Web Appendix I. Informatics in Public Health

Year/ Authors	Aim	Design	Sample	Data sources/ Analytic strategy	Findings
Magruder et al.[9]	To inventory and evaluate IT use and needs in LHDs	Quantitative descriptive	3131 LHDs with 11% response rate (*n*=344)	Survey designed using the 10 essential services of public health as a framework (mailed); Descriptive statistics	More than 500 software programs were reported; Most frequently reported (in order): MS Access, MS Word, MS Excel, HOST, Epi Info, KIPHS, MS Powerpoint, VISION, HSIS, and QS.
Foldy[56]	To provide an inventory of HIE projects in Wisconsin and report challenges and recommendations	Cross-sectional	30 organizations nominated for participation by eHealth board members, staff, consultants, or workgroup members. Response rate of 90% (*n*=27)	Survey through Surveymonkey	Participants with no HIE projects: 20% (*n*=6); The other 21 organizations reported 16 operational and 11 planned HIE projects; Of the 16 operational projects, seven only provide information to central registries for public health or quality surveillance; 1 delivers information to clinical care providers; 8 serve both purposes; 2 provide information to patients.
Landis et al.[46]	To describe SPHERE development, functions, applications, security, and impact on public health assessment.	n/a	n/a	n/a	SPHERE is part of Wisconsin's PHIN; it is the main reporting tool for the Maternal and Child Health program, Family Planning/Reproductive Health, and Children and Youth with Special Healthcare Needs; It is used by more than 150 organizations in Wisconsin; It can be used to monitor health

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					outcomes, comply with reporting requirements, document community needs, track quality, and monitor trends.
McDaniel et al.[25]	To discuss consumer health information from the perspective of the consumer	n/a	n/a	n/a	Provides description of evolution of informatics in healthcare. Briefly provides some examples of systems used for public health: GIS used by one LHD to identify and notify citizens living in an area at high risk for West Nile Virus; NEDSS for collection and exchange of public health, laboratory, and clinical data; Immunization and Volunteer registries; HAN.
Goedert[31]	To explain the direction being taken by Leslie Lenert, M.D., the director of the National Center for Public Health Informatics at the Centers for Disease Control and Prevention	n/a	n/a	n/a	Reports that 450 hospitals were participating in BioSense by the end of 2007; it also gets data from acute care hospitals in 27 states. New director has proposed a change to the way the system is structured, wanting local information to feed into state databases which then transmit information to a federal repository.
Brownstein et al.[30]	To describe the development of HealthMap	n/a	n/a	n/a	HealthMap provides real-time intelligence on global emerging infectious diseases. It is used by 20,000 visitors per month,

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					including LHDs.
Smith et al.[44]	To examine e-health within state governments	Cross-sectional	All US states, territories, and Washington DC. Each was allowed to submit one response (*n*=42)	Survey with descriptive statistics and qualitative comments reported	41 of the 42 respondents reported eHealth implementation in public health; 75% of activity was focused on electronic registries (diseases, immunizations, newborn screening, surveillance, and EPSDT tracking); this was followed by decision support tools and telehealth; 8 states had implemented EMR or EHRs.
Nangle et al.[32]	To summarize public health practice into 5 domains; to discuss the historical foundation, current practices, and future direction to ensure success.	n/a	n/a	n/a	Protecting: core activities are mortality surveillance and notifiable disease reporting; Many states and localities are now using electronic reporting based on national standards to report notifiable diseases to NEDSS; Electronic death registration systems are also being used by most states; BioSense is being implemented by the CDC through communication with hospitals to detect disease outbreaks and bioterrorism; Electronic syndromic surveillance is being used my many state, often with RODS; a LHD in Colorado receives reports and sends health alerts to HIE members;

