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Enabling clinicians to easily find location-based travel health recommendations—is innovation needed?

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Abstract

Background—The types of place names and the level of geographic detail that patients report to clinicians regarding their intended travel itineraries vary. The reported place names may not match those in published travel health recommendations, making traveler-specific recommendations potentially difficult and time-consuming to identify. Most published recommendations are at the country level; however, subnational recommendations exist when documented disease risk varies within a country, as for malaria and yellow fever. Knowing the types of place names reported during consultations would be valuable for developing more efficient ways of searching and identifying recommendations, hence we inventoried these descriptors and identified patterns in their usage.

Methods—The data analyzed were previously collected individual travel itineraries from pretravel consultations performed at Global TravEpiNet (GTEN) travel clinic sites. We selected a clinic-stratified random sample of records from 18 GTEN clinics that contained responses to an open-ended question describing itineraries. We extracted and classified place names into nine types and analyzed patterns relative to common travel-related demographic variables.

Results—From the 1756 itineraries sampled, 1570 (89%) included one or more place names, totaling 3366 place names. The frequency of different types of place names varied considerably:

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Author Contributions

R.R.L., A.W., C.L., R.L., E.R. and M.S. contributed to analytic design and data interpretation. R.R.L., A.W., C.L. and S.R. contributed to data analysis. R.R.L., A.W., C.L. and M.S. drafted the article and all authors read and commented on the final draft.

2119 (63%) populated place, 336 (10%) tourist destination, 283 (8%) physical geographic area, 206 (6%) vague subnational area, 163 (5%) state, 153 (5%) country, 48 (1%) county, 12 (1%) undefined.

Conclusions—The types of place names used by travelers to describe travel itineraries during pretravel consultations were often different from the ones referenced in travel health recommendations. This discrepancy means that clinicians must use additional maps, atlases or online search tools to cross-reference the place names given to the available recommendations. Developing new clinical tools that use geographic information systems technology would make it easier and faster for clinicians to find applicable recommendations for travelers.

Keywords

Travel itinerary; travel health recommendation; GIS technology; consultation; decision making; traveler

Background

The types of names used to describe travel destinations, or place names, and the level of geographic detail with which patients report their intended travel itineraries to clinicians, vary. Some patient itineraries may consist of a single country name; others may report the cities listed on their airline itinerary; and still others may report a detailed itinerary listing specific airports, cities, villages, hotel names and tourist destinations to be visited. When performing individual health risk assessments during pretravel consultations, clinicians must identify travel health risks and recommendations based on the place names in these patient-reported itineraries. One challenge clinicians face is that the patient-reported place names may not match those in published travel health recommendations, making traveler-specific recommendations potentially difficult and time-consuming for clinicians to identify and deliver. More facile and accurate location information could improve the accuracy of recommendations.

To process itinerary descriptions, clinicians usually use a travel medicine reference book or website.[1–5] Most published recommendations are at the country level; however, subnational recommendations (e.g. state name, city name) exist when documented disease risk varies within a country, as for malaria and yellow fever.[6] Clinicians need maps detailed enough to locate the travel destinations and described risk areas[7] and have been advised to acquire separate atlases, world maps, or globes to help with this process.[8] To address this need, the CDC Yellow Book has included some country-specific yellow fever and malaria maps enumerating a limited number of subnational places;[6,9] however, some users find the CDC maps difficult to use.[10]

It has been proposed that incorporating geographic information systems (GIS) technology into clinical decision-support tools could make identifying travel health risks and recommendations easier and faster.[11] Modern GIS-based technologies have been used to create a variety of free Internet-based mapping tools and services, which are rapidly replacing many reference maps and atlases. One of the most popular examples of this technology is Google Maps (Mountain View, CA), which combines a robust place name

search service with a detailed map, making it easy to find many types of places all over the world. Anecdotal reports suggest some clinicians regularly use these Internet search and map services to help them interpret travelers' itineraries, but little is known about how widely such tools have been adopted. An international study suggested that requiring clinicians to rely on their own ability to locate and interpret these numerous mapping resources remains overly burdensome.[12] Knowing the types of places that clinicians are searching for is a necessary first step to solving the recommendation look-up problem.

