
OR-009-801-156 110-0

IPV-1  
OR-009-801-156 010-1

IPV-2  
OR-009-801-156 010-2

IPV-3  
OR-009-801-156 010-3

IPV-4  
OR-009-801-156 010-4

Flu  
Inactivated  
OR-009-801-156 088-0

Flu  
Inactivated  
OR-009-801-156 088-0

Flu Live  
Intranasal  
OR-009-801-156 111-0

Flu Live  
Intranasal  
OR-009-801-156 111-0

COMVAX  
HepB-Hib  
OR-009-801-156 051-0

COMVAX  
HepB-Hib  
OR-009-801-156 051-0

COMVAX  
HepB-Hib  
OR-009-801-156 051-0

Hib-1  
PRP-OMP  
PedvaxHIB  
OR-009-801-156 049-1

Hib-2  
PRP-OMP  
PedvaxHIB  
OR-009-801-156 049-2

Hib-3  
PRP-OMP  
PedvaxHIB  
OR-009-801-156 049-3

Hib-1  
HbOC  
HibTITER  
OR-009-801-156 047-1

Hib-2  
HbOC  
HibTITER  
OR-009-801-156 047-2

Hib-3  
HbOC  
HibTITER  
OR-009-801-156 047-3

Hib-4  
HbOC  
HibTITER  
OR-009-801-156 047-4

Hib-1  
PRP-T  
ActHIB  
OR-009-801-156 048-1

Hib-2  
PRP-T  
ActHIB  
OR-009-801-156 048-2

Hib-3  
PRP-T  
ActHIB  
OR-009-801-156 048-3

Hib-4  
PRP-T  
ActHIB  
OR-009-801-156 048-4

Other  
Specify OR-009-801-156 999-0

Other  
Specify OR-009-801-156 999-0

Other  
Specify OR-009-801-156 999-0

Other  
Specify OR-009-801-156 999-0

Other  
Specify OR-009-801-156 999-0

PCV7-1  
Pneumococcal  
Prevnar  
OR-009-801-156 100-1

PCV7-2  
Pneumococcal  
Prevnar  
OR-009-801-156 100-2

PCV7-3  
Pneumococcal  
Prevnar  
OR-009-801-156 100-3

PCV7-4  
Pneumococcal  
Prevnar  
OR-009-801-156 100-4

MMR-1  
OR-009-801-156 003-1

MMR-2  
OR-009-801-156 003-2

Varicella-1  
OR-009-801-156 021-1

Varicella-2  
OR-009-801-156 021-2

MMRV  
OR-009-801-156 094-0

Hep A-1  
OR-009-801-156 085-1

Hep A-2  
OR-009-801-156 085-2

Td  
OR-009-801-156 009-0

Tdap  
OR-009-801-156 115-0

Tdap  
OR-009-801-156 115-0

Meningococcal  
Menactra  
OR-009-801-156 114-0

Meningococcal  
Menomune  
OR-009-801-156 032-0

Other  
Specify OR-009-801-156 999-0

Other  
Specify OR-009-801-156 999-0

HISTORY  
OR-009-801-156

FORM	DESCRIPTION
Blue Form	<p>All patients that clinics see for the first time need to be enrolled in ALERT, even patients who are already in the ALERT database from another clinic. For each new patient, the blue new enrollee form is used to register a patient into ALERT. This form is also used if the provider has never submitted immunizations to ALERT for a specific child before. The blue form includes the client demographic information intended to be filled out by the parent, but in many cases it is actually filled out by the provider's staff. A new enrollee barcode label is placed at the top of this form, which is used as a client identifier code. It begins with the letters OR (which stands for Oregon), followed by 9 numbers that identify both the provider site and the child.</p> <p>Some of the larger clinics are using copies of their own pre-printed forms (patient facesheets) with demographic information in lieu of the blue form, but these forms are used only in special circumstances. This can create additional paperwork, as often these providers are attaching the new enrollee barcode label onto their patient facesheet and attaching the blank blue form to the patient facesheet.</p>
