Physician Directory: A challenge to measuring electronic health record adoption in a cohort of Connecticut physicians

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Physician Directory: A challenge to measuring electronic health record adoption in a cohort of Connecticut physician

ABSTRACT

Objective To assess the challenges posed by the existing physician directory in the measurement of electronic health record (EHR) adoption rates among a cohort of Connecticut physicians.

Design A population-based mailing was undertaken to assess the number of physicians practicing in Connecticut. This mailing used a list of licensed physicians in Connecticut.

Measurements Information about practice site, practices pertaining to storing of patient information, sources of revenue, and preferred method for receiving survey. Practice status in Connecticut, measured by yes and no. Demographic information was collected on gender, year of birth, race, and ethnicity.

Results The response rate for the postcard mailing was 16% (2,583/16,462). Of the 16,462 unduplicated consumers in our universe, 206 (1%) were retired and 4038 (25%) did not practice in CT. Of the 2,583 valid postcard responses we received, 1,786 were for physicians practicing in CT. Sixty (3%) of these responses did not specify a preferred method for receiving the full physician survey; 26 physicians refused to participate in the survey; 1,786 surveys were sent out using each physician's requested method for receiving the survey, i.e. web-based, regular mail, or telephone. As of February 2012, 785 physicians had returned surveys, resulting in a response rate of 44%.

Limitations The postcard response rate based on the unduplicated lists of 21% is low. We may be missing physician populations which could greatly affect the indicators being used to measure change in electronic health record adoption rates.

Conclusions It is difficult to obtain an accurate physician count of practicing physicians in Connecticut from the existing lists. States that are participating in the projects funded under various Office of the National Coordinator for Health Information Technology (ONC) initiatives must focus on getting an accurate count of the physicians practicing in their state, since their progress is being measured based on this key number.

INTRODUCTION

The influx of American Recovery and Reinvestment Act of 2009 (ARRA) funding through the implementation of the Health Information Technology for Economic and Clinical Health (HITECH) Act provides funds to small, privately-owned primary care practices, federally-qualified health centers, critical area access hospitals, and other community health centers to implement and adopt health information technologies. These technologies include electronic health records (EHRs), e-prescribing systems, and laboratory information systems. These funds were made available to all states through multiple initiatives, such as the Health Information Technology Extension Program, State Health Information Exchange (HIE) Cooperative Agreement Program, and Community College Consortia to Educate Health Information Technology Professionals Program. Much has been written about the

advantages of using HIEs and their resulting benefits to improving quality of care, patient safety, and efficiency of delivering care.(1-3)

BACKGROUND

The ONC has invested about $30 billion to implement the HITECH Act.(4-7) The Health Information Technology Extension Program provides each state with funds to increase its physicians' EHR adoption rate. Similarly, under the HIE program, states are expected to build infrastructure and mechanisms that support the exchange of health information among physicians' offices, hospitals, laboratories, pharmacies, registries, etc. The HIE initiative funds 56 Health Information Exchanges covering all states. One metric indicative of HIE success is the rate of change in the EHR adoption rate among physicians over the course of this four-year initiative. This metric is linked to another outcome measure: the number of physicians who successfully demonstrate the exchange of summary documents with another provider, the state, or a regional HIE. To this end, accurate data on practicing physicians by state are needed. Data sources that list practicing physicians in a state, however, are limited (8), since generating accurate lists of unduplicated physicians in a state is a labor-intensive activity. As a result, this indicator presents a challenge, since it assumes that there is an existing accurate list of the physician population that can be used to survey the physicians for EHR adoption rates. Establishing an accurate baseline list of physicians is important, since progress on many HIT indicators will be based upon the number of physicians that adopt and implement EHRs and other HIT practices. These physicians are eligible for incentives from the Centers for Medicare and Medicaid Services (CMS).(9) Currently, many states realize that their physicians' lists are inaccurate; this makes it difficult for them to calculate this basic measure of existing physicians that use certified EHRs.

In the first year of the HIE cooperative agreements, states have been working to establish a baseline for existing rates of EHR adoption. As part of this grant, ONC has established multiple communities of practice (CoP) targeting important performance outcome measures, including the e-prescribing CoP, the Lab CoP, provider directory CoP, and the Security and Privacy CoP. The "Provider Directory CoP" has been discussing the challenges associated with getting and subsequently maintaining an accurate list/directory of providers, which are related to the fact that physicians practice in multiple settings, change affiliations, and may not practice in all states in which they hold licenses.

In December 2010, the Centers for Disease Control and Prevention (CDC) released statewide results of EHR adoption rates, based on a mailed supplement to the National Ambulatory Medical Care Survey (NAMCS).(10) This supplement was started in 2008. The CDC study reports that 48% of office-based physicians use an EHR, 22% use a basic system, and 7% use a fully-functional EHR. These numbers are slightly higher than those reported in an earlier study; which reported 4% of the physicians as operating an extensive, fully-functional electronic system, while 13% had a basic system.(11)

Currently, these data are the only state-level estimates available that systematically record EHR adoption rates. There are, however, two limitations that impact the NAMCS data's applicability and usefulness. First, the supplement questionnaire does not ask the key question about whether or not the EHR in use is certified.(4) Second, the EHR adoption questions were asked at the practice level and not at the physician level. This distinction is important because the incentives which CMS is promoting are at the physician level and not at the practice level.

Connecticut Health Information Exchange Landscape The Health Information Technology Exchange of Connecticut (HITE-CT), a quasi-public agency, was created by the Public Act 10-117, "*An Act Concerning Revisions to Public Health Related Statutes and the Establishment of the Health Information Technology Exchange of Connecticut,"* Sec. 82-90,96 (codified at CGS §19a-750(c)(1)) (12), by the 2010 Connecticut General Assembly and Governor Rell. It is managed by an appointed Board of Directors who held their first meeting in October 2010 to coordinate and oversee Health Information Exchange (HIE) activities starting in January 1, 2011. Each board member represents a constituent stakeholder group, such as consumer or consumer advocates, primary care physicians, pharmacists, employer and/or business groups.

According to NAMCS estimates for Connecticut, 48% of office-based physicians use an EHR and 15% report having a basic EHR system (10), while another recent evaluation study puts this number at 36%.(13) This paper addresses the challenges of measuring the rate of EHR adoption among physicians on this list.

METHODS

Data The Connecticut Department of Public Health contracted with the University of Connecticut Health Center (UCHC) to evaluate its Health Information Technology and Exchange (HITE) Cooperative Agreement, funded by the Office of the National Coordinator (ONC). The contract period for this evaluation is 7/1/2010-

3/14/2014. This evaluation uses mixed methods, namely survey research and in-depth interviews. A family of surveys is being undertaken to measure CT-HITE's impact, such as physician EHR adoption rate, e-prescribing practices, laboratory readiness for interoperability and states ability to sustain this effort after the federal funds are expended. All studies were reviewed by the IRB at UCHC.

For the physician survey implementation, the evaluators received a list from the Department of Public Health (DPH), which issues licenses of practice to physicians, generated a list of 16,618 physicians in May 2011 and another list of 5,283 physicians from the Department of Social Services Medicaid physician list. No phone numbers or e-mail addresses were available on this list. These lists were combined and after removing duplicates the final list contained a cohort of 18,642 physicians.