To better understand the geographic place names clinicians encounter when searching for travel health risk recommendations, we examined previously collected Global TravEpiNet (GTEN) data, which capture patient-reported travel itineraries during pretravel consultations at participating GTEN clinics. We analyzed these free-text itinerary data to classify the types of place names used to describe a traveler's itinerary during pretravel consultations. The second objective was to summarize types of place names in clinical encounters as compared to those used in CDC's travel health recommendations. If this comparison found place name types differ between clinical conversations and CDC recommendations, the final objective was to identify new uses for geospatial technology (e.g. place name search services and interactive maps) to assist clinicians in efficiently locating the necessary travel health information.

Data and Methods

Global TravEpiNet patient intake forms

Global TravEpiNet (GTEN) is a network of travel clinics from across the USA, comprising academic practices, healthcare consortia, health maintenance organizations, pharmacy-based clinics, private practices and public health clinics.[13] Each GTEN clinic uses a standard electronic form to collect demographic and health characteristics, intended travel itineraries, purposes of travel, and pretravel healthcare received on US residents planning international travel. Travelers typically complete the form online before their appointment, and clinicians confirm and may add details during the pretravel consultation. The form captures intended travel itineraries in two ways: (i) a mandatory question that asks users to select one or more places from a list of country names; and (ii) an optional, open-ended, free-text question that allows users to enter 'additional destination details'. Institutional review boards at all participating GTEN sites have reviewed and approved their participation in the GTEN consortium.

Records containing 'additional destination details' were eligible for inclusion in our analysis if submitted to the GTEN system during 12 January 2009–31 December 2016 from clinics with ≥50 such records. A clinic-stratified random sample of these records was taken to balance representation across all clinics and to accommodate the demands of the manual data processing performed. A final sample of records was assembled from two clinic groupings: (i) For clinics that submitted 50–100 eligible records, all eligible records were included in the analysis; and (ii) from each clinic that submitted >100 eligible records, exactly 100 randomly selected records were included.

Classifying Itinerary place names by type

The free-text responses to the ‘additional destination details’ questions were manually processed by two analysts (R. Lash and C. Lee). A Microsoft Access (Microsoft Office 2016, Redmond, WA) relational database with custom data entry forms was created to ensure accuracy and consistency during data processing. The data entry form enabled each analyst to read the free-text response for an individual patient’s itinerary, identify all the place names reported therein, and copy and paste each place name listed into a related place name table for subsequent classification. Free-text place names were classified into one of the following nine types: multi-national area, country, state, county, populated place, tourist destination, physical geographic area, vague subnational area or undefined (Table 1). Online mapping resources (e.g. Google Maps, CIA World Fact Book) were consulted to determine the place name type of any unfamiliar place names. The following assumptions were needed to handle the variation within the unstructured data:

1. Locations that are both populated places and administrative areas, such as Singapore and Hong Kong, were classified as the populated place type.
2. If a traveler provided a hierarchical place name list, such as ‘Cancun, Quintana Roo, Mexico,’ we interpreted that the traveler was visiting only one destination, ‘Cancun,’ and that the other place names were simply descriptors.
3. Country place names were not counted if they had already been reported in the GTEN form’s mandatory country list question.

Microsoft Access was used to generate summary statistics to descriptively analyze place name type variation across different GTEN clinics, as well as the demographic and travel characteristics of the travelers. Microsoft Excel (Microsoft Office 2016, Redmond, WA) was used to create data visualizations.

Results

There were 88 285 records submitted by 25 clinics to the GTEN system during the period of analysis; 35 119 (40%) records contained responses to the ‘additional destination details’ question. Eighteen (72%) of these 25 clinics submitted ≥50 eligible records; 15 of those clinics submitted >100 eligible records (contributing 1500 records to the analysis); and three clinics submitted 50–100 eligible records (contributing 256 records to the analysis), for a final sample size of 1756 records.