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					Preventing: child health registries for newborn heelstick screening, EHDI as well as CHARM and registries for immunizations and cancer; Promoting: health promotion programs; assessment informatics systems, implementation of PHRs in some states Providing: provider and payer of personal healthcare for disadvantaged populations Participating: making recommendations for reform; exchange of clinical health information based national standards such as HL7 as was done in Utah for clinical laboratory results.
Savory et al.[28]	To improve the effectiveness of the ESSENCE spacial scan statistic by comparing zipcode incidence data to street level data	Unclear; quantitative	Convenience sample of 30 military treatment centers in California	Unclear	ESSENCE is used to monitor outpatient visits at over 250 military health clinics. Improved spacial detection accuracy for disease surveillance can be achieved with street address data.
Feuchtbaum et al.[52]	To describe the long and short-term follow up data collection systems for newborn	Cross-sectional	Cases referred to the California Genetic Disease Screening Program	Descriptive statistics	Implementation of a web-based screening information system for tracking short and long term follow up for children with positive newborn screenings in California is

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	screening in California		between 7/7/2005 and 4/30/2009 (*n*= 4580 for short term follow up; *n*=563 for long term follow up)		described. Initial results indicated that most children receive services through age five.
Office for Oregon Health Policy and Research[6]	To better understand agency information system capacity and needs	Cross-sectional	All 34 Oregon LHDs; 94% response rate (*n*=32)	Electronic survey	Results reported the ability of LHDs to accomplish core public health functions; 50% or more LHDs reported using the following programs: Ahlers, CareWare, ELR lab reporting, Family Net Alert, IRIS, ORCHIDS, and TWIST/WIC, HAN, Medicaid Management Information System, ORPHEUS, OVERS for vital records, Phoenix for food safety, SWS Online for drinking water, Webrad for lab results, and Citrix; 13% do not use an EMR or PMS and among those that do Ahlers is the most common (*n*=20); Many have no external connectivity with local hospitals or clinics (*n*=24) or to surveillance systems with EMRs (*n*=23); Ability to electronically exchange data varies for immunization registries (*n*=28), lab results with

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					other public health agencies (*n*=24), internal and external sources of data (*n*=20), sharing for timely public health intervention and response (*n*=11), and surveillance (*n*=6). 31% are involved a local or regional HIE initiative, 41% are not sure.
National Association of County & City Health Officials[7]	To understand LHDs' data capacity, structure, and function	Quantitative Cross-sectional; Qualitative descriptive	Quantitative: Stratified random sample of LHDs (*N*=724) with 43% response rate; Qualitative: purpose sampling from lists of attendees at four conferences (*N*=41)	Web-based survey; In-person focus groups	There are varying levels of advancement in LHD informatics use with larger departments being more developed. Many people still don't understand what informatics is. 94% have broadband access; 32% report having adequate physical infrastructure for all staff; Of LHDs that provide primary care, 77% use electronic practice management systems as do 65% of those that provide dental care; 52% use an electronic surveillance system; 88% use it to track influenza; 65% use a web-based database to store and access some or all immunization information; 30% report an HIE operating in their area; 53% use Web 2.0 technology to

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					communicate public health emergency information
Monsen et al.[64]	To demonstrate how data from computerized documentation systems by public health agencies to identify MCH client needs and measure care outcomes.	Quantitative exploratory descriptive	Four Minnesota county public health departments	De-identified and aggregated data reported in the public domain; the data were generated through PHN documentation of assessments and service interventions using the Omaha System Descriptive analysis	PHNs address similar serious health issues with low-income, high-risk MCH clients across counties. Statistically significant improvements of client health problems were found for 34 of 40 problems measured ($p<0.05$). Informatics tools and data supported the description of MCH problems and intervention effectiveness in public health departments.
Lewis et al.[27]	To describe the creation of the NCR disease surveillance network	n/a	n/a	n/a	Successful implementation of cross-jurisdictional disease surveillance information sharing was accomplished using ESSENCE which is informed through local data sources (hospitals, poison control centers). Information is de-identified and then transmitted from LHD to state nodes and then on to the central node for the NCR.
Heisey-Grove et al.[61]	To describe changes in the Massachusetts hepatitis C	Quantitative one group pre- and post-intervention	Massachusetts HCV report forms; total *N* is unclear	Descriptive statistics	Pre-intervention: follow up on positive HCV cases done on manual report form by LHDs. Intervention with multiple