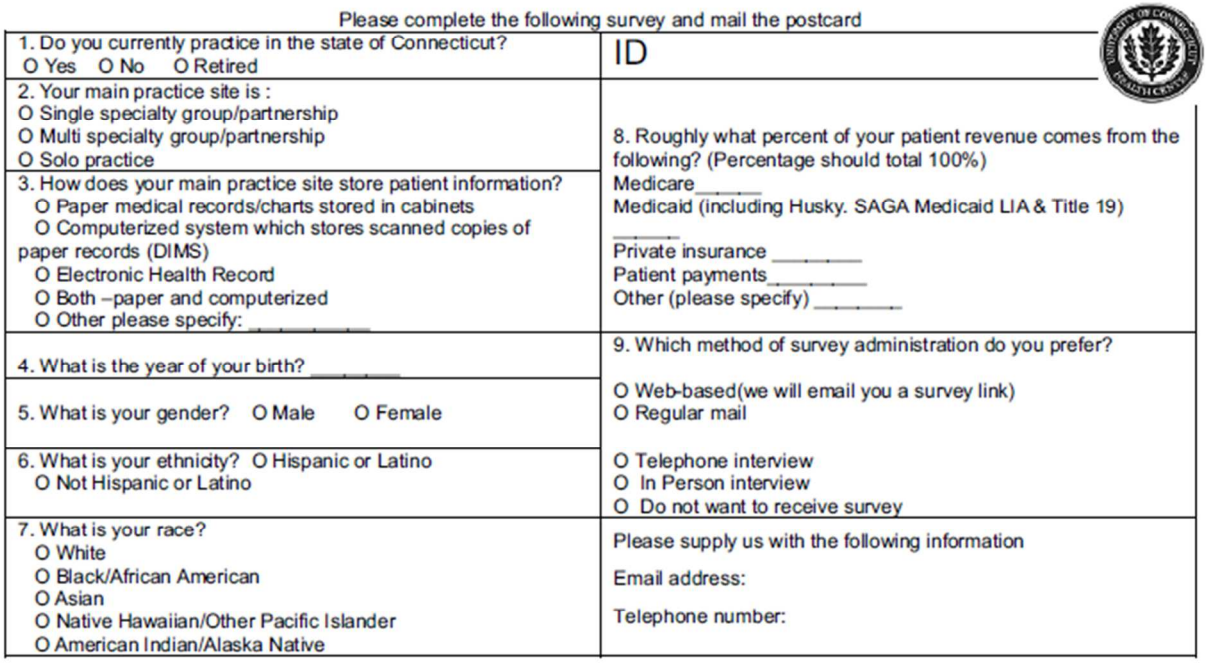
Members of the board of directors of HITE-CT believed that there were about 8,000 physicians actively practicing in Connecticut. Due to the discrepancy between the actual list and the number of physicians believed to be practicing in Connecticut, a two-step survey process was implemented to ascertain the list's accuracy. First, a postcard was mailed to all the physicians on the list. Second, surveys were mailed to physicians who responded to the postcard, to assess physicians use of EHRs; their opinions about their EHR's utility; their familiarity with HIE; and their opinions about barriers and incentives that may impact HIE implementation. This paper discusses the responses to the postcard.

Postcard Survey instrument The postcard asked 10 questions. These questions included whether the person practiced in Connecticut, age, race, ethnicity, gender, practice site, methods used to store medical record data, sources of patient revenue, and preferred methods for receiving the subsequent survey. Figure 1 contains a picture of the postcard.

Postcard Administration Every licensed physician who was on the list as of May 2011 was mailed a postcard through the US postal system. A total of 18,642 postcards was mailed.

Analysis Responses to the first mailing were analyzed using SQL and SPSS.

Figure 1: Postcard Questions



Please complete the following survey and mail the postcard

1. Do you currently practice in the state of Connecticut?
O Yes O No O Retired

2. Your main practice site is :
O Single specialty group/partnership
O Multi specialty group/partnership
O Solo practice

3. How does your main practice site store patient information?
O Paper medical records/charts stored in cabinets
O Computerized system which stores scanned copies of paper records (DIMS)
O Electronic Health Record
O Both –paper and computerized
O Other please specify: _____

4. What is the year of your birth? _____

5. What is your gender? O Male O Female

6. What is your ethnicity? O Hispanic or Latino
O Not Hispanic or Latino

7. What is your race?
O White
O Black/African American
O Asian
O Native Hawaiian/Other Pacific Islander
O American Indian/Alaska Native

ID

8. Roughly what percent of your patient revenue comes from the following? (Percentage should total 100%)
Medicare_____
Medicaid (including Husky. SAGA Medicaid LIA & Title 19) _____
Private insurance _____
Patient payments_____
Other (please specify) _____

9. Which method of survey administration do you prefer?

O Web-based(we will email you a survey link)
O Regular mail

O Telephone interview
O In Person interview
O Do not want to receive survey

Please supply us with the following information

Email address:

Telephone number:

RESULTS

We received 3,459 of the 18,642 postcards that were mailed. Of these, 876 were returned undelivered; 59 respondents practiced in Connecticut but did not chose a preferred method for receiving a survey; and 1,740 were valid addresses with an identified method for receiving the physician survey. Additionally, 10 postcards were returned with a note that the physician had received two postcards. This led us to decide to review the list closely for duplicate physicians. To do this, we systematically used the internet to search for telephone numbers for practices containing possible duplicate physicians, and we then called these practices to confirm that the physician on our list was still practicing at the address listed. Between the mailing and telephone calls to practices, 2,180 were identified as duplicates, 206 physicians were identified as having retired and 4038 were identified as not practicing in CT. A second mailing of 698 postcards was completed in November 2011 with updated addresses for postcards that were returned to us as undelivered from the first mailing.

Response rate The overall postcard response rate was 16%. Of the 16,462 unduplicated physicians in the master list, 30 had died, 206 were retired, 4038 no longer practiced in CT, and 15 did not specify whether or not they practiced in CT. This left an adjusted target population of 12,173

physicians; the response rate for this target population was 21%. Table 1 provides the results from the process undertaken to clean the master physician list.

Table 1: Cleaning physician list

	N	%
Physician list received from CT-DPH	18642	
Duplicates in the list	2056	
Triplicates in the list	100	
Quadruplicates in the list	12	
Quintuplicates in the list	**12**	
Unduplicated Physician list	**16462**	
Responses to the Physician postcard		
No response	13003	79.0%
Postcard returned due to invalid address	876	5.3%
Postcard returned completed	2583	15.7%
Physicians Excluded Due to Death, Retirement, etc.		
Died	30	0.2%
Retired	206	1.3%
No Longer Practices in CT	4038	24.5%
Postcard returned: Unknown if Physician Practices in CT	15	0.1%
Target Population After Exclusions	12173	
Adjusted Postcard Response Rate Based on Target Population		21.3%
Physicians Receiving Full Survey		
Refused to Participate in Survey	26	
Postcard Returned; No Preferred Survey Method Specified	60	
Physician Practices in CT; Survey Sent	1786	
Response rate for survey	*785*	*44.0%*

Characteristics of respondents The age of the physicians ranged from 28-91 years, representing a mean age of 55 years and a standard deviation of 12 years. Sixty-two percent of the respondents were men and 27% were women. Eighty-two percent of the physicians selected white, while 11% selected Asian and 2% selected black as their race. Only 4% of the respondents were of Hispanic origin.

Characteristics of the practice site Most physicians (53%) reported practicing in a single-specialty group practice, 22% of the physicians practiced in a multi-specialty group practice, and 20% had a solo practice.

