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# Leveraging Oracle APEX to Develop a Multilingual Application for COVID Vaccination Scheduling and Administration Engine (VASE)

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## Abstract

In recent years, the demand for multilingual applications has surged as organizations strive to meet the needs of increasingly diverse user populations. The Oracle Application Express (APEX) is a powerful low-code development platform that offers an array of unique and comprehensive built-in globalization features designed to ease the creation of multilingual applications. This paper describes the development of a multilingual application using APEX for scheduling and administering vaccination. This application serves as an integrated solution aimed at streamlining the COVID-19 vaccination campaign by the State of Virginia Department of Health during the pandemic. This study underscores the importance of precise and accurate language in healthcare applications, where clear communication can significantly impact patient outcomes and accessibility. The substantial benefits of using the APEX platform compared to generic translation tools, such as Google Translate, in the context of this application are highlighted in this paper.Furthermore, several potential enhancements that can be incorporated into the application are discussed.

Keywords: COVID, Epidemic, Globalization, Google Translate, Healthcare, Localization, Multilingual Applications, Oracle APEX, Pandemic, Translation, Vaccination Administration, Vaccine scheduling

# I. INTRODUCTION

### A. BACKGROUND

On March 11, 2020, the WHO declared COVID-19 a pandemic after the Severe Acute Respiratory Syndrome Coronavirus or SARS-CoV-1 spread to more than 114 countries [1]. On March 13, 2020, the US government declared a nationwide emergency due to the pandemic [1]. To minimize the devastating effects of the outbreak, authorities had to establish safe testing sites, implement effective tracking strategies, and conduct large-scale vaccination campaigns. It is also essential to improve data tracking and recording systems and launch educational initiatives that raise public awareness about the importance of



vaccines. Vaccination is believed to be the safest approach to achieve herd immunity against this virus [2]. Approximately 60-70% of the entire population must be vaccinated to achieve herd immunity [3], [4].

It is the first pandemic in history where technology has been leveraged on a massive scale in an effort to keep people safe, informed, and productive [5]. As communities faced unprecedented challenges, various healthcare applications to facilitate multiple operations to fight the pandemic, like COVID testing scheduling, vaccination appointment scheduling systems, vaccine administration platforms, immunization information repository systems, and Electronic Health Records (EHR), emerged as vital instruments for orchestrating large-scale testing, tracking, and vaccination initiatives globally.

However, there was much misinformation and negative coverage about the vaccination campaigns and efficacy of the vaccines themselves, although emergency use authorization (EUA) was provided by the Center for Disease Control (CDC). Vaccine hesitancy and delay in acceptance pose an unprecedented challenge for concerned authorities [6]. Therefore, it is imperative for both federal and state government authorities to create awareness and ensure effective communication with accurate information for the entire population.

### **B. REQUIREMENT FOR MULTILINGUAL SUPPORT**

COVID-19 has also highlighted the critical need for multilingual applications with clear, accurate, and accessible communication within various healthcare applications, especially when addressing populations from diverse linguistic and cultural backgrounds. These barriers can profoundly and seriously impact the overall vaccination rate. These barriers can result in missed appointments, where patients may not fully understand the scheduling process, leading to significant delays in receiving necessary medical attention. Furthermore, critical instructions can be easilymisunderstood by putting patients at risk. For instance, a patient might incorrectly fill out a questionnaire designed to gather vital information about their current health condition, medical history, and vaccination history, or they may misinterpret consent forms stipulated by regulatory agencies such as the CDC.

To address these challenges, multilingual functionality becomes indispensable to ensure that all individuals can access accurate information and support regardless of their language or cultural background. Multilingual functionality is essential in multicultural nations like the United States of America (USA), where a rich tapestry of languages and cultures coexists. By breaking down language barriers, essential information can be ensured to reach all citizens, empowering them to make informed decisions during times of great uncertainty and fear.

By providing information in multiple languages, this application ensures that users clearly understand how to navigate the vaccination process, including when, where, and how to receive their vaccinations. This clarity is essential for promoting public health and ensuring that all community members have equal access to the vaccines. By localizing and accurately translating such critical information, healthcare staff at vaccination centers can greatly enhance accessibility and usability for non-native speakers, ultimately fostering a more inclusive and safer environment and achieving herd immunity.

