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IT-enabled Community Health Interventions: Challenges, Opportunities, and Future Directions

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Abstract
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Abstract

Rising health information technology (HIT) adoption and the increasing interoperability of health data have propelled the role of IT in community-wide health transformations. Disseminating the challenges and opportunities that the early adopters of community-wide HIT interventions have experienced is critical for empowering the growing demand for community-based health systems. This special issue of *eGEMs* addresses that need. This issue includes a variety of community-based HIT projects covering topics such as governance, informatics, and learning health systems. These projects represent a diverse set of stakeholders, a wide selection of data sources, and multiple information platforms to collate or exchange data. We hope that this special issue of *eGEMs* will be the first of several future issues dedicated to community-wide HIT transformations.

Introduction

Over the last five years there has been unprecedented effort directed at quality and efficiency improvements in health care using health information technology (HIT). Such activities are now underway at the national, state, and local community levels. Given the complexity and rapid pace of development and change, those involved in crafting and implementing these interventions are often in a position of breaking new ground. Rarely are the experiences of these "digital path breakers" shared widely, and the learning opportunities are often lost. With support from the Commonwealth Fund, AcademyHealth's "Beacon Evidence and Innovation Network" has sponsored this special *eGEMs* issue to capture important insights from a series of vanguard organizations involved in major HIT interventions intended to improve community- or population health through cross-organizational HIT partnerships. The papers published in this special issue emphasize ways to share, integrate, and use new digital data sources, including electronic health records (EHRs) and other electronic sources derived from consumers and public health agencies.

In this commentary we provide an overview of the scope of the papers appearing in this issue and offer a few observations regarding this unique set of publications, including some unifying themes. We then highlight a few challenges and opportunities—as well as future directions—for HIT application to the community, public health, and population-health domains.

Defining the Shared Space for Population Health, Communities, and Health IT (HIT)

The wide-scale adoption of HIT, with a quadrupling of EHR use among physicians in the last decade[1] has enabled diverse parties, such as providers, payers, and government agencies to collaborate on digitally based interventions to improve the health of communities or other defined populations. There have been many population-wide interventions that have used HIT solutions to improve the health of persons enrolled in specific health plans or cared for by a single provider organization. To date, most community HIT efforts have been primarily focused on a defined geographic area and generally represent one-off projects, often with federal funding.[2,3] The Health Information Technology for Economic and Clinical Health (HITECH) Act was designed to boost HIT adoption nationwide, and has been the foremost source of funding for these types of efforts. In addition to incentivizing providers through the Meaningful Use program that has supported clinician and hospital adoption of EHRs, the Office of the National Coordinator for HIT (ONC) has supported Health Information Exchanges (HIEs) to promote the exchange of electronic data across the country, and has supported BEACON Community HIT-supported cross-provider collaborative quality- improvement interventions. These time-limited BEACON grants challenged 17 communities to design, pilot, and evaluate community-based HIT interventions by expanding and sharing data captured in EHRs, and often linking these data to other available data sources (e.g., insurance claims and public health data).[4]

The number of submissions for this special issue is a sign of the increased interest in such collaborations. The papers accepted for publication cover a wide array of applied issues ranging from the role of consumers in a community HIT effort to the development of geographic-based registries of chronic diseases, and include in-depth reviews of the federally funded Beacon Community initiative.

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To date there is no agreed-upon definition of what is or is not a "community-based" HIT intervention. For this reason we encouraged submissions if the project spanned a geographic area and involved more than a single type of stakeholder— ideally representing multiple organizations from a diverse range of stakeholders, including but not limited to payers, providers, and patients. Although the traditional definition of community health—which encompasses both healthy and unhealthy patient populations—does not apply to all papers in this issue, most of these papers have resulted in adopting HIT interventions that affect the health of a large subpopulation of a community.

While a common thread of the papers appearing in this special *eGEMs* issue is the use of EHRs or other HIT applied on a collaborative basis to communities or other target populations, the articles reflect a rich diversity of technical innovations, stakeholders, and organizational and political contexts.