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	surveillance system and their impact on timeliness and completeness of reporting.				modifications took place over several years. Final process: MAVEN used to send an OCR form to providers ordering tests that indicated HCV, including existing cases, until a completed OCR form was received. Returned and completed form data is transferred automatically into MAVEN from the TeleForm database using the HL7 messaging format. Results: Increased timeliness in receipt of HCV case reports. Completeness of reports is still an issue.
Shapiro et al.[57]	To describe situations in which HIOs can be useful in public health	n/a	n/a	n/a	Article primarily explains the potential benefits of using HIOs and standard nomenclature for HIE in public health. Two examples mentioned: New York City health department and New York State
Monsen et al.[65]	To use structured clinical data from PHN documentation to describe risk and family home visiting interventions as well as associations	Retrospective cohort	Convenience sample of disadvantaged clients (*N*=486) that received at least three PHN family home visits from a Midwest LHD	Descriptive and inferential analysis of demographic data, service delivery variables, and assessment variables using the Omaha	PHNs tailor interventions to meet client needs. Use of structured clinical data may support studying the relationship between home visiting interventions and outcomes. They may also be useful for determining client risk and describing practice.

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	between the two.			System. Risk index scores were computed from the variables.	
Monsen et al.[66]	To evaluate parenting and outcomes following family home visiting services among mothers with and without intellectual disabilities.	Two-group comparative, 1:3 match	Mothers receiving family home visits from Minnesota county health agencies (*N*= 68); some with (*n*=17) and some without (*n*=51) intellectual disabilities.	Secondary analysis of de-identified data using the mixed model method	Mothers with intellectual disabilities used more services and had more problems. Both groups showed significant improvement for all problem and outcome scores between admission and discharge (mean increase of 0.37). The findings indicated that standardized clinical data such as that generated through the use of the Omaha System can be used to describe problems, services and outcomes for PHN clients.
NORC at the University of Chicago[22]	To describe state and local health departments obtain, manage, analyze, and communicate information with information technology systems.	Qualitative descriptive, case study, and review of literature and reports	Purposive sampling of experts (*N*=20) and key stakeholders (*N*=45); Literature review sampling method and final sample was not specifically described;	Thematic analysis of interviews with experts and key stakeholders and in-depth site visits.	Florida has a united model for state-wide HIE. A variety of information systems are used by LHDs including: Health Management System EHR, ADAP database for tracking HIV care, CAREWare, Enhanced HIV/AIDS Reporting System, Merlin, PRISM, ESSENCE, Florida SHOTS, SpecimenGate, CHARTS, EHD. In Michigan, LHDs have been involved in establishing sub-state HIEs. Examples of information systems used by LHDs include:

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			In-depth case studies (*N*=3) of LHDs in three regions within Central Michigan, Northern Florida, and Western Oregon		MDSS, MCIR, MSSS, NextGen Electronic Health Record, Netsmart's Insight, Vital Records Registry, CHAMPS, Cancer Registry, Chronic Disease Registry (under construction), in-house databases developed for tracking environmental health data Examples of information systems used in Western OR LHDs: Epic Electronic Health Record, MS Access Databases, Netsmart Insight, ALERT Immunization Information System, ORCHIDS, TWIST, ORPHEUS, Vital Events Registration System
McHugh et al.[51]	To collect information on activities to prevent vaccine-preventable childhood disease in the community.	Not specified	Local health departments who were part of the Assessing Changes in Public Health Functions and Policy Issues study (*N*=10)	Site visits; no other information provided	All 10 LHDs use immunization registries; three were specifically mentioned: Little Rock, AR – All Kids Count, Michigan Childhood Immunization Registry, Cleveland – Consortium for Healthy and Immunized Children