### C. ORACLE APEX

Oracle Application Express (APEX) is a robust, cloud-based, low-code development platform designed to empower users to swiftly and efficiently create secure, scalable applications. Recognized as the world's most popular low-code application platform [7], APEX streamlines the development process, allowing for the rapid deployment of robust and complex software solutions. Its seamless integration with the Oracle



database further enhances its capabilities, making it well-suited for constructing sophisticated database applications.

APEX provides an extensive and feature-rich declarative framework complemented by robust libraries that enable developers to craft exceptional applications easily. By simplifying the coding process, APEX allows developers to shift their focus toward the core aspects of application logic and functionality. This means that they can prioritize user experience and design, avoid the distractions of intricate technical requirements and enable them to deliver innovative solutions efficiently.

Another standout feature of APEX is its comprehensive support for its application in globalization. This key component allows developers to create multilingual applications that can support more than 100 languages. By facilitating translations and localization, APEX addresses various cultural, regional, and linguistic nuances, ensuring that applications can effectively cater to diverse audiences around the globe. This capability not only enhances the user experience but also broadens the reach and impact of applications developed on the platform.

#### D. GOOGLE TRANSLATE

Among the various translation engines available, Google Translate (GT) is the most popular and is widely used worldwide. This application utilizes AI technologies, specifically neural networks, to translate languages in real time. Key features of Google Translate include text-to-text translation, speech-to-text translation, handwritten recognition and translation, and text recognition and translation [8].

Google Translate is powered by Google Neural Machine Translation (GNMT), which translates entire sentences rather than individual words. GNMT aims to determine the most appropriate translation for the whole sentence, and then rephrase it to sound more natural, as if a human was speaking [9].

### **II. SELECTION OF APEX PLATFORM**

Developing a multilingual application is a complex task that requires consideration of both the technical and contextual requirements. The application can be translated by client-side implementations, server-side implementations, or both. Each method has a unique set of features, potential benefits and applications. While client-side translations allow the flexibility of content translation in real-time by leveraging internal or third-party APIs, server-side translation allows deeper customizations with greater control over the nuances of the language and its contextual meaning. Several factors, such as the diversity of possible application users, criticality of the application, context of the app usage, sensitivity of the content, and legal implications, if any, involve considering a more appropriate translation method. [10].

APEX globalization features provide server-side translations and more options for localization. APEX stores all relevant translated data within its database, enhancing data integrity, privacy, and security. Globalization components allow for more customizations and flexibility, allowing developers to set up metadata for more precise translations within the application context. Apart from translations, localization is another crucial aspect, allowing the application to align with the local and unique nuances of the language and to reflect on and respect the legal standards of the country or region where the application is being used. This results in a more inclusive and user-friendly experience. However, this cannot be achieved in real-time, and although it is less, itrequires some time.

Google Translate, a client-side architecture powered by GNMT, allows real-time translation of the application page. It will enable users to switch to another language by simply using browser (Chrome) options for one of the many supported languages. The capability of sentence-based translation significantly improves the translation accuracy [11]. However, the accuracy of translation can vary when using Google



Translate for different language pairs. In a 2010 accuracy assessment study, translation accuracy was determined to be poor among Asian languages such as Hindi, Vietnamese and certain Eastern European languages but good among common European languages such as French, Swedish and Italian. [12]

Finally, the Oracle APEX platform was considered for globalization of the application because of the following considerations:

- The application should be publicly accessible and be used by all residents of the state from diverse backgrounds.
- It should be HIPAA compliant to, ensure data security and patient privacy across all languages.
- It should comply with CDC and other regional guidelines.
- A readily available language switcher component should be available when accessing an application through any device or browser.
- To avoid legal challenges, it is critical to have an accurate translation of the health questionnaire and consent form within the application for a given language.

A few other benefits of using Oracle APEX globalization have also been discovered and are illustrated in the Discussion section of this paper.

# **III. GLOBALIZATION USING APEX**

According to Francis Mignault, globalization in a web application has two significant aspects: translation and localization. Translation allows the application to be switched to different languages without duplicating the logic. Localization display the application content in accordance with the location of the end user [13].

Translations: Translations in APEX are based on the concept of shadow applications. After the principal (primary) application is developed, a copy of the application is saved in metadata for every language added to the application [14].

The following are different steps involved when translating the application:

- Configuring the globalization attributes.
- Mapping the primary application ID with the translated (shadow) application ID for each added language.
- Seeding the translated text to the translation repository.
- Translating static texts, dynamic texts, and programmatic texts in the application.
- Publishing the applications after translations.