To give readers a sense of the richness of these papers, we have arrayed some key features of each project and its focus along several dimensions. These dimensions are outlined below and are represented in Table 1. In response to *eGEMs*' primary domains of focus, the papers focus primarily on governance, informatics, and the integration of "learning health systems" to improve population health. Three "Governance" papers focus in depth on legal, political, and organizational challenges of engaging a diverse set of stakeholders in a community-based HIT intervention (these papers will also be cross-posted in the EDM Forum's governance toolkit). The four "Informatics" papers emphasize the technological challenges of exchanging digital data across heterogeneous data sets while assuring data accuracy, access, and security. And the eight "Learning Health Systems" papers share lessons learned from various stages of design, development, and deployment of HIT-supported solutions targeted at community-wide system transformation and evidence-based care improvement.

The Current State of the Art

To help readers better identify the maturity stage and collaborative scope of the interventions described in this issue, we identified major themes that reflect the rich diversity of the papers and the innovations they describe. Given that these projects represent some of the most advanced efforts to date in the United States that are related to community HIT intervention, these themes can be used to assess the current state of the art and associated gaps. Below are some of our observations of what was and was not reported by the authors as part of their interventions:

- ***HIT Solutions:*** Several HIT tools and modalities were applied across the projects described in this issue (e.g., EHRs, PHRs, HIEs). Perhaps understandably for these cross-provider initiatives, 80 percent of the papers have used HIE infrastructure as their key HIT system to facilitate data exchange across their providers and subpopulations.
- ***Funding:*** All but one of the projects described in this issue were supported, at least in part, by the ONC-funded Beacon Community program or related initiatives such as the CDC Beacon Community program for Public Health.
- ***Geographic Locales:*** The geographical distribution of these projects covered metropolitan and rural communities and several entire states. Two of the papers review existing community-wide HIT projects that span multiple states.[5,6]
- ***Stakeholder Engagement:*** Three of the papers delineate stakeholder engagement.[7,8,9] These papers often address governance challenges and offer solutions to engage stakeholders. Stakeholder diversity is high among these projects as they include representatives from providers, payers, population denominators, and public health entities.
- ***Design and Development:*** Four papers primarily address the design and development of community-based HIT solutions.[10,11,12,13] These papers offer innovative solutions for exchanging data or creating centralized registries of patients among multiple stakeholders.
- ***Deployment and Intervention:*** Three of the submissions discuss the implementation challenges of HIT interventions within a community, such as incorporating HIE notifications in care coordination.[14,15,16] These papers have faced both technical and policy challenges in increasing the diversity of their stakeholders.
- ***Evaluation:*** A third of the articles focus on the evaluation of HIT-enabled, community-based transformations.[17,18,19,20,21]
- ***Sustainability:*** Although sustainability was mentioned by a few of the submissions, none of them dedicated its paper to sustainability challenges faced by community-based HIT projects. Community-based HIT programs will most certainly need guidance from future literature on how to sustain federally and locally funded projects. And of course, journals such as *eGEMs* can be an effective venue to discuss and disseminate solutions for such challenges, as illustrated by the recent *eGEMs* special issue on approaches to achieving the sustainability of health data infrastructure.[22]
- ***Conceptualization:*** Conceptual frameworks are sparsely discussed in the submissions. None of the manuscripts has a dedicated focus on conceptualizing community-based HIT solutions. Future research should entail the conceptualization and translation of overarching population HIT frameworks into community-based HIT interventions.