Pink Form	<p>When an immunization is given, the pink vaccine submission form is used. Providers place barcode stickers specifying the immunization(s) given on the pink form. Barcode stickers specifying immunization information are included for each vaccination that a child receives. As many as 5 barcode stickers can be attached to 1 form. If a sticker does not exist for the immunization given, the provider attaches an "other" barcode sticker to the form and writes down the vaccine name. In addition to the 11-character client identifier described above, the vaccine barcode includes the HL7 code and a dose number. Providers also fill in the date the vaccine was provided as well as the VFC eligibility code for the specific vaccines given on that day.</p>
Green Reassignment Form	<p>The green forms are reassignment forms, which are used when client barcodes need to be reassigned. These forms were only used for a short-term process, which is just about completed.</p>
Green Update Form	<p>Although seldom used, the Update/Addition forms are used to report any changes or corrections to the original client information submitted via blue or pink forms.</p>
Lavender Form	<p>This form is used for adults in the prison, Youth Authority, and Job Corps populations. Demographic and vaccine data is reported on one form for each visit without the use of barcodes. This system was created to provide an easier way for these sites to enter adolescent and adult data, rather than using the barcode system which was created to track childhood</p>

**Appendix B: Manual Data Entry Process**



STEPS	EXPLANATION
Step 1	<ul style="list-style-type: none"> <li>• Mail is opened, which contains blue and pink forms, green update forms, and occasionally green re-assignment forms.</li> <li>• Also included are client history forms, which are usually copies of Vaccine Administration Records (VARs), some of which are from providers submitting electronically through billing systems and require ALERT data entry staff to enter the historic and/or un-billable immunization data using their unique ID number rather than barcodes.</li> <li>• Everything is date stamped and sorted (pink forms are sorted by VFC code).</li> <li>• Steps 2 and 3 below can be processed asynchronously on parallel tracks. One does not have to happen before the other.</li> </ul>
Step 2	<ul style="list-style-type: none"> <li>• The new enrollee barcode label is scanned from the blue form, and then the demographic information from any of the forms is manually typed into Resolve.</li> <li>• If there is a problem with data quality, the issue goes to customer service, along with provider information. The provider is located by entering the first 6 barcode numeric characters into the ALERT Webpage database search function and the identifying information will pop up (i.e., provider name and contact information). The provider page is in two sections, one with ALERT specific information and one with VFC specific information.</li> </ul>
Step 3	<ul style="list-style-type: none"> <li>• The barcodes on the pink forms are scanned and automatically entered into Resolve. The proper VFC code is chosen from a drop-down menu. The date the vaccine was given is entered.</li> </ul>
Step 4	<ul style="list-style-type: none"> <li>• Resolve is then used to 1) deduplicate a child's records if it has not already been done, and 2) compare data of one source with another when researching the source of a problem.</li> </ul>



## Appendix C: Initial Redesigned Forms (Consolidated)

### Oregon Immunization ALERT

Please use the Checkboxes below to indicate if this is a NEW ENROLEE or a PATIENT UPDATE Form