Configuring globalization attributes: The very first step of globalization is to configure globalization attributes such as date, datetime, timestamp, and timestamp timezoneformats for the applications as shown in Fig. 1.In addition, character value comparison behavior can be defaulted to Database Session NLS settings in the globalization section of the shared components.



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Globalization			
Application Primary Language	English (United States) (en-us) V		
Application Language Derived From	Application Primary Language		
Document Direction	Left-To-Right V 🕐		
Application Date Format	MM/DD/YYYY		
Application Date Time Format	мм/DD/үүүү нным рм		
Application Timestamp Format	MM/DD/YYYY HH:MI:SS PM		
Application Timestamp Time Zone Format	MM/DD/YYYY HH24:MISS TZR		
Character Value Comparison			
Character Value Comparison Behavior	Database session NLS setting (default) ~		
Automatic Time Zone	0		
Automatic CSV Encoding	0		

#### **FIGURE 1.** Configuration of globalization attributes.

Adding more application languages: All languages to which the application can be translated must be added to the Define Application Language section. A unique translation application ID must be specified for each language, as shown in Fig. 2. These IDs are mapped with the primary application for the corresponding language to generate an application with translated data. An appropriate Document Direction (Left-To-Right, Right-To-Left) must be selected for a given language. As many mappings as required can be created for each language the primary language can be translated into [13].

Crea	ate/Edit Applicati	on Language Mappir	ng			
To perform a translation, you create application ID. Note that when an ap	a unique application ID for the translated aplication mapping is deleted, any corresp	application. Use this page to map an existing ap bonding translated applications are also deleted.				
	Application S3S VASE 💿					
		112 (0)				
Langange Avabic (nr) 🗸 🕥 Bazilian Kritugueni, Othone (Dirou, Childone (Dalout, English, Freech, German, Italian, Juparene, Konan, Spanish						
	t Direction Right To Left 🗸 🗸					
<ul> <li>Application Language Mappin</li> </ul>	181					
Primary Application	Translated Application	Language	Image Directory			
		Spanish (Traditional Sort) (es)				
		Arabic (ar)	Activate V			

#### FIGURE 2. Adding languages and mapping.

Seeding the translated text: The APEX database schema (APEX\_240100 for the latest version) comprises of a set of tables used for translations, which is called as a translation repository [13]. Once the languages have been added and mapped, all metadata of the primary language must be seeded into the translatory repository, as shown in Fig. 3 [15]. The seeding process extracts all the translatable content of the primary application and populates it in the translation repository.



**FIGURE 3.** Seeding translation applications.



Translating Text: Once translation repository has been seeded, the translated values can be updated either by using the option to download, translate, and upload the XLIFF files or by manually updating the records in the repository. The APEX platform provides an option to translate platform-specific strings, text added through dynamic actions, javaScript functions, etc., and even the data that will be rendered in various components such as lists of values, interactive reports, and any dynamic regions in the page using multiple translation utilities in the translated section in shared components as shown in Fig. 4 [16], [17].

Transla	ation Utilities
	Text Messages Create and manage text messages.
	Dynamic Translations Manage dynamic translation repository.
	Translation Repository Manually edit translated text in the translation repository.

# FIGURE 4. Translation Utilities in APEX App builder shared components.

Publishing the applications: After all the translatable text has been updated in the translation repository, the application must be published, as shown in Fig. 5. The publishing process creates a translated version by combining the metadata of the primary application with the translated text from the repository [7]. Every time the primary application is modified, the seeding and publishing process must be repeated for the modified changes to be reflected in the translated application [15].



# **FIGURE 5.** Publishing translation applications.

Language Switcher: Fig. 6 shows another vital component of globalization in the APEX platform is the addition of a language switcher component in the application, allowing users to easily change the application's current language preference. APEX switches to the corresponding application internally based on the selected language. While rendering the page, the metadata for the primary application page are retrieved, and the corresponding content is dynamically switched with the translated data.



# **FIGURE 6.** Language Switcher component added to the right corner of the application title banner.

Localization: Developers can further localize the application based on the geolocation of the end user and the selected language to update the globalization attributes such as date, datetime, and timestamp formats and to handle the nuances of the local culture, language, and legal considerations.