The demographic and travel characteristics of the sample were similar to those of all travelers in GTEN.[13] The majority of travel itineraries had durations from 1 day to 4 weeks, with two-thirds being between 8 and 28 days. The most common travel destinations were Africa, the Americas, Southeast Asia and the Western Pacific, with only a small proportion of travelers going to Europe or the Eastern Mediterranean. The most common reasons for travel were leisure (56%), followed by business (17%), and humanitarian service work (17%).

Of all the itineraries sampled, 1570 (89%) included one or more place names in the responses to the ‘additional destination details’ questions, totaling 3366 place names (Table

2). Table 2 shows the frequency of the different types of place names: 2119 (63%) populated place, 336 (10%) tourist destination, 283 (8%) physical geographic area, 206 (6%) vague subnational area, 163 (5%) state, 153 (5%) country and 48 (1%) county. Overall, these data show that the populated place name type (which included city, village or airport) was listed 6 times more often than the tourist destination and 10 times more often than state and country types.

We assessed whether the overall patterns described above occurred differentially at individual GTEN sites. The total numbers of place names reported per individual GTEN site ranged from 88 to 325. The proportion of each place name type per GTEN site indicated that the populated place name type comprised the largest proportion at each GTEN site, with a median value of 64% (range = 40–86%). This variation did not appear to correlate with any other known characteristics of the GTEN sites.

Figure 1 shows variation in the proportion of place name types across the four levels of travel duration, with populated place being dominant. However, as the duration of the itinerary increased beyond 28 days, the proportion of Populated Place decreased while the proportion of country and multi-national area Area types increased. It is important to note that these class sizes do not represent equal numbers of travelers; there were 204 travelers with itineraries lasting 1–7 days, 1156 travelers with itineraries lasting 8–28 days, 311 travelers with itineraries lasting 29–180 days, and only 85 travelers with itineraries lasting more than 180 days.

Discussion

We found that populated place was the most common way for patients to report intended travel itineraries in our analysis, except when the intended trip duration was ≥6 months. This means that there may often be a discrepancy between the place names travelers use to report their travel itineraries and those used by clinicians to identify travel health risks. This discrepancy likely occurs because most travelers report their intended travel itineraries as cities, towns or popular tourist destinations, while most risk assessments and recommendations are reported nationally. As a result, there is subjectivity in how clinicians match risks to their patients' itineraries and provide travel health recommendations. This subjectivity could be reduced with improved clinical information search tools.

Bauer and Puotinen[11] envisioned that GIS technology could be incorporated into travel medicine to provide improved clinical information search tools. Integrating this technology may increase the accuracy of clinical recommendations by allowing location-specific targeting for subnational recommendations such as malaria prophylaxis and yellow fever vaccination. A tool that incorporates GIS technology could enable travel health clinicians to quickly and easily search global GIS databases of travel-related diseases and disease risks by traveler destination. If such a tool were developed and inserted into existing reference platforms, we propose that it have four components:

1. Accurate, specific and up-to-date global health risk and recommendation databases.

2. Global place name search capabilities to locate a multitude of place name type descriptions.
3. A computer algorithm that can query the database and return location-specific information.
4. A user interface that displays this information in a format that clinicians can use and understand without needing to consult additional maps or resources.

The present analysis shows that there is a disconnect between the first and second components of an ideal tool and suggests that GIS-based place name search services could resolve part of this problem. Additionally, adoption of common GIS data standards, extensive user testing and systematic evaluation would be needed to ensure that clinicians' information needs were being met.

We believe that our analysis is the first of its kind in travel medicine, though analogous research has already been conducted in tourism and hospitality research with similar results. Hwang *et al.*[14] studied the phone call transcripts from an Illinois state tourism information call center to understand the way domestic travelers use location to search for travel information (e.g. tourist activities, hotels), an important question for informing how tourist destination websites are designed. Consistent with our analysis, the authors classified the place name types reported in travelers' queries as either the state, region within the state, county or city. They found that cities were the most frequent place name type used, with 83% of the single-destination searches and 75% of the multidestination searches using cities, while counties were the least common and states the second-least common name types. Similar research was done on a sample of Internet search queries to study travelers' accommodation searches. This study found that cities were again the most common type of place name used, and they were used four times more frequently than country and state names.[15] This tourism and hospitality research appears to corroborate our findings that travelers use city names to structure their travel itineraries.