Some Key Challenges

This special issue describes cutting edge projects and offers an opportunity to expedite the way of others who may follow in similar footsteps. Based on our review of this collection of leading edge projects, we believe further work is needed in a variety of domains. Overall, many of the challenges faced by the projects described in this special issue are similar and thus likely foreshadow what cross-provider HIT interventions at the community level will encounter in the years to come. The common challenges described across the papers include the following:

- ***Ambiguity of Definitions:*** Developing clear definitions of what constitutes a community-based HIT intervention, given that current definitions are still ambiguous, should be a priority. Future research should develop frameworks and guidelines on how to identify denominators, stakeholders, determinants, data sources, methods, interventions, outcomes, and measures for a given community or population with a defined set of HIT and data infrastructure.
- ***Need for Unified Conceptual Models:*** Conceptual models of population HIT interventions are needed to guide the overall design and deployment of practical community-based HIT solutions. These conceptual models should be validated in practice and eventually unified into overarching models that can be publicly accessed and easily adopted to better target the Institute for Healthcare Improvement's "Triple Aims."[23]
- ***Interoperability Issues:*** Insufficiency of interoperability standards to integrate and exchange information across stakeholders is still a major barrier. The lack of interoperability will be more prominent within community-based HIT interventions that require incorporating nontraditional or emerging data sources (e.g., non-EHR data).
- ***Fragmented Big Data:*** Data are highly fragmented in community-based transformations. Data are often stored in silos, and a series of technical, financial, political, and cultural factors prohibits the stakeholders from sharing them. The emergence of Big Data will be inevitable in such projects given the volume, variety, and velocity of the data that will be evolved over time. New and nontraditional sources of data will only add to this complexity. Future research should address these problems and should also provide appropriate methods to integrate and analyze such uncommon data compositions.
- ***Community-based Quality Measures:*** Accurate and timely metrics are needed to evaluate and compare HIT-enabled, community-based interventions across a diverse set of stakeholders. These metrics should cover various aspects of community-based HIT interventions including performance, process, outcome, patient satisfaction, safety, and population health. Population metrics are immature and national benchmarks are not established yet,[24] thus limiting the comparison of impact and success among community-based HIT projects. Future research should develop a set of community-based HIT measures that retain a high reliability and validity when generalized to other populations.
- ***Stakeholder Diversity:*** Ineffective community-based HIT infrastructure, lack of interoperability, exchange standards that cut across a diverse set of stakeholders (e.g., integrating social data with EHRs), and insufficient incentives to share data across stakeholder groups are all limiting factors to building a diverse set of stakeholders that would represent providers, payers, patients, and public health agencies all together. Defining population needs and identifying interventions that can be beneficial to all stakeholders (cutting across stakeholder categories) should be a priority for future community-based HIT deployments.
- ***Misalignment of Incentives:*** Alignment of incentive structures among stakeholders to share, integrate, and analyze data is critical to the success of community-based interventions. Also, the misalignment of incentives is a major impediment to scaling up and generalizing successful HIT-enabled, community-based transformations to other communities. New federal, state, or local policies, either HIT or payment reform, should address these challenges and incentivize all stakeholders to share data and learn from the collective outcomes. Recent payment reforms such as the population-based all payer hospital payment model in Maryland[25] could be a unique environment to pilot and evaluate such HIT-enabled transformations.
- ***Privacy and Security:*** Access barriers associated with privacy and security protocols are often exacerbated when HIT interventions are deployed across the organizations and geography of an entire community. Engaging the entire community and a diverse set of stakeholders in data governance earlier in the project may provide opportunities to resolve some of these issues.

Next Steps and Conclusion

It is our hope that this special issue will help trigger interest among the next wave of HIT implementers, researchers, and program officers to conduct and fund new HIT-enabled, community-based transformations. These future efforts should build on the fine, albeit challenging, work described in these articles, and they should attempt to surmount some of the existing limitations discussed by the authors and outlined above. Community- and population-targeted HIT interventions such as these will be essential if the digital health infrastructure now spreading across the nation is to meaningfully contribute to improvement in United States health care and public health systems and, more importantly, the health of Americans.