By harnessing these excellent globalization features, a comprehensive multilingual vaccination schedule and administration application has been meticulously designed to meet the needs of all residents of Virginia. This innovative tool is mainly aimed at serving diverse communities, with particular attention given to the Hispanic and Arab populations. This ensures that language barriers are minimized, allowing



individuals from various backgrounds to navigate easily, including answering the sensitive health questionnaire and providing consent in the vaccination scheduling and administration process during the pandemic.

## **IV. DISCUSSION**

In addition to the benefits of APEX globalization and the probable shortfalls discussed in the second section of this paper, that is, the Selection of the APEX platform, a few other observations have been made when comparing APEX with Google Translate after the development and globalization of the application. This section presents the following observations.

1) APEX translation utilizes only the texts found in the translation repository. If a translation was not available in the repository or metadata, the original text was displayed. Consequently, only the metadata are translated as needed, whereas any data entered by end-users in forms, reports, and similar outputs remains untranslated. This approach complies with the established requirements. However, Google Translate dynamically translates everything rendered within the page, including the data entered by the end-user or rendered from the database. This scenario may have a significant impact, especially when verifying the patient's vaccination history, insurance details, and so on.

Registrant Information			tat 🖉
fint Name	Lad Norre	fmai Addres.	Phane Namber
CHRIS	WHITE		(123) 412-3412
Dute of Brth	Race	Ethnicity	Gerder
01/01/2020	White	Hispanic or Latino	Male
House No, Street Address, P.D. Box	Apt/Subs/Floor	70 Code	Giy
100 MAIN ST		23221	RICHMOND VA

**FIGURE 7.** Registrant Information in English.

Información del solicitante			Modificer (2
Nontre	Apellida	Correo Biectrónico	Nièmero de Telifono
CHRIS	WHITE		(123) 412-3412
Fecha de Nacimiento	Rusa	Origen Etnico	Género
01/01/2000	Blanco	Hispano/Latino	Masculino
Neo de Gasa, Callo, Gasilia de Cerrero	AptopSailogFino	Citiligo Postal	Gudel
100 MAIN ST		23221	RICHMOND VA

FIGURE 8. Registrant Information in Spanish with APEX translation.

Información del registrante			LOTAT [2]
Nombre de olla	/gelido	Dirección de correo electrónico	Numero de teléfono
Cristóbal	BLANCO		(123) 412-3412
Fedha de nacimiento	Carrera	Enricidad	Género
01/01/2000	Blanco	Hispano o latino	Masculino
Número de casa, dirección de la calle, apartado postal	Apto/SultyPap	Codigo postal	Ciutad
100 calle principal		23221	Richmond, Virginia

FIGURE 9. Registrant Information in Spanish with Google Translate.

Fig. 7 is a section of the page in the primary application that shows the registrants' details in English. Fig. 8 illustrates the same section when Spanish was selected from the language switcher on the page for APEX translation. Fig. 9 shows the same section translated into Spanish using Google Translate. It is worth noting that even the first and last names of registrants have been translated, irrespective of the application's context.

2) The document direction will be updated based on the selected language attributes and mapping in APEX translation. This option is not available in Google Translate.



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FIGURE 10. Health Questionnaire in English

1090 <b>(</b> )				ت	<ul> <li>محرك جدولة مواعيد اللقاحا</li> </ul>
<ul> <li>الدودة للذلف</li> <li>مقط ومتابه</li> </ul>					
ن کید اموند	ن مراجعة التقاميل	© المواغيد المتادة	© الموافقة على الحمات	النتيان حول الصحة	معلومات الشمول
412-3412 (123)	رقم اوت	، متوان الدرية الإلكترواني	WHITE	امبر اعانا	CHRIS الأولى CHRIS
	Shady Grove	Site - Open Pod Clinic for COVID and Fi	LU Vaccinations at Shady Grove on 11/	12/2024 at 11399 Nucleois Road Gle	n Allen VA 23059 Subal
					باد حول الصحة
نعم ≋لا ⊂لا أعرف	جيلاتين الأرجيتين) أو تجاه جرعة	(البيض أو بروتين البيض، المتتاميسين، ال	بة شديدة تجاه اللغاح أو أي من مكوناته (	سيتلقى اللقاح من ردود فعل تحسس	هل سوق أن عاني الشخص الذي بابقة من أي لقاح للإنظونزا؟
نعم ≢لا ⊂لا أعرف 0 نعم ≋لا ⊂لا أغرف	مبلاتين، الأرميتين) أو تماه مرعة	(البيض أو بروتين البيض، المتتاميسين، ا	بة شديدة تماه اللغاح أو أي من مكوناته ( ي	سيتلقى اللغاج من ردود فعل تحسس ى اللغاج بمثلازمة غيلان ياريه من قبل	ا هل سور أن عاني العضمي الذي بابقة من أي لقاح للإنفلونزا؟ • هل أصرب الشخص الذي سيتلة