Handling of patient records Most physicians (36%) reported using only paper records, 29% reported using a combination of paper and computerized records, 26% were using EHRs, 5% were using scanned images of paper records, and 3% were in the process of moving to an EHR.

Source of patient revenue When asked about income, 43% reported that more than 30% of their revenue came from Medicare, 19% reported that more than 30% of their revenue came from Medicaid, 66% reported that more than 30% of their revenue came from private insurance, and about 7% reported that more than 30% of their revenue came from patient payments.

Selection of method for survey administration A majority (54%) of the physicians wanted to receive their survey in the mail, while 41% preferred the web-based survey. Demographic and sample characteristics are summarized in table 2.

Table 2: Demographics and other sample characteristics

	N=1799	**%**
Mean Age	55 years (SD 12)	
Range	28-91 years	
Gender		
Male	1110	61.7%
Female	492	27.3%
Missing	197	11.0%
Ethnicity		
Hispanic or Latino origin	64	3.6%
Not Hispanic or Latino	1678	93.3%
Missing	57	3.2%
Race		
White	1481	82.3%
Black/African-American	44	2.4%
Asian	198	11.0%
Native Hawaiian/Other Pacific Islander	10	0.6%
American Indian	3	0.2%
Multiple Races	0	0.0%
Missing	63	3.5%
Practice Type		
Solo practice	365	20.3%
Single specialty group	950	52.8%
Multi-specialty group	403	22.4%
Did not respond	81	4.5%
How does your main practice site store patient information		
Paper medical records/charts stored in cabinets	649	36.1%
Both-Paper and computerized	517	28.7%

	N=1799	%
Electronic Health Record	473	26.3%
Computerized system which stores scanned copies of paper records (DIMS)	88	4.9%
Other	48	2.7%
Multiple Storage Methods	12	0.7%
Missing	12	0.7%
% of patient revenue, Medicare		
None	109	6.1%
Less than 30	478	26.6%
More than 30	769	42.7%
Missing	443	24.6%
% of patient revenue, Medicaid		
None	132	7.3%
Less than 30	869	48.3%
More than 30	333	18.5%
Missing	465	25.8%
% of patient revenue, Private Insurance		
None	36	2.0%
Less than 30	321	17.8%
More than 30	1180	65.6%
Missing	262	14.6%
% of patient revenue, Patient Payments		
None	72	4.0%
Less than 30	1012	56.3%
More than 30	125	6.9%
Missing	590	32.8%
% of patient revenue, Other		
None	163	9.1%
Less than 30	138	7.7%
More than 30	80	4.4%
Missing	1418	78.8%
Preferred method of survey administration		
Web-based	736	40.9%
Regular mail	962	53.5%
Telephone interview	21	1.2%
In-person interview	12	0.7%
Multiple	9	0.5%
Missing	59	3.3%

DISCUSSION

The physician list was inadequate for the purpose of administering the survey. DPH licenses physicians to practice in Connecticut, but does not maintain a list of practicing physicians. We found that physicians move, retire, graduate from medical school, and die. Any one of these issues by itself does not create a lot of noise, but together these issues render the list suspect for calculating outcome measures.

Currently, DPH uses both electronic and paper processes for license renewal. We recommend that the state licensing and renewal application add two questions that may improve the list substantially over a period of one year, given that all physicians have to renew their licenses annually. First, physicians should be asked whether or not they practice in the state. Second, it may be useful to have all physicians designate the sites at which they practice; these sites should be flagged as either primary or secondary sites. This is important because, even though physicians may practice at multiple sites, we want them to respond to our survey based on their experience at their primary site. Third, it may be time to mandate that all renewals be done electronically; this would eliminate the process of merging the two sources of license renewal data to obtain a master list. Last, a subset of these physicians will be applying to CMS for incentives. As a result, the projected number of physicians who are likely to apply for these incentives could be off by a significant magnitude.

There has been pressure on the states that received HIE grants to document baseline EHR adoption rates quickly. This may not be feasible, given that it took a year to get the survey out into the field and then realize that the list was not accurate. We were concurrently cleaning the list as we were sending surveys out to physicians. It would have been more prudent to first clean the list and then send out the postcard. Also, ONC would be better off allowing states to use the rates estimated by NAMCS as their baselines; this would allow states the necessary time to get their provider directories in order and to then implement a statewide physician survey based on the population or a sample to measure change overtime in EHR adoption rates.

Limitations The postcard response rate is a challenge as the state tries to estimate how many of its physicians will apply and attest successfully to receive incentive payments from CMS. The evaluation team is calling the practices in the list to identify duplicates, since at least 50% of the physicians indicate that they practice at more than one site. Cleaning of the physician list will need to be an ongoing process; as every year new physicians are added to the existing list of licensed physicians.

CONCLUSION

It is extremely difficult for states that do not have a centralized provider directory to maintain an accurate list of practicing providers. For such states, the environment scan data incorporated in the statewide strategic and operational plan submitted to the ONC may have some errors and limitations. Even though they might be the best baseline data available at the state level, ONC will need to be cautious in using this indicator, since the effort to clean the physician list is up to the state. Measuring progress on the EHR adoption indicator can be accurate only if all states use a systematic process for cleaning their lists of practicing physicians. In the state of Connecticut, we were able to remove duplicates the list using a simple process of checking the internet, followed by calls to doctors' offices. Other states may want to follow this simple process if they do not have the funds available to buy systems and hire staff whose sole responsibility is to clean their physician list. As a result, each list's accuracy will vary proportional to the time and resources spent on cleaning the list.

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STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*

Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any pre-specified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	4
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*4*
Bias	9	Describe any efforts to address potential sources of bias	4
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	4
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*c*) Explain how missing data were addressed	5-6
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed	NA

		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6-8
		(b) Indicate number of participants with missing data for each variable of interest	7-8
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	7-8
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	NA
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	NA
		Cross-sectional study—Report numbers of outcome events or summary measures	NA
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	9
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Limitations The postcard response rate based on the unduplicated lists adjusted for exclusions such as death, retired, and do not practice in CT, is 30%, which is low. We may be missing physician populations which could greatly affect the indicators being used to measure change in electronic health record adoption rates.

Conclusions It is difficult to obtain an accurate physician count of practicing physicians in Connecticut from the existing lists. States that are participating in the projects funded under various Office of the National Coordinator for Health Information Technology (ONC) initiatives must focus on getting an accurate count of the physicians practicing in their state, since their progress is being measured based on this key number.

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advantages of using HIEs and their resulting benefits to improving quality of care, patient safety, and efficiency of delivering care.(1-3)

BACKGROUND

The ONC has invested about $30 billion to implement the HITECH Act.(4-7) The Health Information Technology Extension Program provides each state with funds to increase its physicians' EHR adoption rate. Similarly, under the HIE program, states are expected to build infrastructure and mechanisms that support the exchange of health information among physicians' offices, hospitals, laboratories, pharmacies, registries, etc. The HIE initiative funds 56 Health Information Exchanges covering all states. One metric indicative of HIE success is the rate of change in the EHR adoption rate among physicians over the course of this four-year initiative. This metric is linked to another outcome measure: the number of physicians who successfully demonstrate the exchange of summary documents with another provider, the state, or a regional HIE. To this end, accurate data on practicing physicians by state are needed. Data sources that list practicing physicians in a state, however, are limited (8), since generating accurate lists of unduplicated physicians in a state is a labor-intensive activity. As a result, this indicator presents a challenge, since it assumes that there is an existing accurate list of the physician population that can be used to survey the physicians for EHR adoption rates. Establishing an accurate baseline list of physicians is important, since progress on many HIT indicators will be based upon the number of physicians that adopt and implement EHRs and other HIT practices. These physicians are eligible for incentives from the Centers for Medicare and Medicaid Services (CMS).(9) Currently, many states realize that their physicians' lists are inaccurate; this makes it difficult for them to calculate this basic measure of existing physicians that use certified EHRs.