Table 1. Summary of Articles in this Special Issue

Author and Title	*eGEMs* Theme	Data Collected and/or Used*	Community-based HIT Platform or Infrastructure	Key Organization	Funder	Geography	Primary Areas of Focus	Interventions*
Des Jardins: "The Keys to Governance and Stakeholder Engagement: The Southeast Michigan Beacon Community Case Study"	Governance	• Data collected through process observation *Larger intervention:* • In-and-outpatient EHR data • Claims (Medicaid and Medicare) • Lab data received from lab vendors	• HIE • Community-wide CDR	Southeast Michigan Beacon Community	ONC-Beacon	Southeast Michigan (Wayne County: Detroit, Highland Park, Hamtramck, Dearborn, and Dearborn Heights)	• Diabetes	• Governance *Larger intervention:* • Clinical decision support • Patient education • Workflow management • Patient health navigator
Khurshid: "How a Beacon Community Program in New Orleans Helped Create a Better Health Care System By Building Relationships Before Technology"	Governance	• Patient survey data *Larger intervention:* • In-and-outpatient EHR data • EHR-based registries • Other data sources exchange via HIE	• HIE • m-Health	Greater New Orleans Beacon Community	ONC-Beacon	Louisiana (Greater New Orleans)	• Diabetes • CVD	• Governance *Larger intervention:* • Clinical decision support • Risk stratification • Workflow management • Learning community • Patient education
Dullabh: "How Patients Can Improve the Accuracy of their Medical Records"	Informatics	• EHR-based medication data • PHR-usage log files • Data collected via survey and focus groups of patients	• PHR (tethered)	Geisinger Healthcare	Internal	Pennsylvania (Berwick and Pottsville)	• COPD • Asthma • HTN diabetes • HF	• Medication reconciliation • Patient engagement
Revere: "Leveraging Health Information Exchange to Improve Population Health Reporting Processes: Lessons in Using a Collaborative-Participatory Design Process"	Governance	• Data collected by survey of public health officials • Focus groups and brainstorming data *Larger intervention:* • In-and-outpatient EHR data • Lab, radiology, and other data sources exchange via HIE • Public health data	• HIE • CDR/W • ELR detection and notification	Indiana HIE	ONC-HIE	Indiana (statewide)	• Reportable diseases and conditions	• Governance *Larger intervention:* • Surveillance • Clinical decision support • Workflow management • Encounter notification

Table 1. Summary of Articles in this Special Issue (cont'd)

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Heider: "Developing a Community-Wide Electronic Health Record Disease Registry in Primary Care Practices: Lessons Learned from the Western New York Beacon Community"	Informatics	• Outpatient EHR-based data • Outpatient EHR-based registries	• RHIO/HIE	Western New York Beacon Community	NYS-Grant & ONC-Beacon	Western New York	• Diabetes	• Population health management • Quality benchmarking
Goldwater: "Emphasizing Public Health Within a Health Information Exchange: An Evaluation of the District of Columbia's Health Information Exchange Program"	Learning Health System	• Data collected from surveys of HIE stakeholders, interviews, and small group discussion	• HIE (+HISP & Direct) • ELR	District of Columbia HIE	ONC-HIE	District of Columbia	• HIV/AIDS • Health disparity	• HIE effectiveness evaluation
Maloney: "Creating a Connected Community: Lessons Learned from the Western New York Beacon Community"	Learning Health System	• HIE effectiveness (multiple data categories) • In-and-outpatient including home health care and long-term care facility EHR data • Lab, radiology, and other data sources exchange via HIE	• RHIO/HIE	Western New York Beacon Community	NYS-Grant & ONC-Beacon	Western New York	• Diabetes	• HIE performance on data sources, result deliveries, lookups, and patient consents
Torres: "Building and Strengthening Infrastructure for Data Exchange: Lessons from the Beacon Communities"	Learning Health System	• Data captured during site visits, interviews, etc.	• Beacon HIEs (multiple)	NORC at University of Chicago	ONC-Beacon	17 locations (some statewide, some regional, and some limited to a city)	• Various focus areas depending on each project	• Reviews and dissemination of findings
Massoudi: "Beacon Communities' Public Health Initiatives: A Case Study Analysis"	Learning Health System	• Data generated from case studies, interviews, and document reviews	• Beacon HIEs (multiple)	RTI International	CDC-BCPH	6 locations (some statewide, some regional, and some limited to a city)	• Various focus areas depending on each project	• Reviews and dissemination of findings