**FIGURE 11.** Health Questionnaire in Arabic with APEX translation.

				English Arabic	
+VASE محرك جدولة مواعيد لقاح				Geogle Translate	🕀 DAU 🗸
					🔶 al> 🛛 daytay bis 🔶
0	•				
مطوبات المسحل	استبيان الصحة	الموافقة على الخدمات	مواغيد المواغيد	تناصيل المرادعة	تأكيد الموعد
کریس الاسر الول ۱۹۰۰ - Shady Grove - مالی	م القالين 1004 - مقال أوسط القالين COVID :	اليض - اليض - اليض - Shady Grove 11399 - ب - 11/12/20	عنوان البريد الأكبوني Nuckols Read Gien Allen W	رغم الليغون 4 23059	(123) 412-3412
استبيان الصحة					
ن، الجيلاتين، الأرجينين) أو تحاه جرعة * سابقة من أي لقاح ضد الإنتلونزا؟	ض أو بروتين البيض، الجنتاميسير	ية شديدة نجاه اللقاح أو أي من مكوناته (الي	بيمه أن عانى من ردود فعل تحسسيا	هل سبق للشخص الذي سيتم تطه	لا اعرف ○ لا 🛎 نعم ○
يمه أن أصيب بمثلازمة غيلان باريه؟ •	ل سبق للشخص الذي سيتم تطع	ъ			لا اعرف⊂ لا® تعم⊂
					🔶 calas — Angling Mais 🔶

FIGURE 12. Health Questionnaire in Arabic with Google Translate.

Fig. 10 shows a section of the primary application of the Health Questionnaire. Fig. 11 shows the same section when Arabic is selected in the language switcher for the APEX translation. It is evident that the entire layout of the application has changed to a "Right-To-Left" direction, which is appropriate for the Arabic language. In contrast, Fig. 12 illustrates the same section translated into Arabic using Google Translate. Although the text has been translated, the page layout remains in a "Left-To-Right" direction, which is not user-friendly.

3) For APEX translation, the preferred language must be set only once, and this language remains consistent across all pages within a given session. In contrast, Google Translate requires the user to translate the page each time they navigate to a new page; this preference is not retained.



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**FIGURE 13.** Registrant Information in Spanish with APEX translation.

· Motor de Programación	n para Citas de Vacunación				🕀 Lingui
				🔶 Reg	nesar Guardar y Continuae
0	•	•		0	•
Información del solicitante	Cuestionario de Salud	Consentimiento para los servicios	Citas Disponibles	Roxkar is información	Confirmar la cita
Nonine CHRIS	Ap-Sid	· WHITE	Correo Restrónico	Número de E Teléfono	123) 412-3412
Once Shady Grove Site	- Open Pod Clinic for COVID and FL	U Vaccinations at Shady Grove on 11/12/	2024 at 11399 Nuckols Road Glen	Allen VA 23059	
Oince Shady Grove Site	- Open Pod Clinic for COVID and Fi	JJ Vaccinations at Shady Grove on 11/12/	2024 at 11399 Nuckols Road Glen /	Nilen VA 23059	
Otro: Shady Grove Site stionario de Salud "¿La persona que se va a vaci entamicina, gelatina, arginina	- Open Pod Clinic for COVID and FL inar ha experimentado alguna ve ) o a una dosis antesior de cualqu	U Vaccinations at Shady Grove on 11/12/ creacciones alérgicas graves a la vacur en vacuna contra la grape?	2024 at 11399 Nucleols Road Glen / a o a alguno de sus componenti	Nen VA 23059 es ĝivevos o proteina de huevo, 🔗	Sĩ ♥ No ○ No sé
Omo: Shady Grove Site stionarto de Salud * ¿La persona que se va a vaco enternicina, golatina, arginina * ¿La persona que se va a vaco	- Open Pod Clinic for COVID and FL unar ha experimentado alguna ve j o a una closis anterior de cualqu unar ha tenido alguna vez del sinc	U Vacinations at Shady Grove on 11/12/ creacciones alérgicas graves a la vacur en vacuna contra la gripo? frome de Guillain Barré?	2024 at 11399 Nuckols Road Glen / ao a alguno de sus component	Nien VA 23059 es Orwevos o proteina de huevo, O	šî ≢ No ○ Nosé Si ≢ No ○ Nosé

FIGURE 14. Health Questionnaire in Spanish with APEX translation.