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Williams et al.[29]	To determine LHD GIS infrastructure and use for planning; to test possibilities for using maps to address gaps in public health service needs.	Qualitative and case studies	Large county health departments (*N*=4)	Interviews with 65 staff at four LHDs; Case studies to test possibilities for using maps to address gaps in public health service needs	Interview results: GIS used to assess community health needs. The focus commonly was on population risk factors and distribution of diseases. Some mapping of services was completed but usually along with and linked to population health needs.
Ringel et al.[54]	To determine how well health departments communicated H1N1 information via their web sites within 24 hours of the declaration of the public health emergency.	Not specified	State public health departments (*n*=50) and the District of Columbia; LHDs (*n*=153)	Review of state and local health department web sites	LHD results: 34% (*n*=52) provided H1N1 information within 24 hours with more than half linking to the CDC website
Kauerauf[33]	To describe an information system in an award application	N/A	N/A	Application submitted by the system administrator at the Illinois Department of Public Health	I-NEDSS used by all 95 LHDs in Illinois for disease reporting, control, and prevention. A survey of users indicated 81% were satisfied. Strengths were cited as accessibility, more timely reporting, and user friendliness. HL7 used for lab result reporting.

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Octania-Pole[38]	To describe an information system in an award application.	N/A	N/A	Application submitted by the director of data systems at the New Jersey Department of Health and Senior Services	CDRSS is the main tool for notifiable communicable disease reporting and management among New Jersey health care partners and state and LHDs. Mandatory use for LHDs planned due to positive feedback from health officers. HL7 and PHIN VADS terminologies used.
Ising[41]	To describe an information system in an award application.	N/A	N/A	Application submitted by the Technical Team Lead	North Carolina Bioterrorism and Emerging Infection Prevention System used for surveillance and early detection of disease outbreaks (name changed to NC DETECT).
Le[42]	To describe an information system in an award application.	N/A	N/A	Application submitted by the New York State environmental and public health tracking network information technology coordinator	New York State environmental and public health tracking network data exchange system is used for environmental hazard and health outcome data communication. It is part of the New York State Health Commerce Network to which all LHDs have access.
Health IT News[59]	To describe HealthBridge, its expanded service area, and its receipt of federal funds for improvements.	N/A	N/A	N/A	HealthBridge is a health information network used to transmit clinical lab tests, radiology reports, and other results electronically to connect 17 LHDs, 29 hospitals, more than 4400 physician users, and many nursing homes, labs, and radiology centers

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					in the Greater Cincinnati-Northern Kentucky tri-state area.
Pare[50]	To describe an information system in an award application.	N/A	N/A	Application submitted by the system program manager.	The Utah statewide immunization information system is used by all LHDs in the state. The system uses HL7 standards for minimal data exchange. Users expressed satisfaction with the system in a 2002 survey. Positive features were ease of use and immunization information. Additional training for users was suggested.
California Department of Public Health[62]	To provide information on meaningful use and public health in the state of California.	Not specified	California LHDs (*N*= 61); Response rate of 33%	Survey; analysis not specified	Results specific to information system and standard terminology use in LHDs: Four counties in California can receive HL7 syndromic surveillance; Four counties can receive HL7 lab results; one region can receive HL7 immunization data
Banger et al.[45]	To summarize lessons learned by State and Regional Demonstrations in Health IT when developing HIEs.	N/A	N/A	Synthesis of information from six funded state and regional demonstrations in Health IT. Data included monthly teleconferences, biannual in-person meetings, written	Results specific to information system and standard terminology use in LHDs: The Utah Health Information Network supported EMR-lite, a master patient index, and virtual health records query functionality for partners, including LHDs, hospitals, labs, health centers, physicians, and payers.