In the first year of the HIE cooperative agreements, states have been working to establish a baseline for existing rates of EHR adoption. As part of this grant, ONC has established multiple communities of practice (CoP) targeting important performance outcome measures, including the e-prescribing CoP, the Lab CoP, provider directory CoP, and the Security and Privacy CoP. The "Provider Directory CoP" has been discussing the challenges associated with getting and subsequently maintaining an accurate list/directory of providers, which are related to the fact that physicians practice in multiple settings, change affiliations, and may not practice in all states in which they hold licenses.

In December 2010, the Centers for Disease Control and Prevention (CDC) released statewide results of EHR adoption rates, based on a mailed supplement to the National Ambulatory Medical Care Survey (NAMCS).(10) This supplement was started in 2008. The CDC study reports that 48% of office-based physicians use an EHR, 22% use a basic system, and 7% use a fully-functional EHR. These numbers are slightly higher than those reported in an earlier study; which reported 4% of the physicians as operating an extensive, fully-functional electronic system, while 13% had a basic system.(11)

Currently, these data are the only state-level estimates available that systematically record EHR adoption rates. There are, however, two limitations that impact the NAMCS data's applicability and usefulness. First, the supplement questionnaire does not ask the key question about whether or not the EHR in use is certified.(4) Second, the EHR adoption questions were asked at the practice level and not at the physician level. This distinction is important because the incentives which CMS is promoting are at the physician level and not at the practice level.

An HIE 2011 expert survey undertaken by CAQH and eHealth initiative to identify data elements needed to create provider directories, reported that provider directories are at the core of a successful exchange and need frequent updates. Additionally, they identified that health plans are the best source of provider information, followed by Medicaid offices, and providers themselves. (12)

Connecticut Health Information Exchange Landscape The Health Information Technology Exchange of Connecticut (HITE-CT), a quasi-public agency, was created by the Public Act 10-117, "*An Act Concerning Revisions to Public Health Related Statutes and the Establishment of the Health Information Technology Exchange of Connecticut,*" Sec. 82-90,96 (codified at CGS §19a-750(c)(1)) (13), by the 2010 Connecticut General Assembly and Governor Rell. It is managed by an appointed Board of Directors who held their first meeting in October 2010 to coordinate and oversee Health Information Exchange (HIE) activities starting in January 1, 2011. Each board member represents a constituent stakeholder group, such as consumer or consumer advocates, primary care physicians, pharmacists, employer and/or business groups.

According to NAMCS estimates for Connecticut, 48% of office-based physicians use an EHR and 15% report having a basic EHR system (10), while another recent evaluation study puts this number at 36%.(14) This paper addresses the challenges of measuring the rate of EHR adoption among physicians on this list.

METHODS

Data The Connecticut Department of Public Health contracted with the University of Connecticut Health Center (UCHC) to evaluate its Health Information Technology and Exchange (HITE) Cooperative Agreement, funded by the Office of the National Coordinator (ONC). The contract period for this evaluation is 7/1/2010-3/14/2014. This evaluation uses mixed methods, namely survey research and in-depth interviews. A family of surveys is being undertaken to measure CT-HITE's impact, such as physician EHR adoption rate, e-prescribing practices, laboratory readiness for interoperability and states ability to sustain this effort after the federal funds are expended. All studies were reviewed by the IRB at UCHC.

For the physician survey implementation, the evaluators received a list from the Department of Public Health (DPH), which issues licenses of practice to physicians, generated a list of 16,618 physicians in May 2011 and another list of 5,283 physicians from the Department of Social Services Medicaid physician list. No phone numbers or e-mail addresses were available on this list. These lists were combined and after removing duplicates the final list contained a cohort of 18,642 physicians.

Members of the board of directors of HITE-CT believed that there were about 8,000 physicians actively practicing in Connecticut. Due to the discrepancy between the actual list and the number of physicians believed to be practicing in Connecticut, a two-step survey process was implemented to ascertain the list's accuracy. First, a postcard was mailed to all the physicians on the list. Second, surveys were mailed to physicians who responded to the postcard, to assess physicians use of EHRs; their opinions about their EHR's utility; their familiarity with HIE; and their opinions about barriers and incentives that may impact HIE implementation. This paper discusses the responses to the postcard.

Postcard Survey instrument The postcard asked 10 questions. These questions included whether the person practiced in Connecticut, age, race, ethnicity, gender, practice site, methods used to store medical record data, sources of patient revenue, and preferred methods for receiving the subsequent survey. Figure 1 contains a picture of the postcard.

Postcard Administration Every licensed physician who was on the list as of May 2011 was mailed a postcard through the US postal system. A total of 18,642 postcards was mailed.

Analysis Responses to the postcard mailing were analyzed using SQL and SPSS.

RESULTS

We received 4,104 of the 18,642 postcards that were mailed. Of these, 999 were returned undelivered; nine respondents practiced in Connecticut but did not chose a preferred method for receiving a survey; and 2,159 were valid addresses with an identified method for receiving the physician survey. Additionally, 10 postcards were returned with a note that the physician had received two postcards. This led us to review the list closely for duplicate physicians. To do this, we systematically used the internet to search for telephone numbers for practices containing possible duplicate physicians, and we then called these practices to confirm that the physician on our list was still practicing at the address listed. Between the mailing and telephone calls to practices, 2,180 were identified as duplicates, 233 physicians were identified as having retired, and 5,828 were identified as not practicing in CT. A second mailing of 713 postcards was completed in November 2011 with updated addresses for postcards that were returned to us as undelivered from the first mailing. A subsequent third mailing was completed in March 2012, to 6,496 non-respondents from the first list. A fourth postcard mailing in May 2012 went to 117 physicians whose postcards from the third mailing had been returned undeliverable.

Response rate The overall postcard response rate was 19%. Of the 16,462 unduplicated physicians in the master list, 44 had died, 233 were retired, 5,828 no longer practiced in CT, and 30 did not specify whether or not they practiced in CT. This left an adjusted target population of 10,327 physicians; the response rate for this target population was 30%. Table 1 provides the results from the process undertaken to clean the master physician list.

Table 1: Cleaning physician list

	N	%
Physician list received from CT-DPH	18642	
Duplicates in the list	2056	
Triplicates in the list	100	
Quadruplicates in the list	12	
Quintuplicates in the list	**12**	
Unduplicated Physician list	**16462**	
Responses to the Physician postcard		
No response	12358	75.1%
Postcard returned due to invalid address	999	6.1%
Postcard returned completed	3105	18.9%
Physicians Excluded Due to Death, Retirement, etc.		
Died	44	0.3%%

Retired	233	1.4%
No Longer Practices in CT	5828	35.4%
Postcard returned: Unknown if Physician Practices in CT	30	0.2%
Target Population After Exclusions	10327	
Adjusted Postcard Response Rate Based on Target Population		30.1%
Physicians Receiving Full Survey		
Refused to Participate in Survey	91	
Postcard Returned; No Preferred Survey Method Specified; Unable to Contact Physician to Get Preferred Method	9	
Physician Practices in CT; Survey Sent	2159	
Response rate for survey	*898*	*41.6%*

Characteristics of respondents The age of the physicians ranged from 28-91 years, representing a mean age of 55 years and a standard deviation of 12 years. Sixty-eight percent of the respondents were men and 31% were women. Eighty-three percent of the physicians selected white, while 11% selected Asian and 3% selected black as their race. Only 3% of the respondents were of Hispanic origin.