				English Spanis	
or de programación de cita	s para vacunas VASE+			Georgie Translate	
					🔶 /trás 🛛 Guardar y continu
•	•	•		0	
Información del registrante	Cuestionario de salud	Consentiniento para servicios	Rianjas horarias para ditas	Detalles de la revisión	Confirmar cita
Northre de pila <b>Cristóbal</b>	Apoli	ico BLANCO	Dirección de correo electrónico	Naime Taki	o de (123) 412-3412 Iono
Norriere de pile <b>Cristóbal</b> Classe <b>Sitio de Shady Gr</b>	Aprili ave: clínica de cápsulas abiertas pr	ico BLANCO ara vacunas contra la COVID y la gripe -	Discolón de correo siectórico en Shady Geove el 12/11/2024 en 113	Núno 148 99 Nuckols Road Glen Allen VA 23	n de (123) 412-3412 Iono 059 (citas disponibles: 88)
Nantare de pila Cristóbal China Sitie de Shady Gr ormación del registrante	Aprili	BLANCO     BLANCO     BLANCO     Secondaria la COVID y la gripe	Direction de correco skototoco en Shady Grove el 12/11/2024 en 113	Nona Isii 99 Nuckols Road Glen Allen VA 23	odr. (123) 412-3412 Ison 059 (citas disposibles: 08)
Nontare de pla Cristolitad Clinica Sitia de Shady Gri ormación del registrante ordeo de pla	Accele pres: clínica de cápoulas abiertas po	ELANCO ees vacumas contra la COVID y la gripe - Agnitic Within	Disculón de carreco ekontenero en Shady Geore el 12/11/2024 en 113	Vena Isl 99 Nuckels Road Gien Allen VA 23 Venta de sammers	u dz. (123) 412-3412 loso 059 (citas disposibles: 88)
Nontare de pla Cristolitad Crisso Sitia de Stady Gr ormación del registrante ordes de pla HRS	Accele pove: clínica de cápoulas abiertas po	ELANCO Rear vecanas contra la COVID y la gripe o forma della seguina d	Direction de cremo decorreco en Shady Grove el 12/11/2024 en 113	Norma and 99 Nuckels Road Gien Allen VA 23 Fecto de normanis 01/07/2000 Camera*	o.dc. (123) 412-3412 lono 5559 (citas dispositifee: 88)
Nontrocopia Cristolad troca Sitis de Standy Gra crimación del registrainte antro apida Massaline Massaline	4,:11	ELANCO Wa visuala contra la COVID y la gripe functo: Wittis Emicidia" Plante a latino Hispana e latino	Dección de creero decorreco en Shady Grove el 12/11/2024 en 113	Maren International Cleve Allen VA 23 PS Nackols Reservants Science 200 Carrent <sup>a</sup> Maria	wie (123) 412-3412 kozo 559 (obtas disposibiles: 68) esiliteo
Nontrocopia Cristolad troca State de Shady Gro contraction dell'orgisterante anton capita anton capita Mascoline Farmanico Coto	Accili	iai BLANCO was vacanas contra la COMD y la gripe was internas contra la COMD y la gripe "Mettina "Mettina "Mettina "Mettina "Mettina "Mettina "Mettina "Mettina "Mettina "Mettina" "Mettina "Mettina" "Mettina"	Descale de como electorio un Shedy Grove el 12/11/2024 en 113	P Nackola Road Gien Allen VA 23 P Nackola Road Gien Allen VA 23 P Nackola Road Gien Allen VA 23 P Nackola Gieneralizatione o nativo de Nacio Nac	etic (123) 412-3412 hori 599 (chao disposibles 63) (asilito asilito (asilito)





# FIGURE 16. Health Questionnaire (next page) switching back to English.

Fig. 13 shows the first page, Registrant Information, which was translated into Spanish. Fig. 14 illustrates the subsequent page, Health Questionnaire, in the appointment scheduling process, clearly indicating that the page has been rendered in Spanish without needing to reselect the language, as it is set as the preferred language for the session. By contrast, Fig. 15 shows the first page of the app after



manually selecting Spanish using Google Translate. However, Fig. 16 shows the next page, which was rendered in English instead of the previously selected Spanish. Users of the application

4) The language switcher component is located in the app title section and function independently of the device or the browser. While Google Translate is available by default in the Chrome browser, users must install an extension to access it in other browsers such as Microsoft Edge or Safari.