Table 1. Summary of Articles in this Special Issue (cont'd)

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Fernald: "Supporting Primary Care Practices in Building Capacity to Use Health Information Data"	Learning Health System	• Data captured during site visits, interviews, and focus groups	• HIE • REC	Colorado Beacon Community	ONC-Beacon	Colorado (statewide)	• Quality Improvement among primary care practices	• Quality improvement • Collaborative learning • HIT support
Gutteridge: "Enhancing a Geriatric Emergency Department Care Coordination Intervention Using Automated Health Information Exchange-Based Clinical Event Notifications"	Informatics	• HIE log files • CEN-EHR log files	• HIE • CEN	Sinai Healthcare and New York HIE	CMS-CMMI	New York (New York City metropolitan area and Long Island)	• Needs of older adults in emergency departments	• Clinical event notification • Care coordination
Laws: "The Community Health Applied Research Network (CHARN) Data Warehouse: a Resource for Patient-Centered Outcomes Research and Quality Improvement in Underserved, Safety Net Populations"	Learning Health System	• Data generated through process observation *Larger intervention:* • Patient demographics • Encounter data • Diagnosis data • Lab results • Medication orders	• Community-wide CDR\W	HRSA	HRSA	Multiple partners at various locations (CA, IL, MA, OR)	• Underserved and safety net populations	• Quality improvement
Tennison: "The Utah Beacon Experience: Integrating Quality Improvement, Health Information Technology, and Practice Facilitation to Improve Diabetes Outcomes in Small Healthcare Facilities"	Learning Health System	• Qualitative data collected through process observation • Self-assessment surveys of clinics	• Outpatient EHRs	Utah Beacon Community	ONC-Beacon	Utah (Salt Lake Metropolitan Statistical Area)	• Diabetes	• Staff training for EHR optimization • Quality improvement in small health care facilities

Table 1. Summary of Articles in this Special Issue (cont'd)

Author and Title	*eGEMs* Theme	Data Collected and/or Used*	Community-based HIT Platform or Infrastructure	Key Organization	Funder	Geography	Primary Areas of Focus	Interventions*
Chute:" The Southeastern Minnesota Beacon Project for Community-driven Health Information Technology: Origins, Achievements, and Legacy"	Learning Health System	• Data generated through process observation *Larger intervention:* • In-and-outpatient EHR data • Lab, radiology, and other data sources exchange via HIE	• HIE • CDR/W	South-eastern Minnesota Beacon Community	ONC-Beacon	Southeastern Minnesota	• Childhood asthma • Adult diabetes • Influenza vaccination	• Care coordination • Integration of Patient Reported Outcomes (PROs) • Event notification • Medication reconciliation
Kanger: "Evaluating The Reliability Of EHR-Generated Clinical Outcomes Reports: A Case Study"	Informatics	• Outpatient EHR data • Data sources exchange via HIE	• HIE	Greater New Orleans HIE	ONC-Beacon	Louisiana (Greater New Orleans)	• Diabetes quality measures	• Improvement of data reliability extracted from EHRs

Notes: *In some of the papers, "Data Collected and/or Used" and "Interventions" columns also include items used in the original community-based HIT program. These items are listed under "Larger Intervention" headings.

Acronym Key: BCPH = Beacon Communities for Public Health; CDC = Centers for Disease Control and Prevention; CDR/W = Clinical Data Repository/Warehouse; CEN = Clinical Event Notification (system); CHARN = Community Health Applied Research Network; CMS = Center for Medicare and Medicaid Services; CVD = Cardiovascular Diseases; Direct = Direct Secure Messaging; EHR = Electronic Health Record; ELR = Electronic Lab Reporting; HF = Heart Failure; HIE = Health Information Exchange; HISP = Health Information Service Provider; HRSA = Health Resources and Services Administrations; HTN = Hypertension; ONC = Office of the National Coordinator; PHR = Personal Health Record; Pay = Payers; Pop = Population, community, or identified group of patients; Pro = Providers (inpatient or outpatient); Pub = Public health agencies or state and local health departments. REC = Regional Extension Center; RHIO = Regional Health Information Organization; m-Health = mobile Health