Our analysis has some limitations. Because the 'additional destination detail' question on the GTEN form is optional and users are not given any specific instructions on what type of information to put in, little is known about why some forms contain more detailed destination information and others do not. Similarly, because both the patient and the clinician are able to enter information into the intake form, it is difficult to associate patterns in the data with the information-seeking behavior of either the patient or the clinician. An additional limitation is the specificity of existing travel recommendations. Due to variations in laboratory and surveillance capacity internationally, data are not available to define areas of subnational disease transmission.

We believe our analysis is a first step toward providing clinicians with the detailed and helpful information they need to provide more targeted travel health recommendations to their patients, based on the geographic travel locations their patients describe. The time-consuming process clinicians currently go through could be made less burdensome by developing GIS-based clinical decision-support tools that incorporates innovative and increasingly common GIS technology, such as travel health recommendations formatted as GIS databases, place name search services and interactive web maps.

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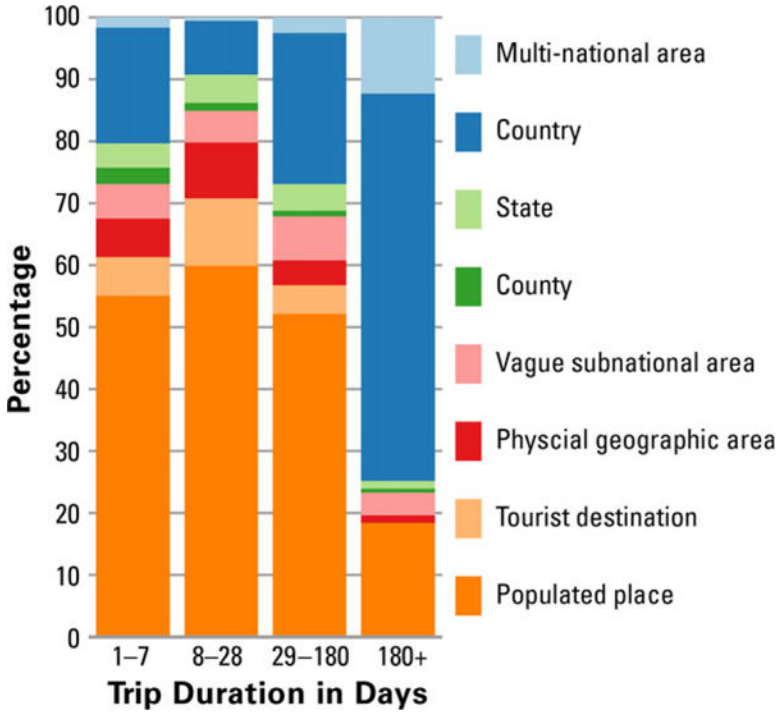

Figure 1.
Place name type variation by trip duration.

Table 1

Unique place names classified as one of nine types

Place name type	Definition	Example
Multi-national area	An area encompassing more than one country	South America
Country	A sovereign political entity found on GTEN country list	Brazil
State	A subnational first-order administrative region within a country or territory	Kwazulu-Natal
County	A subnational second-order administrative region within a country or territory, nested within a state or province	Kildare
Populated place	A city, village or airport	Cape Town
Tourist destination	Any specific park, resort or cultural heritage site	Angkor Wat
Physical geographic area	A mountain, mountain range, river, ocean or ecological zone	Andes Mountains
Vague subnational area	An area clearly within a country or territory but for which the location or boundaries are ill-defined and not clearly demarcated on any available map	Urban regions
Undefined	A named location which cannot be found in any of the online resources consulted	[place name not located as spelled]

After place names were extracted from the ‘additional destination details’ field, they were classified as one of the nine types of place names listed and defined above.

Table 2

Frequency of different place name types

Place name type	*N* (%)
Populated place	2119 (63)
Tourist destination	336 (10)
Physical geographic area	283 (8)
Vague subnational area	206 (6)
State	163 (5)
Country	142 (4)
Multi-national area	57 (2)
County	48 (1)
Undefined	12 (1)
Total place names	3366