Year/ Authors	Aim	Design	Sample	Data sources/ Analytic strategy	Findings
				deliverables, and other reports and summaries.	
Wine et al.[49]	To summarize leading projects and future directions in health IT to raise awareness and contribute to knowledge development.	N/A	N/A	Discussion and recommendations of the Intergovernmental Advisory Board of the American Council for Technology. Input sought from all levels of government and industry partners regarding actions to advance health IT and use interoperable standards.	Projects featured included the following systems used by LHDs: North Carolina Immunization Registry and plans for use of HL7 for data exchange in the Los Angeles County LHD.
State of Michigan[26]	To document and communicate the strategic and operational health information exchange plan for the state.	N/A	N/A	N/A	Results specific to information system and standard terminology use in LHDs: The one system specifically mentioned as used by LHDs was the Michigan Health Alert Network. This will be part of the state's Health Information

Year/ Authors	Aim	Design	Sample	Data sources/ Analytic strategy	Findings
					Network.
State of Indiana[43]	To document and communicate the strategic and operational health information exchange plan for the state.	N/A	N/A	N/A	Results specific to information system and standard terminology use in LHDs: HealthBridge is used for transmitting reportable diseases to LHDs. The Regenstrief Institute's Indiana Network for Patient Care uses active surveillance with laboratory reports and data from the Public Health Information Network Notifiable Condition Mapping system. This information is sent to LHDs and health officers. HL7 messaging is used.
Ohio Health Information Partnership[60]	To document and communicate the strategic and operational health information exchange plan for the state.	N/A	N/A	N/A	Results specific to information system and standard terminology use in LHDs: LHDs are part of the HIE initiative. Many types of data are described as reported and/or accessible to LHDs (such as syndromic surveillance data, immunizations, nutrition) but specific systems are not mentioned. HL7 messaging is being piloted.

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State of North Carolina[24]	To document and communicate the strategic and operational health information exchange plan for the state.	N/A	N/A	N/A	Results specific to information system and standard terminology use in LHDs: LHDs are part of the HIE initiative. NC HAN is used for health and bioterrorism alerts. All have access to syndromic surveillance data through NC DETECT, reportable lab results through NC EDSS, and immunization data through NCIR. Other systems include NC Health Information System for electronic health records, and NC-CATCH for community health profiles.
HIMSS Health Care Information Exchange Open Source Task Force[58]	To describe how open source software is used by HIEs.	N/A	N/A	Contacting names from lists of open source development organizations, reviewing information on websites, and connecting with HIE partners.	Multiple systems used by HIEs described. HealthBridge specifically mentioned as used by LHDs in the Greater Cincinnati area.
Hersh[34]	To describe an information system in an award application.	N/A	N/A	Application submitted by the director of the Pennsylvania Bureau of Epidemiology	PA-NEDSS described as the first fully integrated system in the nation. Used for disease surveillance case management, electronic lab reporting, outbreak tracking, and communicating alerts.

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Guthrie[35]	To outline, define, and examine medical surveillance systems and needs.	N/A	N/A	Not specified in presentation slides	Results specific to information system and standard terminology use in LHDs: Epi-X described for its support of communications on disease outbreaks between the CDC, state health departments, and LHDs. Specific users not mentioned.
California Immunization Registry[48]	A website describing the CAIR with resources for LHDs and other users, parents and the publics, and schools and childcare centers.	N/A	N/A	N/A	Results specific to information system and standard terminology use in LHDs: The CAIR is used by LHDs in the state of California. Regions, counties, and cities in the registry are listed on the website.
Public Health Information Network[39]	To share interoperable system success stories in an effort to increase their development and adoption in health care and public health.	N/A	Not specified	Not specified	Results specific to information system and standard terminology use in LHDs: EpiCom implemented in Florida in 2003 to facilitate information exchange and tracking of outbreaks by state and local public health departments, law enforcement, emergency response, and private health care. It was used successfully in Orange and Collier Counties to identify links between cases in an E. Coli outbreak.