References

1. Hsiao CJ, Hing E, Ashman J. Trends in Electronic Health Record system use among office-based physicians: United States, 2007-2012. *National Center for Health Statistics.* May 20, 2014. Available from: http://www.cdc.gov/nchs/data/nhsr/nhsr075.pdf.
2. Joint Public Health Informatics Taskforce. Future information capabilities for public health. Sep 2013. Available from: http://jphit.org/wp-content/uploads/2013/09/1-PH-IS-Futures-Intro.pdf.
3. Schachter A, Rein A, Sabharwal R. Beacon Policy Brief: Building a foundation of electronic data to measure and drive improvement. *The Office of National Coordinator.* Aug 2013. Available from: http://www.healthit.gov/sites/default/files/beacon_quality_measurement_brief_final_14aug13.pdf.
4. Schachter, op. cit.
5. Torres, Gretchen; Swietek, Karen; Ubri, Petry S.; Singer, Rachel; Lowell, Kristina; and Miller, Wilhelmine (2014) "Building and Strengthening Infrastructure for Data Exchange: Lessons from the Beacon Communities," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 9. DOI: http://dx.doi.org/10.13063/2327-9214.1092. Available from: http://repository.academyhealth.org/egems/vol2/iss3/9.
6. Massoudi, Barbara L. MPH, PhD; Marcial, Laura H.; Haque, Saira; Bailey, Robert; Chester, Kelley; Cunningham, Shellery; Riley, Amanda; and Soper, Paula (2014) "Beacon Communities' Public Health Initiatives: A Case Study Analysis," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 14. DOI: http://dx.doi.org/10.13063/2327-9214.1093 Available from: http://repository.academyhealth.org/egems/vol2/iss3/14
7. Des Jardins, Terrisca R. (2014) "The Keys to Governance and Stakeholder Engagement: The Southeast Michigan Beacon Community Case Study," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 2. DOI: http://dx.doi.org/10.13063/2327-9214.1068, Available from: http://repository.academyhealth.org/egems/vol2/iss3/2
8. Khurshid, Anjum and Brown, Lisanne (2014) "How a Beacon Community Program in New Orleans Helped Create a Better Health Care System By Building Relationships Before Technology," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 3. DOI: http://dx.doi.org/10.13063/2327-9214.1073. Available from: http://repository.academyhealth.org/egems/vol2/iss3/3