FIGURE 17. Language switcher component in Google chrome.



FIGURE 18. Language switcher component in Microsoft edge.

			·	Back Save a	and Continue 🕇
	•	•	•	•	•
Registrant Information	Health Questionnaire	Consent For Services	Appointment Slots	Review Details	Confirm Appointment
Clinic Shady	Grove Site - Ope	n Pod Clinic for C	OVID and FLU	/accinations at Sha	ady Grove on

FIGURE 19. Language switcher component in Apple safari.

ASE+ Vaccine App	ointe	ment Scheduling Engin	e				🌐 Languages
							Back     Serve and Continue
•		Back	Alt-Left Arrow			0	0
Registrary Inform		forward	Alt+Tight Arrow	Consent For Services	Appointment Slots	Review Details	Centirm Appointment
		Reload	Ctri+R				
		Save and	Chi+S				
Cirik Sh		Piet.	CMI+P	ccinations at Shady Grove on 11/	12/2024 at 11399 Nuckels Read Glen Al	len VA 23059 (Available Appointme	nts - 88)
		Cast.					
egistrant Informat	(3)	Search with Google Lons					
		Open in reading mode					
Hist Name	Ħ	Create QR Code for this page		Last Name		Dute of Ekth	Ð
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FIGURE 20. Google Translate option in Google chrome browser.

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FIGURE 21. Google Translate option missing in Microsoft Edge browser (by default).



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FIGURE 22. Google Translate option missing in Apple safari browser (by default).

Fig. 17, 18, and 19 illustrate the availability of the language switcher component on Google Chrome, Microsoft Edge, and Safari, respectively. As shown in Fig. 20, the Google Translate option is available by default on the Chrome browser. By contrast, Microsoft Edge features its own translation option, as depicted in Fig. 21, and the same is true for Safari, as shown in Fig. 22. Microsoft Edge and Apple Safari have their own translation options. Without the installation of an extension, the Google Translate option would not be available for third-party browsers.

### **V. FUTURE WORK OUTLOOK**

While the feedback for the application has been overwhelmingly positive, there have been several requests from Local Health Departments to include more languages apart from Spanish and Arabic. Considering the demand for several other languages and the limitations of resources, it can be challenging to include translations within APEX for all the requested languages. However, it is recommended that the application be upgraded with the following changes to create an optimal solution.

Upgrade the application to a hybrid model with existing built-in translations for popular languages such as Spanish and Arabic and an optional integration feature to utilize the Google Translate API for other ondemand languages.

The language switcher displays a segregated list of application-defined languages and other languages supported by Google Translate. When an application-defined language is selected, the page should be rendered with translated metadata from the database, and when another language is selected, the Google Translate API can be invoked to translate the page to that language.

A disclaimer banner can be displayed dynamically at the top of the page. The disclaimer should effectively communicate with the user about any probable inaccurate accuracy and should be well drafted to legally protect the organization.

To expedite the process of adding a new language to the application of APEX globalization, that is, populating the metadata with translations for the new language, a translation workflow module can be developed in which professional translators have access to save the translated text for a given metadata text in a given language, which can be verified and approved by the application owners. Once the translated text repository has been approved, metadata can be saved programmatically in the APEX translatory repository for the newly added language.

#### **VI. CONCLUSION**

Google Translate, powered by GNMT, is renowned AI translator that adopts sentence-based translation. In general, translation algorithms produce meaningful translations but may miss nuances and may not be as accurate as the original message. However, it is real-time and can be free of rich resource requirements.



The built-in globalization features of the Oracle APEX provide superior accuracy and customization, which are crucial in the healthcare sector. The application can be translated and localized securely and precisely for better user experience. However, this is not a real-time solution and requires relatively more resources.

This paper highlights the strengths of APEX globalization compared to Google Translate for vaccine scheduling and administration applications, with various examples when translating to Spanish and Arabic languages. Unlike Google Translate, the Oracle APEX provides the control, accuracy, and data privacy necessary for healthcare applications, making it a suitable choice for developers building multilingual applications in regulated industries.

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