<b>New Enrollee</b> <small>* Use for new patients</small>	<b>Patient Update</b> <small>* Use to update, add, or correct patient information already submitted to ALERT  <small>* You cannot change or correct information submitted by a clinic/source other than your own.</small></small>	Date of Update: (MM/DD/YYYY)      /      /  Staff Providing Update (initials):  Staff Phone #:      -      -      -
Clinic or Attending Provider Stamp (REQUIRED)		<i>For Provider's Office Staff Use</i> <small>* Place Completed NAME bar code label here for New Enrollee -OR-  <small>* Enter the following information if Patient Update</small></small> Current ALERT Barcode Number: OR- -OR- Current Electronic Transfer ID Number: (assigned by your clinic for e-transfer records)
<b>REQUIRED INFORMATION</b> <small>* For PATIENT UPDATES only fill out information that has changed. For NEW ENROLEES all information is required.</small>		
Date of Birth: (MM/DD/YYYY)      /      /		
First name(s):		Middle name:
Last names(s):		Place of birth: (state or country)
Last name at birth:		
Mother's maiden name: <small>(mother's last name before she was married)</small>		
Parent/Guardian first name:		Primary Language:
Parent/Guardian last name:		
<b>Home Address</b>		
Street:		Apt#:
City:	State:	Zip:
<b>Mailing Address (if different than above):</b>		
Street:		Apt#:
City:	State:	Zip:
Home Phone:      -      -      -	Child Social Security #:      -      -      -	
Work Phone:      -      -      -	Medical ID# or Insurance #:	
<b>TO CONTACT ALERT:</b> Phone: 800-980-9431 (Statewide) 971-673-0275 (Portland Metro) FAX: 971-673-0276 Email: OHD.ALERT@state.or.us		<b>Comments:</b>

**PLEASE PRINT IN BLACK INK**

Optional for clinics: Attach a copy of the child's immunization record and ALERT will enter the full immunization history.

## Oregon Immunization Alert Vaccine Reporting/Update Form

\* Use to add new vaccine information or to update or correct patient vaccination information already submitted to ALERT

<input type="checkbox"/> New Vaccine <small>* Use for new vaccination information</small>	<input type="checkbox"/> Vaccination Correction/Update <small>* Use to update, add, or correct patient information already submitted to ALERT</small>  <small>** You cannot change or correct information submitted by a clinic/source other than your own.</small>	Date of Update: (MM/DD/YYYY) <input type="text"/> / <input type="text"/> / <input type="text"/>  Staff Providing Update: _____  Staff Phone Number: <input type="text"/> - <input type="text"/> - <input type="text"/>
--	--	--

CLINIC INFORMATION (required) Clinic or Attending Provider Stamp	<i>For Provider's Office Staff Use</i> * Enter the following information if Vaccination Correction or Update  Current ALERT Barcode Number:    OR- <input type="text"/> - <input type="text"/> - <input type="text"/>  -OR- Current Electronic Transfer ID Number: _____ <small>(assigned by your clinic for e-transfer records)</small>
---	---

Date vaccine given: (MM/DD/YYYY) <input type="text"/> / <input type="text"/> / <input type="text"/>	<b>Please use only for vaccines given on date shown</b>
---	---

Vaccine Eligibility: <small>(must check one)</small>		Place Barcode Label Here
<b>Public Bar Code Sites Only</b> <input type="checkbox"/> Medicaid/OHP <input type="checkbox"/> Amer. Indian/Alaskan Native <input type="checkbox"/> No Insurance <input type="checkbox"/> Underinsured <input type="checkbox"/> Copay unaffordable <input type="checkbox"/> Billable (Fully Insured) <input type="checkbox"/> Locally Owned <input type="checkbox"/> Other <input type="checkbox"/> Unknown <input type="checkbox"/> History Only (Shots Previously Given)	<b>Private Bar Code Sites Only</b> <input type="checkbox"/> Medicaid/OHP <input type="checkbox"/> Amer. Indian/Alaskan Native <input type="checkbox"/> No Insurance <input type="checkbox"/> Underinsured <input type="checkbox"/> Fully Insured <input type="checkbox"/> History Only (Shots Previously Given)	
Place Barcode Label Here		
Place Barcode Label Here		
Place Barcode Label Here		
Place Barcode Label Here		

**IMMUNIZATION CHANGES, ADDITIONS, AND/OR CORRECTIONS** (Use only for missing or incorrect immunizations; for new immunizations, use the above NEW VACCINE reporting areas. Please attach any relevant immunization documentation)