Characteristics of the practice site Most physicians (53%) reported practicing in a single-specialty group practice, 23% of the physicians practiced in a multi-specialty group practice, and 20% had a solo practice.

Handling of patient records Most physicians (36%) reported using only paper records, 29% reported using a combination of paper and computerized records, 27% were using EHRs, 4% were using scanned images of paper records, and 3% were in the process of moving to an EHR.

Source of patient revenue When asked about income, 43% reported that more than 30% of their revenue came from Medicare, 18% reported that more than 30% of their revenue came from Medicaid, 67% reported that more than 30% of their revenue came from private insurance, and about 7% reported that more than 30% of their revenue came from patient payments.

Selection of method for survey administration A majority (56%) of the physicians wanted to receive their survey in the mail, while 40% preferred the web-based survey. Demographic and sample characteristics are summarized in table 2.

Table 2: Demographics and other sample characteristics

	N=2159	**%**
Mean Age	55 years (SD 12)	
Range	28-91 years	
Gender		

	N=2159	%
Male	1460	67.6%
Female	659	30.5%
Missing	40	1.9%
Ethnicity		
Hispanic or Latino origin	74	3.4%
Not Hispanic or Latino	2017	93.4%
Missing	68	3.1%
Race		
White	1784	82.6%
Black/African-American	55	2.5%
Asian	228	10.6%
Native Hawaiian/Other Pacific Islander	12	0.6%
American Indian	3	0.1%
Multiple Races	0	0.0%
Missing	77	3.6%
Practice Type		
Solo practice	433	19.7%
Single specialty group	1141	52.8%
Multi-specialty group	495	22.6%
Did not respond	90	4.2%
How does your main practice site store patient information		
Paper medical records/charts stored in cabinets	771	35.7%
Both-Paper and computerized	621	28.8%
Electronic Health Record	582	27.0%
Computerized system which stores scanned copies of paper records (DIMS)	94	4.4%
Other	48	2.2%
Multiple Storage Methods	30	1.4%
Missing	13	0.6%
% of patient revenue, Medicare		
None	95	4.4%
Less than 30	563	26.1%
More than 30	932	43.2%
Missing	569	26.4%
% of patient revenue, Medicaid		
None	138	6.4%
Less than 30	1031	47.7%
More than 30	390	18.1%
Missing	600	27.8%
% of patient revenue, Private Insurance		
None	14	0.6%
Less than 30	358	16.6%
More than 30	1437	66.6%

	N=2159	%
Missing	350	16.2%
% of patient revenue, Patient Payments		
None	23	1.1%
Less than 30	1204	55.8%
More than 30	146	6.8%
Missing	786	36.4%
% of patient revenue, Other		
None	36	1.7%
Less than 30	151	7.0%
More than 30	82	3.8%
Missing	1890	87.5%
Preferred method of survey administration		
Web-based	855	39.6%
Regular mail	1198	55.5%
Telephone interview	21	1.0%
In-person interview	12	0.6%
Multiple	16	0.7%
Missing	57	2.6%

DISCUSSION

The physician list was inadequate for the purpose of administering the survey as indicated by the difference between our start-up count of 18,642 and the final adjusted count of 10,327. DPH licenses physicians to practice in Connecticut, but does not maintain a list of practicing physicians. We found that physicians move, retire, graduate from medical school, and die. Any one of these issues by itself does not create a lot of noise, but together these issues render the list suspect for calculating outcome measures. At any given time it is difficult for the DPH or any other body to know who is practicing in the state of Connecticut. This issue is being identified as a challenge across states. (12) As work is being done to setup health information and health insurance exchanges, accurate provider directories are the first step in setting up functional exchanges for health provision and coordination.

Currently, DPH uses both electronic and paper processes for license renewal. We recommend that the state licensing and renewal application add two questions that may improve the list substantially over a period of one year, given that all physicians have to renew their licenses annually. First, physicians should be asked whether or not they practice in the state. Second, it may be useful to have all physicians designate the sites at which they practice; these sites should be flagged as either primary or secondary sites. This is important because, even though physicians may practice at

multiple sites, we want them to respond to our survey based on their experience at their primary site. Third, it may be time to mandate that all renewals be done electronically; this would eliminate the process of merging the two sources of license renewal data to obtain a master list. Last, a subset of these physicians will be applying to CMS for incentives. As a result, the projected number of physicians who are likely to apply for these incentives could be off by a significant magnitude.

There has been pressure on the states that received HIE grants to document baseline EHR adoption rates quickly. This may not be feasible, given that it took a year to get the survey out into the field and then realize that the list was not accurate. We were concurrently cleaning the list as we were sending surveys out to physicians. It would have been more prudent to first clean the list and then send out the postcard. Also, ONC would be better off allowing states to use the rates estimated by NAMCS as their baselines; this would allow states the necessary time to get their provider directories in order and to then implement a statewide physician survey based on the population or a sample to measure change overtime in EHR adoption rates.

Lastly, we feel that the two-step approach, using a postcard followed by a survey, is prudent in two ways. First we would have wasted a lot of our funds had we just mailed out our survey at a cost of $1 per survey in comparison to 25 cents per postcard. Second, we were surprised that 56% of the respondents preferred regular mail to web-based surveys. Given that most surveys with physicians are done using the internet, we would have lost a lot of responses had we only used the web-based method for survey administration.

Limitations The postcard response rate is a challenge as the state tries to estimate how many of its physicians will apply and attest successfully to receive incentive payments from CMS. The evaluation team called the practices in the list to identify possible duplicates, since at least 50% of the physicians indicate that they practice at more than one site. Cleaning of the physician list will need to be an ongoing process, since every year new physicians are added to the existing list of licensed physicians. It is possible that the question about “revenue sources (Q8)” may have depressed the response rate, since physicians may have perceived this as a “Big Brother”-style question. It is possible that the physicians feel “survey fatigue” or that they did not want to respond to this survey. We believe that asking these questions on a license renewal application may yield better results, since every physician in the state has to renew their license annually. Also, it is possible that

respondents who chose 'no' or 'retired' to the first question did not return the survey as we did not have clear skip instructions asking them to return the survey even if they only answered Q1.

CONCLUSION

It is extremely difficult for states that do not have a centralized provider directory to maintain an accurate list of practicing providers. For such states, the environment scan data incorporated in the statewide strategic and operational plan submitted to the ONC may have some errors and limitations. Even though they might be the best baseline data available at the state level, ONC will need to be cautious in using this indicator, since the effort to clean the physician list is up to the state. Measuring progress on the EHR adoption indicator can be accurate only if all states use a systematic process for cleaning their lists of practicing physicians. In the state of Connecticut, we were able to remove duplicates from the list using a simple process of checking the internet, followed by calls to doctors' offices. Other states may want to follow this simple process if they do not have the funds available to buy systems and hire staff whose sole responsibility is to clean their physician list. As a result, each list's accuracy will vary proportional to the time and resources spent on cleaning the list.

Funding: This work was supported by Award Number 90HT0043/01 from the ONC.

Competing Interests

There are no competing interests.

Data Sharing

At this time these data are not available for public use as the study is still ongoing.

