Tailoring Interface for Spanish Language: A Case Study with CHICA System

Vibha Anand, Paul G. Biondich, Aaron E. Carroll, and Stephen M. Downs

Children's Health Services Research, Indiana University School of Medicine Regenstrief Institute for Health Care, Indianapolis
vanand@iupui.edu

Abstract. We developed a clinical decision support system (CDSS) – Child Health Improvement through Computer Automation (CHICA) - to deliver patient specific guidance at the point of clinical care. CHICA captures structured data from families, physicians, and nursing, staff using a scannable paper user interface - Adaptive Turnaround Documents (ATD) while remaining sensitive to the workflow constraints of a busy outpatient pediatric practice. The system was deployed in November 2004 with an English language only user interface. In July 2005, we enhanced the user interface with a Spanish version of the pre-screening questionnaire to capture information from Spanish speaking families in our clinic. Subsequently, our results show an increase in rate of family responses to the pre-screening questionnaire by 36% (51% vs. 87%) in a four month time period before and after the Spanish interface deployment and up to 32% (51% vs. 83%) since November 2004. Furthermore, our results show that Spanish speaking families, on average, respond to the questionnaire more than English speaking families (85% vs. 49%). This paper describes the design, implementation challenges and our measure of success when trying to adapt a computer scannable paper interface to another language.

1 Introduction

Computer alert and reminder systems are an effective way to improve rates of preventive services [1-7]. However, these successes have generally been limited to systems that are embedded in computerized physician order entry systems or inpatient noting systems. Unfortunately, for many outpatient preventive services, a reminder at the time of note writing or order entry is often too late, as these events frequently take place after the physician has completed the visit. "Just in time" information delivery requires that a reminder be delivered at the time the physician is making a decision, and this is often while he or she is conversing with a patient. This timeliness is even more important in pediatric practice, where preventive services often include developmental assessment, risk assessment, counseling and anticipatory guidance. Computers within exam rooms may not be a satisfactory solution, as they can be expensive and susceptible to damage by curious pediatric patients. Computers can also slow the patient encounter and negatively impact the content of physician-patient communications[8]. In fact, at our institution, which houses one of the most successful electronic

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medical record systems in the world,[9] pediatricians have long been resistant to the introduction of computers in their clinics.

We developed a guideline-based decision support system that could be seamlessly integrated into the delicate workflow of a high volume pediatric clinic. We considered six essential criteria: (1) collecting data directly from patients or their parents, (2) providing reminders to nurses about age- appropriate screening data, (3) prioritizing needed preventive services (4) providing tailored prompts and reminders to physicians unobtrusively during the encounters with patients, (5) capturing data directly from physicians, and (6) requiring little or no training of staff. However, as we deployed the system in November 2004, we quickly realized that our first criterion, collecting data from patient and their families, was not adequately met because of language barriers for the high number of Spanish speaking families that our clinic serves. We added Spanish language to the scannable paper interface of our system and deployed it in July 2005. This paper describes the design, implementation and challenges of deploying a bilingual scannable paper interface and our results thus far.

2 Methods

Preliminary work by one of our investigators demonstrated the feasibility of using tailored scannable paper forms to provide patient specific reminders to physicians and capture data through optical scanning.[10, 11] We expanded this model, using advances in Optical Character Recognition (OCR) technology and international standards for knowledge representation (Arden Syntax[12]) and data communication (HL7) and developed Child Health Improvement through Computer Automation (CHICA) system [13] as an extension of the Regenstrief Medical Record System (RMRS), an inpatient and outpatient information system which contains 30 years of data and more than 300 million numeric or coded patient observations[9].

3 System Overview

The Child Health Improvement through Computer Automation (CHICA) system consists of (1) a knowledge base of guideline rules, (2) a repository of patient data, (3) a tailored document printing and scanning engine and (4) business rules to direct the communication as well as the printing and scanning of patient specific documents. At each visit CHICA generates two tailored scannable forms and additional "Just in Time" informational forms if needed for the visit. The first collects information from the patient or the parent and from the nurse before the physician encounter. The second provides reminders and collects data from the physician.

Workflow: When a patient checks into the clinic, the registration system sends an HL7 ADT message to the RMRS; the message is then routed to CHICA (Figure 1(a)). CHICA uses this "trigger" to query the RMRS for all relevant clinical data for the patient (b). Upon receipt and parsing of these data, CHICA generates a highly tailored "Pre-Screener Form" (PSF) for the parent or adolescent (c).