<input type="checkbox"/> <b>Vaccination Correction</b>	Vaccine Reported: <input type="text"/> Actual Given: <input type="text"/>
<input type="checkbox"/> <b>Date Correction</b>	Date Reported: <input type="text"/> / <input type="text"/> / <input type="text"/> Corrected Date: <input type="text"/> / <input type="text"/> / <input type="text"/>
<input type="checkbox"/> <b>Vaccine Eligibility Correction</b>	Eligibility Reported: <input type="text"/> Actual Eligibility: <input type="text"/>

<b>TO CONTACT ALERT:</b> Phone: 800-980-9431 (Statewide) 971-673-0275 (Portland Metro) FAX: 971-673-0276 Email: <a href="mailto:OHD.ALERT@state.or.us">OHD.ALERT@state.or.us</a>	<b>Comments:</b>  
--	--------------------------

**PLEASE PRINT IN BLACK INK**

Optional for clinics: Attach a copy of the child's immunization record and ALERT will enter the full immunization history.

## Appendix D: Final Redesigned Forms

### CharacTell Forms

<b>OREGON IMMUNIZATION ALERT NEW ENROLLEE AND UPDATE FORM</b> <small>Please use the checkboxes below to indicate if this is a NEW ENROLLEE or a PATIENT UPDATE form</small>										
<input type="checkbox"/> New enrollee  <small>* Use for new patients</small>	<input type="checkbox"/> Patient update <small>* Use to update, add, or correct patient information already submitted to ALERT                      * You cannot change or correct information submitted by a clinic/source other than your own.</small>  Staff providing update (initials): _____  Staff phone #: _____ - _____ - _____ Ext. _____									
Clinic or Attending Provider Stamp (REQUIRED)	<div style="text-align: center; background-color: #f0f0f0; padding: 5px;"> <small>For Provider's Office Staff Use</small>  <b>* Place completed NAME barcode label here for NEW ENROLLEE</b>  <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="font-size: 8px;">Name First</td> <td style="font-size: 8px;">Middle</td> <td style="font-size: 8px;">Last</td> </tr> <tr> <td style="font-size: 8px;">Birthdate MM/DD/YY</td> <td colspan="2" style="text-align: center;"> </td> </tr> <tr> <td colspan="3" style="font-size: 8px;">OR-000-000-007</td> </tr> </table> </div> <div style="margin-top: 5px;"> <small>* Enter the following information if PATIENT UPDATE</small>                      Current ALERT barcode number: _____ OR- _____ - _____                 </div>	Name First	Middle	Last	Birthdate MM/DD/YY			OR-000-000-007		
Name First	Middle	Last								
Birthdate MM/DD/YY										
OR-000-000-007										
<b>REQUIRED INFORMATION</b> <small>* For PATIENT UPDATES only fill out information that has changed. For NEW ENROLLEES all information is required.</small>										
Date of birth (MM/DD/YYYY): _____ / _____ / _____ Male: _____ Female: _____  First name(s): _____ Middle name: _____ Last name(s): _____ Suffix: _____ Last name at birth: _____  Child social security #: _____ - _____ - _____ Place of birth: _____ <small>Social Security Numbers are used only to match immunization information received from multiple sources, and will not be re-released</small> (state or country)  Medicaid ID#: _____										
Parent/Guardian first name: _____ Primary language: _____ Parent/Guardian last name: _____  <b>Home Address</b> Street: _____ Apt#: _____ City: _____ State: _____ Zip: _____  <b>Mailing Address (if different than above):</b> Street: _____ Apt#: _____ City: _____ State: _____ Zip: _____  Home phone: _____ - _____ - _____ Mother's maiden name: _____ Work phone: _____ - _____ - _____ (Last name before marriage)										
<b>TO CONTACT ALERT:</b> Phone: 800-980-9431 (Statewide) 971-673-0275 (Portland Metro) FAX: 971-673-0276 Email: OHD.ALERT@state.or.us	<b>Comments:</b>   									

**PLEASE PRINT IN BLACK INK**

**Optional for clinics:** Attach a copy of the child's immunization record and ALERT will enter the full immunization history.