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STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*

Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any pre-specified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	4
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*4*
Bias	9	Describe any efforts to address potential sources of bias	4
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	4
		(*b*) Describe any methods used to examine subgroups and interactions	NA
		(*c*) Explain how missing data were addressed	5-6
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed	NA

		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	NA
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	NA
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6-8
		(b) Indicate number of participants with missing data for each variable of interest	7-8
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	7-8
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	NA
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	NA
		Cross-sectional study—Report numbers of outcome events or summary measures	NA
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	NA
		(*b*) Report category boundaries when continuous variables were categorized	NA
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	NA
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	9
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10
Generalisability	21	Discuss the generalisability (external validity) of the study results	10
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	10

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.
Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Physician Directory: A challenge to measuring electronic health record adoption in a cohort of Connecticut physicians

ABSTRACT

Objective To assess the ~~challenges posed by~~ limitations of the existing physician directory in ~~the~~ measuring~~ement of~~ electronic health record (EHR) adoption rates among a cohort of Connecticut physicians.

Design A population-based mailing ~~was undertaken to~~ assessed the number of physicians practicing in Connecticut. ~~This mailing used a list of licensed physicians in Connecticut.~~

Measurements Information about practice site, practices pertaining to storing of patient information, sources of revenue, and preferred method for receiving survey. Practice status in Connecticut, measured by yes and no. Demographic information was collected on gender, year of birth, race, and ethnicity.

Results The response rate for the postcard mailing was 1~~9~~6% (~~2,583~~3,105/16,462). Of the 16,462 unduplicated consumers in our universe, 2~~06~~33 (1%) were retired and 5828~~4038~~ (35~~25~~%) did not practice in CT. Of the 3,105~~2,583~~ valid postcard responses we received, 2,159~~1,786~~ were for physicians practicing in CT. ~~Sixty~~Nine (0.43%) of these responses did not specify a preferred method for receiving the full physician survey; ~~26~~ 91 physicians refused to participate in the survey; ~~1,786~~2,159 surveys were sent out using each physician's requested method for receiving the survey, i.e. web-based, regular mail, or telephone. As of August~~February~~ 2012, ~~785~~ 898 physicians had returned surveys, resulting in a response rate of 4~~2~~4%.

Limitations The postcard response rate based on the unduplicated lists adjusted for exclusions such as death, retired, and do not practice in CT, is ~~of~~ 30~~21~~%, which is low. We may be missing physician populations which could greatly affect the indicators being used to measure change in electronic health record adoption rates.

Conclusions It is difficult to obtain an accurate physician count of practicing physicians in Connecticut from the existing lists. States that are participating in the projects funded under various Office of the National Coordinator for Health Information Technology (ONC) initiatives must focus on getting an accurate count of the physicians practicing in their state, since their progress is being measured based on this key number.

INTRODUCTION

The influx of American Recovery and Reinvestment Act of 2009 (ARRA) funding through the implementation of the Health Information Technology for Economic and Clinical Health (HITECH) Act provides funds to small, privately-owned primary care practices, federally-qualified health centers, critical area access hospitals, and other community health centers to implement and adopt health information technologies. These technologies include electronic health records (EHRs), e-prescribing systems, and laboratory information systems. These funds were made available to all states through multiple initiatives, such as the Health Information Technology Extension Program, State Health Information Exchange (HIE) Cooperative Agreement Program, and Community College Consortia to

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Educate Health Information Technology Professionals Program. Much has been written about the advantages of using HIEs and their resulting benefits to improving quality of care, patient safety, and efficiency of delivering care.(1-3)

BACKGROUND

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Currently, these data are the only state-level estimates available that systematically record EHR adoption rates. There are, however, two limitations that impact the NAMCS data's applicability and usefulness. First, the supplement questionnaire does not ask the key question about whether or not the EHR in use is certified.(4) Second, the EHR adoption questions were asked at the practice level and not at the physician level. This distinction is important because the incentives which CMS is promoting are at the physician level and not at the practice level.

An HIE 2011 expert survey undertaken by CAQH and eHealth initiative to identify data elements needed to create provider directories, reported that provider directories are at the core of a successful exchange and need frequent updates. Additionally, they identified that health plans are the best source of provider information, followed by Medicaid offices, and providers themselves. (12)

Connecticut Health Information Exchange Landscape The Health Information Technology Exchange of Connecticut (HITE-CT), a quasi-public agency, was created by the Public Act 10-117, "*An Act Concerning Revisions to Public Health Related Statutes and the Establishment of the Health Information Technology Exchange of Connecticut,"* Sec. 82-90,96 (codified at CGS §19a-750(c)(1)) (132), by the 2010 Connecticut General Assembly and Governor Rell. It is managed by an appointed Board of Directors who held their first meeting in October 2010 to coordinate and oversee Health Information Exchange (HIE) activities starting in January 1, 2011. Each board member represents a constituent stakeholder group, such as consumer or consumer advocates, primary care physicians, pharmacists, employer and/or business groups.

According to NAMCS estimates for Connecticut, 48% of office-based physicians use an EHR and 15% report having a basic EHR system (10), while another recent evaluation study puts this number at

36%.(143) This paper addresses the challenges of measuring the rate of EHR adoption among physicians on this list.

METHODS

Data The Connecticut Department of Public Health contracted with the University of Connecticut Health Center (UCHC) to evaluate its Health Information Technology and Exchange (HITE) Cooperative Agreement, funded by the Office of the National Coordinator (ONC). The contract period for this evaluation is 7/1/2010-3/14/2014. This evaluation uses mixed methods, namely survey research and in-depth interviews. A family of surveys is being undertaken to measure CT-HITE's impact, such as physician EHR adoption rate, e-prescribing practices, laboratory readiness for interoperability and states ability to sustain this effort after the federal funds are expended. All studies were reviewed by the IRB at UCHC.

For the physician survey implementation, the evaluators received a list from the Department of Public Health (DPH), which issues licenses of practice to physicians, generated a list of 16,618 physicians in May 2011 and another list of 5,283 physicians from the Department of Social Services Medicaid physician list. No phone numbers or e-mail addresses were available on this list. These lists were combined and after removing duplicates the final list contained a cohort of 18,642 physicians.

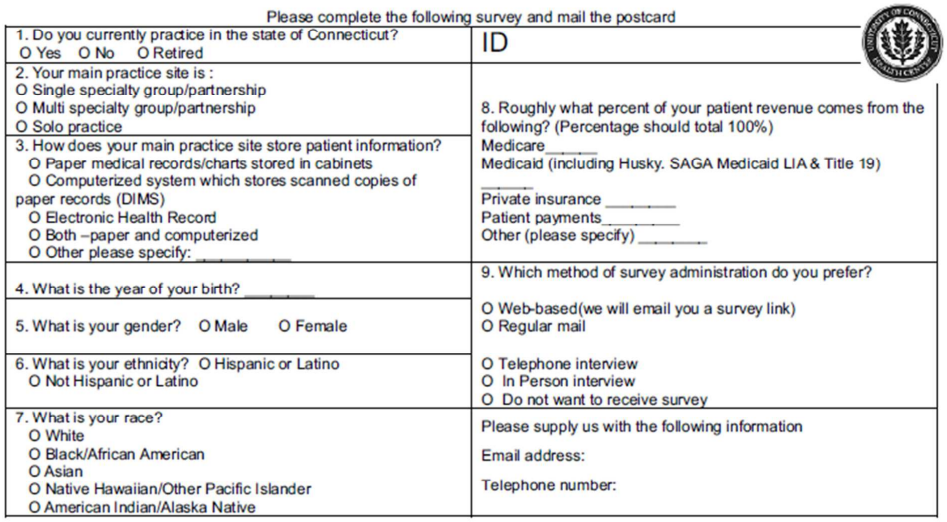
Members of the board of directors of HITE-CT believed that there were about 8,000 physicians actively practicing in Connecticut. Due to the discrepancy between the actual list and the number of physicians believed to be practicing in Connecticut, a two-step survey process was implemented to ascertain the list's accuracy. First, a postcard was mailed to all the physicians on the list. Second, surveys were mailed to physicians who responded to the postcard, to assess physicians use of EHRs; their opinions about their EHR's utility; their familiarity with HIE; and their opinions about barriers and incentives that may impact HIE implementation. This paper discusses the responses to the postcard.