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Mackiewski & Taft[23]	To learn how information systems were used by LHDs and where they were and were not effective.	Quantitative and Qualitative	Quantitative: Survey of LHDs with 84% response rate (*N*=76) Qualitative: purposive selection of directors and staff from LHDs in MN (*N*=11)	Quantitative: 10 question survey Qualitative: Interviews; themes identified with data analysis	Results specific to systems used in LHDs: 1200 data sets used; 1300 total applications used ranging from 4-51 per LHD; 380 home grown applications reported; two thirds used either CHAMPS. CareFacts, or PH-Doc; Key systems were identified as MIIC, Rapid Inspection, MAXIS, Social Security Information System, MN-ITS, Client Case Management system, PRISM, Medical Fiscal Intermediary Shared System, WIC, Win Clinic Assessment Software Application, E-Chronicle, EH-DOC
Smith[53]	To discuss common activities in the California Health and Human Services Agency regarding data linkages and web-based query systems.	N/A	Representatives from the California Department of Public Health, Department of Health Care Services, and Office of Statewide Planning and Development; number not specified	Interviews during two days of meetings; data analysis method not specified	LHDs specific information: LHDs were identified as the main audience for the following systems: California Cancer Registry, EPICenter for injury data, Vital Statistics Query System, C-STATS archive of tobacco statistics.

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Lawson et al.[40]	To describe how EARS was implemented in Knox County with several different data sources.	N/A	N/A	N/A	A multifaceted syndromic surveillance system using EARS was implemented by the Knox County LHD with six community partners in TN to monitor an array of syndromes. System creation, operation, and implementation are described.
Pina et al.[36]	To describe the discrete tasks for which the current system is used.	Qualitative observational analysis	Purposive selection of employees (*N*=11) based on job title and job functions	Semi-structured interviews, participatory observation, and focus groups; Data analysis method not specified but authors note that data saturation was achieved.	Seattle & King County LHD in Washington uses CD-Database for communicable disease reporting. Seventeen primary tasks were found to be associated with use of the CD-Database.
Turner et al.[37]	To increase understanding of communicable disease activities in public health.	Ethnographic inquiry	Purposive selection of employees (*N*=9) for interviews	Interviews, observations, and focus groups; multiple analysts used content analysis and the constant comparative method for data analysis.	Kitsap County LHD in Washington uses the PHIMS. Four main workflow processes were identified for communicable disease reporting. The information system was not being utilized as intended.

Abbreviations: IT is information technology; LHD indicates local health department; MS is Microsoft; KIPHS is Kansas Integrated Public Health System; VISION is Virginia Information System Integrated Online Network; HSIS is Human Services Information

System; HIE is health information exchange; SPHERE is Secure Public Health Electronic Record Environment; PHIN is Public Health Information Network; GIS is Geographic Information System; NEDSS is National Electronic Disease Surveillance System; HAN is Health Alert Network; EPSDT is early periodic screening, diagnosis, and treatment; EMR is electronic medical record; EHR is electronic health record; CDC is Centers for Disease Control and Prevention; RODS is Remote Outbreak Detection and Surveillance; EHDI is Early Hearing Detection and Intervention; CHARM is Child Health Advanced Records Management system; PHR is personal health record; HL7 is Health Level Seven International; ORCHIDS is Oregon Child Health Information Data System; ORPHEUS is Oregon Public Health Epidemiology User System; ESSENCE is Electronic Surveillance System for Early Notification of Community-based Epidemics; WIC is Women, Infants, and Children; PMS is practice management system; MCH is maternal child health; PHN is public health nurse; NCR is National Capital Region: HCV is Hepatitis C virus; MAVEN is Massachusetts Virtual Epidemiological Network; OCR is optical character recognition; HIO is health information organization; CHARTS is Community Health Assessment Resource Tool Set; EHD is Environmental Health Database; MDSS is Michigan Disease Surveillance System, MCIR is Michigan Care Improvement Registry, MSSS is Michigan Syndromic Surveillance System; CDRSS is Communicable Disease Reporting and Surveillance System; NC DETECT is North Carolina Disease Event Tracking and Epidemiologic Collection Tool; CAIR is California Immunization Registry; MIIC is Minnesota Immunization Information Connection; EARS is Early Reporting Aberration System; CD is Communicable Disease; PHIMS is Public Health Issue Management System.