Private FQ barcode sites ONLY		
Date vaccine given: (MM/DD/YYYY) <input type="text"/> / <input type="text"/> / <input type="text"/>		← Please use only for vaccines given on date shown
<b>Vaccine eligibility: (must check one)</b> <input type="checkbox"/> Medicaid/OHP <input type="checkbox"/> Amer. Indian/Alaskan Native <input type="checkbox"/> No Insurance <input type="checkbox"/> Underinsured <input type="checkbox"/> Fully Insured <input type="checkbox"/> History Only (Shots Previously Given)	Mfg: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	Place barcode label here
	Lot#: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	
	Mfg: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	Place barcode label here
	Lot#: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	
	Mfg: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	Place barcode label here
	Lot#: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	
Mfg: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	Place barcode label here	
Lot#: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>		

FQHC barcode sites ONLY		
Date vaccine given: (MM/DD/YYYY) <input type="text"/> / <input type="text"/> / <input type="text"/>		← Please use only for vaccines given on date shown
<b>Vaccine eligibility: (must check one)</b> <input type="checkbox"/> Medicaid/OHP <input type="checkbox"/> Amer. Indian/Alaskan Native <input type="checkbox"/> No Insurance <input type="checkbox"/> Not VFC eligible <input type="checkbox"/> History Only (Shots Previously Given)	Mfg: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	Place barcode label here
	Lot#: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	
	Mfg: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	Place barcode label here
	Lot#: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	
	Mfg: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	Place barcode label here
	Lot#: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	
Mfg: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	Place barcode label here	
Lot#: <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>		

**Public barcode sites ONLY**

Date vaccine given:  /  /



**Please use only for vaccines given on date shown**

- Vaccine eligibility: (must check one)**
- Medicaid/OHP
  - Amer. Indian/Alaskan Native
  - No Insurance
  - Underinsured
  - Copay unaffordable
  - Billable (Fully Insured)
  - Locally Owned
  - Other
  - Unknown
  - History Only (Shots Previously Given)

Mfg:   
Lot#:

Mfg:   
Lot#:

Mfg:   
Lot#:

Mfg:   
Lot#:

Mfg:   
Lot#:

Place barcode label here

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Place barcode label here

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Place barcode label here

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Place barcode label here

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Place barcode label here

6665540866

**Oregon Immunization ALERT New Enrollee and Update Form**

Please use the Check boxes below to indicate if this is a NEW ENROLLEE or a PATIENT UPDATE Form

**New Enrollee**  
\*Use for new patients

**Patient Update** \*Use to update, add, or correct patient information already submitted to ALERT  
\*You cannot change or correct information submitted by a clinic/source other than your own.

Staff Providing Update (initials):

Staff Phone:  -  -  Ext:

Clinic or Attending Provider Stamp  
(REQUIRED)

*For Provider's Office Staff Use*

\*Place Completed NAME bar code here for New Enrollee

Name First Middle Last

Birthdate MM/DD/YY

OR-000-000-007



\*Enter the following information if Patient Update

Current ALERT Barcode Number: OR-  -  -

**REQUIRED INFORMATION**

\*For PATIENT UPDATES only fill out information that has changed. For NEW ENROLLEES all information is required.

Date of Birth (MM/DD/YYYY):  /  /  Male:  Female:

First name(s):  Middle name:

Last name(s):  Suffix:

Last name at birth:  Place of birth:

Child Social Security #:  -  -  Medical ID# or Insurance #:

*Social Security Numbers are used only to match immunization information received from multiple sources, and will not be re-released*

Parent/Guardian first name:  Primary Language:

Parent/Guardian last name:

Home Address:

Street:  Apt#:   
City:  State  Zip code:

Mailing Address (if different than above):

Street:  Apt#:   
City:  State  Zip code:

Home Phone:  -  -  Mother's maiden name:

Work Phone:  -  -  (Last name before marriage)

**TO CONTACT ALERT:**  
Phone: 800-980-9431 (Statewide)  
971-673-0275 (Portland Metro)  
FAX: 971-673-0276  
Email: OHD.ALERT@state.or.us

Comments:

**PLEASE PRINT IN BLACK INK**

Optional for clinics: Attach a copy of the child's immunization record and ALERT will enter the full immunization history.

**FQHC barcode sites ONLY**

Date vaccine given: <input type="text"/> / <input type="text"/> / <input type="text"/>		Please use only for vaccines given on date shown		
mm      dd      yyyy				
<b>Vaccine eligibility:</b> (must check one)  <input type="checkbox"/> Medicaid/OHP <input type="checkbox"/> Amer. Indian/Alaskan Native <input type="checkbox"/> No Insurance <input type="checkbox"/> Not VFC eligible <input type="checkbox"/> History Only (Shots Previously Given)	Mfg: <input type="text"/>	Line up label:	TEXT HERE	BARCODE HERE
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	Lot#: <input type="text"/>			
	Mfg: <input type="text"/>	Line up label:	TEXT HERE	BARCODE HERE
	Lot#: <input type="text"/>			

**FQHC barcode sites ONLY**

Date vaccine given: <input type="text"/> / <input type="text"/> / <input type="text"/>		Please use only for vaccines given on date shown		
mm      dd      yyyy				
<b>Vaccine eligibility:</b> (must check one)  <input type="checkbox"/> Medicaid/OHP <input type="checkbox"/> Amer. Indian/Alaskan Native <input type="checkbox"/> No Insurance <input type="checkbox"/> Not VFC eligible <input type="checkbox"/> History Only (Shots Previously Given)	Mfg: <input type="text"/>	Line up label:	TEXT HERE	BARCODE HERE
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	Lot#: <input type="text"/>			
	Mfg: <input type="text"/>	Line up label:	TEXT HERE	BARCODE HERE
	Lot#: <input type="text"/>			