9. Goldwater, Jason; Jardim, Juliette; Khan, Tasnuva; and Chan, Karen (2014) "Emphasizing Public Health Within a Health Information Exchange: An Evaluation of the District of Columbia's Health Information Exchange Program," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 8. DOI: http://dx.doi.org/10.13063/2327-9214.1090. Available from: http://repository.academyhealth.org/egems/vol2/iss3/8
10. Revere, Debra; Dixon, Brian E.; Hills, Rebecca; Williams, Jennifer L.; and Grannis, Shaun J. (2014) "Leveraging Health Information Exchange to Improve Population Health Reporting Processes: Lessons in Using a Collaborative-Participatory Design Process," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 12. DOI: http://dx.doi.org/10.13063/2327-9214.1082. Available from: http://repository.academyhealth.org/egems/vol2/iss3/12
11. Heider, Arvela R.; Maloney, Nancy; Satchidanand, Nikhil; Allen, Geoff; Mueller, Raymond; Gangloff, Steven; and Singh, Ranjit (2014) "Developing a Community-Wide Electronic Health Record Disease Registry in Primary Care Practices: Lessons Learned from the Western New York Beacon Community," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 7. DOI: http://dx.doi.org/10.13063/2327-9214.1089 Available from: http://repository.academyhealth.org/egems/vol2/iss3/7
12. Maloney, Nancy; Heider, Arvela R.; Rockwood, Amy; Singh, Ranjit (2014). "Creating a Connected Community: Lessons Learned from the Western New York Beacon Community," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3. In press.
13. Laws, Reesa; Gillespie, Suzanne; Puro, Jon; Van Rompaey, Stephan; Quach, Thu; Carroll, Joseph; Chang Weir, Rosy; Crawford, Phil; Grasso, Chris; Kaleba, Erin; and McBurnie, Mary Ann (2014) "The Community Health Applied Research Network (CHARN) Data Warehouse: a Resource for Patient-Centered Outcomes Research and Quality Improvement in Underserved, Safety Net Populations," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 11. DOI: http://dx.doi.org/10.13063/2327-9214.1097. Available from: http://repository.academyhealth.org/egems/vol2/iss3/11
14. Gutteridge, David L. MD, MPH; Genes, Nicholas MD, PhD; Hwang, Ula MD, MPH; Kaplan, Benjamin; GEDI WISE Investigators, The; and Shapiro, Jason MD, MA (2014) "Enhancing a Geriatric Emergency Department Care Coordination Intervention Using Automated Health Information Exchange-Based Clinical Event Notifications," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 6. DOI: http://dx.doi.org/10.13063/2327-9214.1095 Available from: http://repository.academyhealth.org/egems/vol2/iss3/
15. Tennison, Janet; Rajeev, Deepthi; Woolsey, Sarah; Black, Jeff; Oostema, Steven J.; and North, Christie (2014) "The Utah Beacon Experience: Integrating Quality Improvement, Health Information Technology, and Practice Facilitation to Improve Diabetes Outcomes in Small Healthcare Facilities," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 5. DOI: http://dx.doi.org/10.13063/2327-9214.1100 Available from: http://repository.academyhealth.org/egems/vol2/iss3/5
16. Chute, Christopher G.; Hart, Lacey A.; Alexander, Alex K.; Jensen, Daniel W. (2014) "The Southeastern Minnesota Beacon Project for Community-driven Health Information Technology: Origins, Achievements, and Legacy," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3. In press.
17. Dullabh, Prashila; Sondheimer, Norman; Katsh, Ethan; and Evans, Michael A. (2014) "How Patients Can Improve the Accuracy of their Medical Records," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 10. DOI: http://dx.doi.org/10.13063/2327-9214.1080 Available from: http://repository.academyhealth.org/egems/vol2/iss3/10.
18. Torres, op. cit.
19. Massoudi, op. cit.
20. Fernald, Douglas; Wearner, Robyn; and Dickinson, W. Perry (2014) "Supporting Primary Care Practices in Building Capacity to Use Health Information Data," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3, Article 4. DOI: http://dx.doi.org/10.13063/2327-9214.1094. Available from: http://repository.academyhealth.org/egems/vol2/iss3/4
21. Kanger, Chatrian; Brown, Lisanne. Mukherjee, Snigdha; Xin, Haichang; Diana, Mark; Khurshid, Anjum (2014) "Evaluating The Reliability Of EHR-Generated Clinical Outcomes Reports: A Case Study," *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol. 2: Iss. 3. In Press.
22. Wilcox, Adam (Ed.), (2014). Sustaining the Effective Use of Health Care Data. *eGEMs (Generating Evidence & Methods to improve patient outcomes)*: Vol 2: Iss. 2. Available from: http://repository.academyhealth.org/egems/vol2/iss2/
23. The IHI Triple Aim Initiative. *Institute for Healthcare Improvement.* 2014. Available from: http://www.ihi.org/Engage/Initiatives/TripleAim/pages/default.aspx
24. Teutsch S, Grumbach K, Hasnain-Wynia R, et al. Toward quality measures for population health and the leading health indicators. *Institute of Medicine.* Jul 2013. Available from: http://www.iom.edu/~/media/Files/Report%20Files/2013/Quality-Measures/QualityMeasuresRB.pdf.
25. Rajkumar R, Patel A, Murphy K, et al. Maryland's All-Payer Approach to Delivery-System Reform. *N Eng J Med.* Jan 2014:1-3.