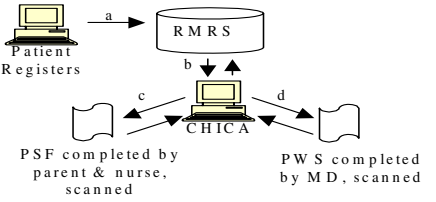


Fig. 1. Workflow

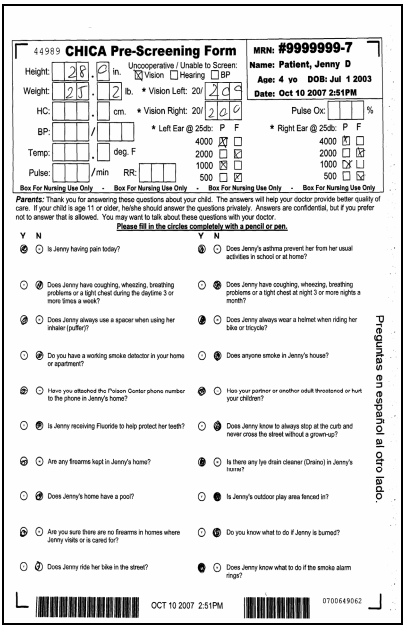


Fig. 2. Pre-screener Form (PSF)

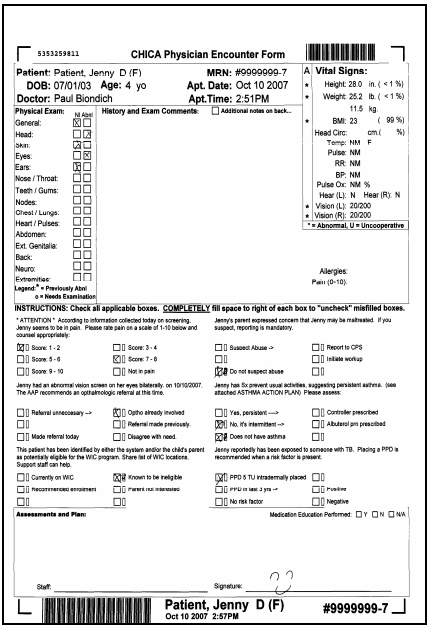


Fig. 3. Physician Worksheet (PWS)

The PSF (Figure 2) has two sections: the top for the nursing staff and the bottom for the parent or adolescent. The parent or adolescent section consists of 20 "yes or no" questions that assess patient information, for example, common parental concerns like diet, risk behaviors like smoking, safety issues like car seats, or risk factors like lead exposure. Question selection and relevance are determined by applying the logic contained within Arden Syntax Medical Logic Modules (MLMs) to data contained within the individual's electronic medical record (EMR). Questions are based on standard national guidelines and written at a 6th grade literacy level. The parent (or the adolescent) fills out the bottom section in the waiting room. If the PSF is partially completed, the system still performs gracefully.

The nursing staff fills out the top section of the PSF. This section contains a structured template for recording measurements of height, weight, head circumference,

blood pressure, and other screening tests. Based on the child's age, suggested fields are highlighted, helping the staff adhere to guidelines while avoiding unnecessary or redundant measurements. The completed PSF is scanned into the CHICA (a TIFF image of PSF is also saved) system. The software interprets the scanned data and writes all newly-recorded observations into the EMR.

Next, CHICA prints a tailored Physician Worksheet (PWS) for use by the physician (Figure 1(d)). The PWS (Figure 3) includes calculated height and weight percentiles and body mass index. It also contains a physical examination grid and areas for a hand written history, physical examination, impression and plan. The main section of the PWS form contains 6 guideline prompts for the physician. These are again selected by Arden MLMs, which query the child's EMR data, including data recently captured by the PSF. Each prompt consists of an explanation of the prompt followed by 6 checkbox responses that allow the physician to document data, procedures, or referrals. After the encounter, the PWS is scanned, and the data (with a TIFF image of the PWS) are recorded in the EMR.

Together, the PSF and the PWS implement a complete preventive services program. The PSF collects needed data from the patient/parent that informs the construction of the PWS. Because structured data are captured from both forms, the system supports multi-step guidelines and generates tailored follow-up questions and prompts at subsequent visits.