**Public barcode sites ONLY**

<b>Date vaccine given:</b> <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> / <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <div style="display: flex; justify-content: space-around; font-size: small;"> <span>mm</span> <span>dd</span> <span>yyyy</span> </div>		<b>Please use only for vaccines given on date shown</b>																																				
<b>Vaccine eligibility: (must check one)</b> <input type="checkbox"/> Medicaid/OHP <input type="checkbox"/> Amer. Indian/Alaskan Native <input type="checkbox"/> No Insurance <input type="checkbox"/> Underinsured <input type="checkbox"/> Copay unaffordable <input type="checkbox"/> Billable (Fully insured) <input type="checkbox"/> Locally Owned <input type="checkbox"/> Other <input type="checkbox"/> Unknown <input type="checkbox"/> History Only (Shots Previously Given)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border: none;">Mfg:</td> <td style="border: 1px solid black; width: 100px; height: 15px;"></td> </tr> <tr> <td style="border: none;">Lot#:</td> <td style="border: 1px solid black; width: 100px; height: 15px;"></td> </tr> <tr> <td style="border: none;">Mfg:</td> <td style="border: 1px solid black; width: 100px; height: 15px;"></td> </tr> <tr> <td style="border: none;">Lot#:</td> <td style="border: 1px solid black; width: 100px; height: 15px;"></td> </tr> <tr> <td style="border: none;">Mfg:</td> <td style="border: 1px solid black; width: 100px; height: 15px;"></td> </tr> <tr> <td style="border: none;">Lot#:</td> <td style="border: 1px solid black; width: 100px; height: 15px;"></td> </tr> <tr> <td style="border: none;">Mfg:</td> <td style="border: 1px solid black; width: 100px; height: 15px;"></td> </tr> <tr> <td style="border: none;">Lot#:</td> <td style="border: 1px solid black; width: 100px; height: 15px;"></td> </tr> <tr> <td style="border: none;">Mfg:</td> <td style="border: 1px solid black; width: 100px; height: 15px;"></td> </tr> <tr> <td style="border: none;">Lot#:</td> <td style="border: 1px solid black; width: 100px; height: 15px;"></td> </tr> </table>	Mfg:		Lot#:		Mfg:		Lot#:		Mfg:		Lot#:		Mfg:		Lot#:		Mfg:		Lot#:		<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border: none; width: 100px;"><b>Line up label:</b></td> <td style="border: 1px solid black; width: 100px; height: 20px; text-align: center;">TEXT HERE</td> <td style="border: 1px solid black; width: 100px; text-align: center;">BARCODE HERE</td> </tr> <tr> <td style="border: none;"><b>Line up label:</b></td> <td style="border: 1px solid black; width: 100px; height: 20px; text-align: center;">TEXT HERE</td> <td style="border: 1px solid black; width: 100px; text-align: center;">BARCODE HERE</td> </tr> <tr> <td style="border: none;"><b>Line up label:</b></td> <td style="border: 1px solid black; width: 100px; height: 20px; text-align: center;">TEXT HERE</td> <td style="border: 1px solid black; width: 100px; text-align: center;">BARCODE HERE</td> </tr> <tr> <td style="border: none;"><b>Line up label:</b></td> <td style="border: 1px solid black; width: 100px; height: 20px; text-align: center;">TEXT HERE</td> <td style="border: 1px solid black; width: 100px; text-align: center;">BARCODE HERE</td> </tr> <tr> <td style="border: none;"><b>Line up label:</b></td> <td style="border: 1px solid black; width: 100px; height: 20px; text-align: center;">TEXT HERE</td> <td style="border: 1px solid black; width: 100px; text-align: center;">BARCODE HERE</td> </tr> </table>	<b>Line up label:</b>	TEXT HERE	BARCODE HERE	<b>Line up label:</b>	TEXT HERE	BARCODE HERE	<b>Line up label:</b>	TEXT HERE	BARCODE HERE	<b>Line up label:</b>	TEXT HERE	BARCODE HERE	<b>Line up label:</b>	TEXT HERE	BARCODE HERE	
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**IMPORTANT:** In order to preserve model integrity, only modify data in **GREEN** boxes!

**Purpose:** Calculate cost effectiveness of manual vs. forms-scanning technology given the following:

	Parameters	Units
Initial Application software/training/technical support cost =	\$ 15,000.00	(initial cost)
Scanning software amortization period (number of years software will be used) =	3	
Subsequent software upgrades/training/support cost =	\$ 2,000.00	\$/year
Scanner(s)/PC(s) with appropriate hardware and software cost(s) =	\$ 2,500.00	\$/year
Clerical personnel salary plus fringe benefits cost(s) =	\$ 105,000.00	\$/year
Application average increase in throughput over manual entry =	0.16667	
Application mean data entry seconds/form data entry speed =	50	seconds/form
Manual data mean seconds/form data entry speed =	60	seconds/form

**Model Specification:**

Cost/form = (cost/second) \* (METHOD mean second/form)

Total cost/year = (initial costs/amortization period + annual costs/year) + (cost/form \* N forms)

To calculate which data entry method is more cost effective:

- 1) Choose an amortization period (cell I5) and modify any parameters in green cells as appropriate
- 2) Scroll down column F from row 27 onward until you find the row with the number of reports to be entered manually
- 3) Check the cost-effective mode result in the same row of column K.

**Calculations:**

	Base Personnel Costs:		Base Cost/N Forms				Cumulative Cost/N Forms		Manual Cost > Automated Cost for N Forms
	Units		N Forms	Manual	Automated	Manual	Automated		
Salary:	\$105,000.00	year							
Work days/year (net):	200	days							
Hours/day:	8	hours							
Base cost/hour:	\$ 65.63	\$/hour	0	\$ -	\$ -	\$ -	\$ 9,500.00		FALSE
Max minutes/hour worked:	50	minutes	1	\$ 1.31	\$ 1.09	\$ 1.31	\$ 9,501.09		FALSE
			2	\$ 2.63	\$ 2.19	\$ 2.63	\$ 9,502.19		FALSE
			3	\$ 3.94	\$ 3.28	\$ 3.94	\$ 9,503.28		FALSE
			4	\$ 5.25	\$ 4.38	\$ 5.25	\$ 9,504.38		FALSE
			5	\$ 6.56	\$ 5.47	\$ 6.56	\$ 9,505.47		FALSE
			6	\$ 7.88	\$ 6.56	\$ 7.88	\$ 9,506.56		FALSE
			7	\$ 9.19	\$ 7.66	\$ 9.19	\$ 9,507.66		FALSE
			8	\$ 10.50	\$ 8.75	\$ 10.50	\$ 9,508.75		FALSE
			9	\$ 11.81	\$ 9.84	\$ 11.81	\$ 9,509.84		FALSE

**Manual Entry Costs:**

Cost/hour manual entry:	\$ 87.50	\$/hour
Cost/minute manual entry:	\$ 1.31	\$/minute
Cost/second manual entry:	\$ 0.0219	\$/second
Cost/day manual entry:	\$ 700.00	\$/day
Cost/year manual entry:	\$140,000.00	\$/year



**Application Costs:**

Application software purchase:	\$ 15,000.00	(initial)
Upgrades/training/support:	\$ 2,000.00	\$/year
PC hardware and software:	\$ 2,500.00	\$/year
Amortization period:	3	year(s)

**Application Entry Personnel Costs:**

Cost/hour automated entry:	\$ 72.92	\$/hour
Cost/minute automated entry:	\$ 1.09	\$/minute
Cost/second automated entry:	\$ 0.0182	\$/second
Cost/day automated entry:	\$ 583.33	\$/day
Cost/year automated entry:	\$116,666.67	\$/year

# Appendix F: End User Form Design Usability Survey

	<b>OREGON IMMUNIZATION ALERT Scannable Forms Project Form Evaluation Survey</b>	
<b>Please circle in a response for each of the eight questions below. Please do not leave any unanswered.</b>		
<p>1. The required information on the forms is clearly defined. <input type="radio"/> strongly disagree   <input type="radio"/> disagree   <input type="radio"/> neutral   <input type="radio"/> agree   <input type="radio"/> strongly agree</p> <p>2. The forms are well organized. <input type="radio"/> strongly disagree   <input type="radio"/> disagree   <input type="radio"/> neutral   <input type="radio"/> agree   <input type="radio"/> strongly agree</p> <p>3. Response areas are easily recognized. <input type="radio"/> strongly disagree   <input type="radio"/> disagree   <input type="radio"/> neutral   <input type="radio"/> agree   <input type="radio"/> strongly agree</p> <p>4. I was not confused about where to enter requested information on the forms. <input type="radio"/> strongly disagree   <input type="radio"/> disagree   <input type="radio"/> neutral   <input type="radio"/> agree   <input type="radio"/> strongly agree</p> <p>5. The purpose of the forms is clearly defined. <input type="radio"/> strongly disagree   <input type="radio"/> disagree   <input type="radio"/> neutral   <input type="radio"/> agree   <input type="radio"/> strongly agree</p> <p>6. I believe a patient's family member could fill out the Enrollee form correctly and easily. <input type="radio"/> strongly disagree   <input type="radio"/> disagree   <input type="radio"/> neutral   <input type="radio"/> agree   <input type="radio"/> strongly agree</p> <p>7. The barcode areas are easily recognized. <input type="radio"/> strongly disagree   <input type="radio"/> disagree   <input type="radio"/> neutral   <input type="radio"/> agree   <input type="radio"/> strongly agree</p> <p>8. The forms are more difficult to fill out than the original ALERT forms. <input type="radio"/> strongly disagree   <input type="radio"/> disagree   <input type="radio"/> neutral   <input type="radio"/> agree   <input type="radio"/> strongly agree</p>		
<b>Comments:</b> <hr/> <hr/> <hr/> <hr/>		