Postcard Survey instrument The postcard asked 10 questions. These questions included whether the person practiced in Connecticut, age, race, ethnicity, gender, practice site, methods used to store medical record data, sources of patient revenue, and preferred methods for receiving the subsequent survey. Figure 1 contains a picture of the postcard.

Postcard Administration Every licensed physician who was on the list as of May 2011 was mailed a postcard through the US postal system. A total of 18,642 postcards was mailed.

Analysis Responses to the postcard~~first~~ mailing were analyzed using SQL and SPSS.

Figure 1: Postcard Questions



Please complete the following survey and mail the postcard

1. Do you currently practice in the state of Connecticut?
O Yes O No O Retired

ID

2. Your main practice site is :
O Single specialty group/partnership
O Multi specialty group/partnership
O Solo practice

3. How does your main practice site store patient information?
O Paper medical records/charts stored in cabinets
O Computerized system which stores scanned copies of paper records (DIMS)
O Electronic Health Record
O Both –paper and computerized
O Other please specify: _____

4. What is the year of your birth? _____

5. What is your gender? O Male O Female

6. What is your ethnicity? O Hispanic or Latino
O Not Hispanic or Latino

7. What is your race?
O White
O Black/African American
O Asian
O Native Hawaiian/Other Pacific Islander
O American Indian/Alaska Native

8. Roughly what percent of your patient revenue comes from the following? (Percentage should total 100%)
Medicare_____
Medicaid (including Husky. SAGA Medicaid LIA & Title 19) _____
Private insurance _____
Patient payments_____
Other (please specify) _____

9. Which method of survey administration do you prefer?

O Web-based(we will email you a survey link)
O Regular mail

O Telephone interview
O In Person interview
O Do not want to receive survey

Please supply us with the following information

Email address:

Telephone number:

RESULTS

We received ~~3,459~~4,104 of the 18,642 postcards that were mailed. Of these, ~~876~~ 999 were returned undelivered; ~~59~~nine respondents practiced in Connecticut but did not chose a preferred method for receiving a survey; and 2,159~~1,740~~ were valid addresses with an identified method for receiving the physician survey. Additionally, 10 postcards were returned with a note that the physician had received two postcards. This led us ~~to decide~~ to review the list closely for duplicate physicians. To do this, we systematically used the internet to search for telephone numbers for practices containing possible duplicate physicians, and we then called these practices to confirm that the physician on our list was still practicing at the address listed. Between the mailing and telephone calls to practices, 2,180 were identified as duplicates, ~~206~~233 physicians were identified as having retired, and ~~4038~~5,828 were identified as not practicing in CT. A second mailing of ~~698~~713 postcards was completed in November 2011 with updated addresses for postcards that were returned to us as undelivered from the first mailing. A subsequent third mailing was completed in March 2012, to 6,496 non-respondents from the first list. A fourth postcard mailing in May 2012 went to 117 physicians whose postcards from the third mailing had been returned undeliverable.

Response rate The overall postcard response rate was 1~~6~~9%. Of the 16,462 unduplicated physicians in the master list, ~~30~~44 had died, ~~206~~233 were retired, ~~4038~~5,828 no longer practiced in

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CT, and 1530 did not specify whether or not they practiced in CT. This left an adjusted target population of 10,32712,173 physicians; the response rate for this target population was 2130%. Table 1 provides the results from the process undertaken to clean the master physician list.

Table 1: Cleaning physician list

	N	%
Physician list received from CT-DPH	18642	
Duplicates in the list	2056	
Triplicates in the list	100	
Quadruplicates in the list	12	
Quintuplicates in the list	**12**	
Unduplicated Physician list	**16462**	
Responses to the Physician postcard		
No response	123581300 3	75.179.0%
Postcard returned due to invalid address	999876	6.15.3%
Postcard returned completed	31052583	18.915.7%
Physicians Excluded Due to Death, Retirement, etc.		
Died	3044	0.3%0.2% %
Retired	233206	1.41.3%
No Longer Practices in CT	58284038	35.424.5%
Postcard returned: Unknown if Physician Practices in CT	3015	0.20.1%
Target Population After Exclusions	12173 10327	
Adjusted Postcard Response Rate Based on Target Population		30.121.3%
Physicians Receiving Full Survey		
Refused to Participate in Survey	2691	
Postcard Returned; No Preferred Survey Method Specified; Unable to Contact Physician to Get Preferred Method	609	
Physician Practices in CT; Survey Sent	178622159	
Response rate for survey	*898785*	*41.644.0%*

Characteristics of respondents The age of the physicians ranged from 28-91 years, representing a mean age of 55 years and a standard deviation of 12 years. Sixty-eightwo percent of the respondents were men and 2731% were women. Eighty-threewo percent of the physicians selected white, while 11% selected Asian and 32% selected black as their race. Only 34% of the respondents were of Hispanic origin.

Characteristics of the practice site Most physicians (53%) reported practicing in a single-specialty group practice, 232% of the physicians practiced in a multi-specialty group practice, and 20% had a solo practice.

Handling of patient records Most physicians (36%) reported using only paper records, 29% reported using a combination of paper and computerized records, 276% were using EHRs, 54% were using scanned images of paper records, and 3% were in the process of moving to an EHR.

Source of patient revenue When asked about income, 43% reported that more than 30% of their revenue came from Medicare, 189% reported that more than 30% of their revenue came from Medicaid, 667% reported that more than 30% of their revenue came from private insurance, and about 7% reported that more than 30% of their revenue came from patient payments.

Selection of method for survey administration A majority (564%) of the physicians wanted to receive their survey in the mail, while 401% preferred the web-based survey. Demographic and sample characteristics are summarized in table 2.