4 Challenges

When the system was initially deployed in November 2004, a large number of patient families in our clinic population did not respond to the PSF questionnaire. Our clinic serves a large Spanish speaking population. Using ethnicity (Hispanic) as a proxy for language preference we estimated 35% (Table 1) of our clinic population consists of Spanish speaking families. The questionnaire in English presented a big language barrier for these families.

Table 1. Demographic Distribution of Clinic Population

Race	% N = 10234
Black	42%
Hispanic	35%
White	16%
Asian	3%
American Indian	< 1%
Other	4%

Since PWS prompts are prioritized by guidelines (risk factors, age of child) and query the most recent data (including questionnaire responses) to assess relevance; the unanswered but scanned PSFs often produced PWS prompts that were not the most

pertinent to the patient's visit. For example, an anticipatory guidance prompt may not appear to advise the parent of smoking risks to child's health because the parent did not indicate there was a smoker in the home (the questionnaire on PSF was not answered). Furthermore, the CHICA database, which is also used for retrospective data analyses and for conducting clinical studies, was not capturing family data for these families. Therefore, as the PSF plays an integral role in informing the reminders for the physician encounter (PWS), it was critical that the needs of the Spanish speaking patient population be met.

We considered asking each patient family about their language of choice at the time of registration on their first visit, but this would have required changes to our registration system and workflow processes. Additionally, it would also not have met the needs of bilingual patient families adequately and burdened the staff with tracking the patient's visit order. We also considered using demographic data such as race or family name in the patient's electronic medical record as a proxy for language. Finally, we considered failure to answer the first questionnaire in English to default their language choice to Spanish. However, none of these solutions seemed graceful enough; family names indicate ethnicity, not language preference; data derived from medical records is not most accurate surrogate for language. As we required augmenting the PSF with a Spanish version without having to alter workflow processes or requiring prior knowledge of the preferred language of the patient and their families, we looked away from human centered solutions and started to explore technically innovative solutions to the problem.

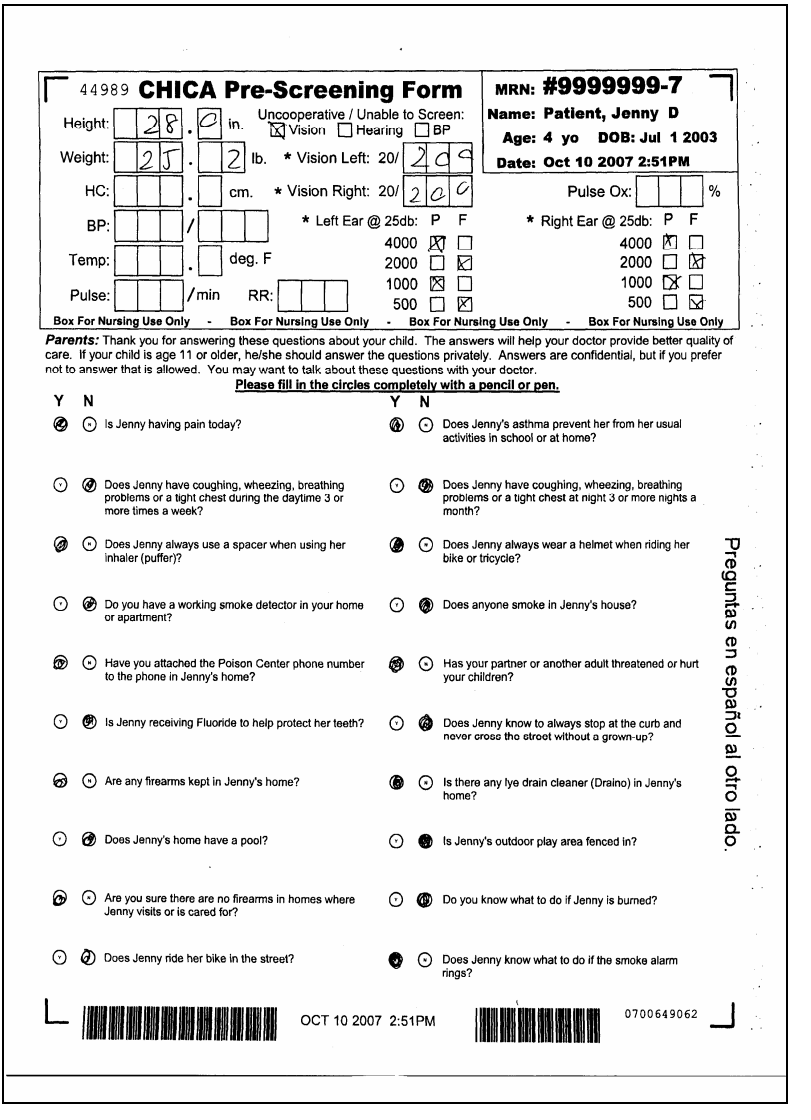
A Technical Solution. First, we changed the PSF form from a single sided form to a dual sided form to print the same set of questions on each side in English and Spanish at each visit (Figure 4a and 4b). The form remained single page but now each side had the same set of questions on the other side in the Spanish. A single page form was appropriate for various reasons – to limit the text on the questionnaire, a single page is easy to track through clinic workflow, and because the forms are answered in the waiting room by families with young children, there is a high likelihood of multiple pages being missed or not returned for scanning. This latter error would result in the OCR software not reading the form at all and a single page form can minimize the risk of unrecognized or misread forms.

Second, since the questions on the PSF are dynamically generated by a set of MLM rules, it required extending the functionality of the MLM parser - to include parsing of Spanish characters to generate Spanish language questionnaire text and to correctly substitute for phrases relating to gender such as "his/her," "him/her" or "he/she." Therefore, we modified the "action slot" and the "logic slot" of each MLM rule that generates a PSF question to include the Spanish version of the question text and to substitute any dynamic variables with correct language for gender.

Third, since there were now two copies of the questionnaire text – one for English and one for Spanish, we changed the CHICA database schema to accommodate an extra copy of the text when producing the ATD for the pre-screener form (PSF).

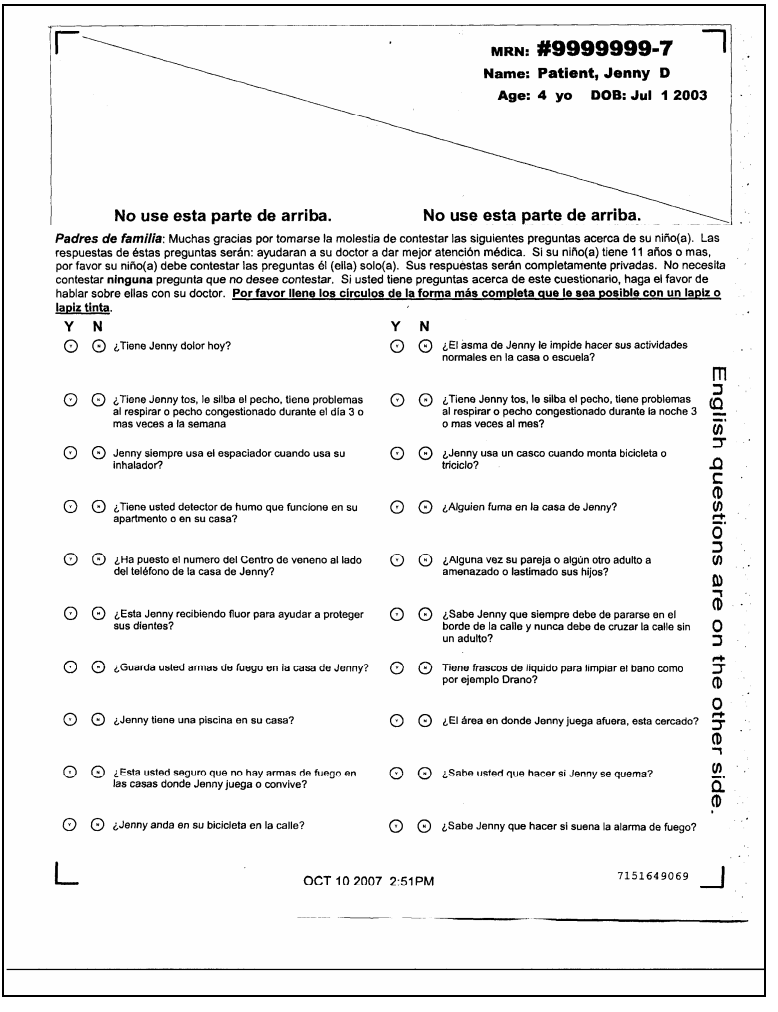
Finally, to print the forms dual sided, we installed duplex printers in the clinic location. With dual sided forms, the patient or the family can choose to answer either

language side at a given visit. An algorithm was developed to evaluate responses from either side of PSF when it gets scanned. This algorithm records responses from the side that has the largest number of questions marked. In case of ties between the sides, it takes the responses from the English side.



(a)

Fig. 4. (a) PSF in English. (b) Spanish Side of PSF.



(b)

Fig. 4. (*continued*)

Translation. For the content of the PSF questionnaire, we translated the English questions in the CHICA knowledge base into Spanish (example Figure 4b), using the services of native Spanish speakers. This process required a few iterations as some medical words in the English language were ambiguous in Spanish and required context information. At the end of this process, we went through reverse translation, where a Spanish version of the question was translated to English, independently, by a second native speaker and a bilingual physician. This validated our translation for an ethnically diverse Spanish speaking population. A total of 176 PSF rules were translated into Spanish in our system.

We measured the PSF response rates at various points in time between Nov. 4th 2004 (system deployment date) and 4 months before and after the implementation of Spanish interface (July 28th 2005). In April 2006, we started recording actual language choice for each question on the PSF, when the PSF is scanned in the system and the question is answered.

Results. When we look at a 4 month time period before deploying the Spanish interface (July 28, 2005); of those PSF that were scanned, only 51% had a response on the questionnaire. In the same time period after deployment, the response rate increased to 87%, an improvement of 36%, when Spanish language was provided as a choice (Table 2).

Table 2. PSF Response rates 4 months before and after Spanish Language Choice deployed

Time Period	#PSF Printed	#PSF Scanned	#PSF Answered (At least 1 question answered)
Before Spanish Interface	5652	4697 (83%)	2374 (51%)
After Spanish Interface	6227	5306 (85%)	4621 (87%)

When we looked at the time period since we started measuring language choice for each question answered (April 2006) and now, the response rate has been steady at 83% (Table 3). Of those answered, 74% of the questions were answered in English and 26% were answered in Spanish.

Table 3. PSF Response rates

#PSF Printed	#PSF Scanned	#PSF Answered (At least 1 question answered)	
45,537	36,606 (80%)	30,517 (83%)	
		English	Spanish
		22,605 (74%)	7912 (26%)

Since April 2006, we also have been able to link language choice with patients' demographics. The race/ethnicity distribution in this cohort is 35% Hispanic and 65% other (Table 1). If we measure patients' language choice in this cohort (n = 10234), 79% chose to respond in English and 21% in Spanish (Table 4), suggesting that 14% of Hispanic families may be responding to our questionnaire in English. We also found that 3% of patients switched to Spanish from English, and 2% switched to English from Spanish when compared to their first visit since we deployed Spanish interface (Table 4).

Table 4. Patients' language choice

#Patients	Language Choice English	Language Choice Spanish	Language Change (1st -> Last visit) (English to Spanish)	Language Change (1st -> Last visit) (Spanish to English)
10,234	8090 (79%)	2144 (21%)	340 (3%)	245 (2%)

Finally, our results also show that Spanish speaking families respond to the PSF questionnaire 36% more (85% vs. 49%) than other families (Table 5).

Table 5. PSF Response rate by preferred language

Questions	English	Spanish
Asked	52,5164	14,9412
Answered	25,9055 (49%)	12,7018 (85%)

5 Discussion

We believe that implementing the Spanish version of the interface has essentially removed the language barrier for Spanish speaking patient families in our clinic without altering the workflow processes. We think it provides an added value for non-Spanish speaking physicians and clinic staff by providing patient answers to the question regardless of the patient's preferred language. Since deployment of the Spanish version, the response rate to the PSF has improved considerably, thus informing the physician encounters to better address the patient's needs for the visit and therefore enhancing the care process [14-16]. We also believe that higher response rates to PSF questionnaires in Spanish indicate that the needs of the Spanish speaking families to communicate with their care givers in our clinic has been adequately addressed with this solution. Finally, we believe that our methods can be generically applied to most questionnaires where language may be a barrier.

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