Table 2: Demographics and other sample characteristics

	N=17992159	**%**
Mean Age	55 years (SD 12)	
Range	28-91 years	
Gender		
Male	14601110	67.661.7%
Female	659492	30.527.3%
Missing	40197	1.911.0%
Ethnicity		
Hispanic or Latino origin	7464	3.43.6%
Not Hispanic or Latino	20171678	93.493.3%
Missing	6857	3.13.2%
Race		
White	17841481	82.682.3%
Black/African-American	5544	2.52.4%
Asian	228198	10.611.0%
Native Hawaiian/Other Pacific Islander	1210	0.6%
American Indian	3	0.10.2%
Multiple Races	0	0.0%
Missing	7763	3.63.5%
Practice Type		
Solo practice	433365	19.720.3%
Single specialty group	1141950	52.8%
Multi-specialty group	495403	22.622.4%

	N=~~17992~~2159	%
Did not respond	~~81~~90	4.2~~4.5~~%
How does your main practice site store patient information		
Paper medical records/charts stored in cabinets	771~~649~~	35.7~~36.1~~%
Both-Paper and computerized	621~~517~~	28.8~~28.7~~%
Electronic Health Record	582~~473~~	27.0~~26.3~~%
Computerized system which stores scanned copies of paper records (DIMS)	94~~88~~	4.4~~4.9~~%
Other	48~~48~~	2.2~~2.7~~%
Multiple Storage Methods	30~~12~~	1.4~~0.7~~%
Missing	13~~12~~	0.6~~0.7~~%
% of patient revenue, Medicare		
None	95~~109~~	4.4~~6.1~~%
Less than 30	563~~478~~	26.1~~26.6~~%
More than 30	932~~769~~	43.2~~42.7~~%
Missing	569~~443~~	26.4~~24.6~~%
% of patient revenue, Medicaid		
None	138~~132~~	~~7~~6.4~~.3~~%
Less than 30	1031~~869~~	47.7~~48.3~~%
More than 30	390~~333~~	18.1~~18.5~~%
Missing	600~~465~~	27.8~~25.8~~%
% of patient revenue, Private Insurance		
None	14~~36~~	0.6~~2.0~~%
Less than 30	358~~321~~	16.6~~17.8~~%
More than 30	1437~~1180~~	66.6~~65.6~~%
Missing	350~~262~~	16.2~~14.6~~%
% of patient revenue, Patient Payments		
None	23~~72~~	1.1~~4.0~~%
Less than 30	1204~~1012~~	55.8~~56.3~~%
More than 30	146~~125~~	6.8~~6.9~~%
Missing	786~~590~~	36.4~~32.8~~%
% of patient revenue, Other		
None	36~~163~~	~~9~~1.7~~.1~~%
Less than 30	151~~138~~	7.0~~7.7~~%
More than 30	~~80~~82	3.8~~4.4~~%
Missing	~~1418~~1890	87.5~~78.8~~%
Preferred method of survey administration		
Web-based	855~~736~~	39.6~~40.9~~%
Regular mail	1198~~962~~	55.5~~53.5~~%
Telephone interview	21	1.0~~1.2~~%
In-person interview	12	0.6~~0.7~~%
Multiple	16~~9~~	0.7~~0.5~~%
Missing	~~59~~57	2.6~~3.3~~%

DISCUSSION

The physician list was inadequate for the purpose of administering the survey as indicated by the difference between our start-up count of 18,642 and the final adjusted count of 10,327. DPH licenses physicians to practice in Connecticut, but does not maintain a list of practicing physicians. We found that physicians move, retire, graduate from medical school, and die. Any one of these issues by itself does not create a lot of noise, but together these issues render the list suspect for calculating outcome measures. At any given time it is difficult for the DPH or any other body to know who is practicing in the state of Connecticut. This issue is being identified as a challenge across states. (12) As work is being done to setup health information and health insurance exchanges, accurate provider directories are the first step in setting up functional exchanges for health provision and coordination.

Currently, DPH uses both electronic and paper processes for license renewal. We recommend that the state licensing and renewal application add two questions that may improve the list substantially over a period of one year, given that all physicians have to renew their licenses annually. First, physicians should be asked whether or not they practice in the state. Second, it may be useful to have all physicians designate the sites at which they practice; these sites should be flagged as either primary or secondary sites. This is important because, even though physicians may practice at multiple sites, we want them to respond to our survey based on their experience at their primary site. Third, it may be time to mandate that all renewals be done electronically; this would eliminate the process of merging the two sources of license renewal data to obtain a master list. Last, a subset of these physicians will be applying to CMS for incentives. As a result, the projected number of physicians who are likely to apply for these incentives could be off by a significant magnitude.

There has been pressure on the states that received HIE grants to document baseline EHR adoption rates quickly. This may not be feasible, given that it took a year to get the survey out into the field and then realize that the list was not accurate. We were concurrently cleaning the list as we were sending surveys out to physicians. It would have been more prudent to first clean the list and then send out the postcard. Also, ONC would be better off allowing states to use the rates estimated by NAMCS as their baselines; this would allow states the necessary time to get their provider directories in order and to then implement a statewide physician survey based on the population or a sample to measure change overtime in EHR adoption rates.

Lastly, we feel that the two-step approach, using a postcard followed by a survey, is prudent in two ways. First we would have wasted a lot of our funds had we just mailed out our survey at a cost of $1 per survey in comparison to 25 cents per postcard. Second, we were surprised that 56% of the respondents preferred regular mail to web-based surveys. Given that most surveys with physicians are done using the internet, we would have lost a lot of responses had we only used the web-based method for survey administration.

Limitations The postcard response rate is a challenge as the state tries to estimate how many of its physicians will apply and attest successfully to receive incentive payments from CMS. The evaluation team ~~is~~ called~~ing~~ the practices in the list to identify possible duplicates, since at least 50% of the physicians indicate that they practice at more than one site. Cleaning of the physician list will need to be an ongoing process, since~~, as~~ every year new physicians are added to the existing list of licensed physicians. It is possible that the question about "revenue sources (Q8)" may have depressed the response rate, since physicians may have perceived this as a "Big Brother"-style question. It is possible that the physicians feel "survey fatigue" or that they did not want to respond to this survey. We believe that asking these questions on a license renewal application may yield better results, since every physician in the state has to renew their license annually. Also, it is possible that respondents who chose 'no' or 'retired' to the first question did not return the survey as we did not have clear skip instructions asking them to return the survey even if they only answered Q1.

CONCLUSION

It is extremely difficult for states that do not have a centralized provider directory to maintain an accurate list of practicing providers. For such states, the environment scan data incorporated in the statewide strategic and operational plan submitted to the ONC may have some errors and limitations. Even though they might be the best baseline data available at the state level, ONC will need to be cautious in using this indicator, since the effort to clean the physician list is up to the state. Measuring progress on the EHR adoption indicator can be accurate only if all states use a systematic process for cleaning their lists of practicing physicians. In the state of Connecticut, we were able to remove duplicates from the list using a simple process of checking the internet, followed by calls to doctors' offices. Other states may want to follow this simple process if they do not have the funds

available to buy systems and hire staff whose sole responsibility is to clean their physician list. As a result, each list's accuracy will vary proportional to the time and resources spent on cleaning the list.

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Figure 1: Postcard Questions

Please complete the following survey and mail the postcard

1. Do you currently practice in the state of Connecticut? O Yes O No O Retired	ID
2. Your main practice site is : O Single specialty group/partnership O Multi specialty group/partnership O Solo practice	8. Roughly what percent of your patient revenue comes from the following? (Percentage should total 100%) Medicare_____ Medicaid (including Husky. SAGA Medicaid LIA & Title 19) _____ Private insurance _____ Patient payments_____ Other (please specify) _____
3. How does your main practice site store patient information? O Paper medical records/charts stored in cabinets O Computerized system which stores scanned copies of paper records (DIMS) O Electronic Health Record O Both –paper and computerized O Other please specify: _____	
4. What is the year of your birth? _____	9. Which method of survey administration do you prefer? O Web-based(we will email you a survey link) O Regular mail O Telephone interview O In Person interview O Do not want to receive survey
5. What is your gender? O Male O Female	
6. What is your ethnicity? O Hispanic or Latino O Not Hispanic or Latino	
7. What is your race? O White O Black/African American O Asian O Native Hawaiian/Other Pacific Islander O American Indian/Alaska Native	Please supply us with the following information Email address: Telephone number: