

## Appendix: Site Descriptions

**Table I.** Acronyms used in the Appendix.

Full Name	Acronym
Brigham and Women's Hospital	BWH
Clinical Content Consultants	CCC
Computerized Patient Record System	CPRS
Computerized provider order entry	CPOE
Electronic Medical Record	EMR
Health Maintenance Organization	HMO
Indianapolis Network for Patient Care	INPC
Kaiser Permanente Northwest	KPNW
Longitudinal Medical Record	LMR
Massachusetts General Hospital	MGH
Mid-Valley Independent Physicians Association	MVIPA
Partners HealthCare System	Partners
Regenstrief Medical Records System	RMRS
Robert Wood Johnson Medical School	RWJMS
The Regenstrief Institute	Regenstrief
University of Medicine and Dentistry of New Jersey	UMDNJ
Veterans Health Administration	VHA
Veterans Health Information Systems and Technology Architecture	VISTA

Kaiser Permanente Northwest (KPNW) is a large, non-profit, group-practice health maintenance organization (HMO) located in the Pacific Northwest that cares for over 470,000 Health Plan members in the Northwest Oregon and Southwest Washington areas [1]. KPNW is one of eight semi-autonomous Kaiser Permanente regions nationwide that share clinical decision support tools and content. KPNW operates over 30 outpatient clinics and one 199-bed hospital and contracts for additional hospital beds in six regional hospitals. A second owned-and-operated hospital is under construction. Northwest Permanente PC, a multi-specialty medical practice of over 800 providers, provides the medical care and clinical leadership. A pioneer in the use of clinical information systems, KPNW uses a comprehensive suite of applications purchased from Epic Systems Corporation (EpicCare; Epic Systems Corporation, Verona, Wis) for all outpatient encounters—over 1.5 million outpatient visits annually—and for all inpatient documentation and computerized physician order entry at Kaiser Sunnyside Hospital. Among the earliest adopters of EpicCare, beginning implementation in 1994, KPNW has had considerable influence on its development. In addition, KPNW develops clinical content, including CDS rules, and benefits from an extensive internally developed clinical knowledge management infrastructure. KPNW was a recipient of the Davies Award in 1998 and has been thoughtful about its approach to CDS development and implementation [2,3,4,5].

Mid-Valley Independent Physicians Association (MVIPA) is comprised of 500 physician members in a variety of specialties, including approximately 200 primary care physicians. MVIPA serves two counties in and around Salem, Oregon. Currently, over 200 providers from 35 independent practices are using CDS supported by MVIPA as well as an EMR system purchased from NextGen® Healthcare Information Systems. CDS at MVIPA is dependent on content supplied by NextGen, but extensive customization is possible and the Independent Physicians Association has developed some content of its own as well.

Based in Boston, Massachusetts, Partners HealthCare System (Partners) is a large integrated health system that has been using decision support interventions for two decades. Partners members include academic medical centers such as the Brigham and Women's Hospital (BWH) and Massachusetts General Hospital (MGH), both teaching affiliates of Harvard Medical School; community hospitals; a psychiatric hospital; rehabilitation hospitals; and a large network of community-based ambulatory care physicians. Partners serves a patient population from across the greater Boston area that is varied in socioeconomic status and ethnicity. Over 5,000 practitioners complete 1.2 million ambulatory care visits and 100,000 inpatient admissions annually. At Partners, clinical decision support has evolved from medication dosing and drug-drug interaction interventions to guideline-based care reminders. BWH developed an Electronic Medical Record (EMR) in 1989 and its successor, the Longitudinal Medical Record (LMR) was developed in 1997 and is still in active use today. Currently, 1,455 primary care physicians and 1,679 specialists affiliated with BWH and MGH use the LMR. While most practices within Partners use the LMR, others use a commercial system purchased from GE Centricity (approved by Partners) or other vendors; Partners required all providers to use an EMR in 2010. The LMR allows users to manage patient data and supports CDS. On an average day, the LMR processes 25,000 notes, 11,500 medication, 73,000 reminders, 2,000 drug-drug interaction alerts, and 6,200 clinical messages. The most recent innovation in CDS at Partners is the Smart Form, which has been described elsewhere [6,7]. Briefly, the Smart Form is an EMR-based, clinical workflow tool designed to efficiently and effectively integrate data capture, clinical visit documentation, and actionable CDS for specific conditions. Currently, the Smart Form has been used for acute respiratory infections, tobacco cessation, long-term management of coronary artery disease, and long-term management of diabetes mellitus [7,8, 9].

Specializing in medical informatics and health services research since 1972, the Regenstrief Institute (Regenstrief) is a research organization located in Indianapolis, Indiana. Regenstrief is affiliated with the Indiana University School of Medicine. Regenstrief developed its order entry system, the Medical Gopher, in the 1980s for outpatient and subsequently inpatient use in Wishard Memorial Hospital (located in Indianapolis) and affiliated clinics [10]. Wishard Health Services is a county safety-net health system with 15,000 adult inpatient admissions and 1.2 million outpatient visits annually [11]. Regenstrief also developed one of the nation's first EMRs, the Regenstrief Medical Records System (RMRS). RMRS offers actionable CDS capabilities for the hospitals and affiliated clinics. To date, the computerized provider order entry (CPOE) system, which also has CDS capability, has been used for over 32 million physician orders, and the RMRS has a database of 6 million patients [10]. Regenstrief investigators also created an operational community-wide secure data exchange, the Indianapolis Network for Patient Care (INPC). INPC is now available in 15 hospitals and more than 100 clinics and day surgery facilities; it carries over 900 million discrete observations, 20 million text reports, 65 million radiology images, and 450,000 EKG tracings. Finally, Regenstrief investigators were leaders in the development of HL7 clinical data standards.

The University of Medicine and Dentistry of New Jersey (UMDNJ) is a health sciences institution comprised of eight schools and located in four campuses across New Jersey (Camden, Newark, Piscataway/New Brunswick, and Stratford). UMDNJ has four Principal Teaching Hospitals—UMDNJ-University Hospital, Robert Wood Johnson University Hospital, Cooper Hospital/University Medical Center, and Kennedy Memorial Hospital/University Medical Center; three affiliated University Hospitals—Hackensack University Medical Center, Meridian Hospitals Corporation/Jersey Shore University Medical Center, and University Medical Center at Princeton; and affiliations to over 80 New Jersey hospitals. UMDNJ clinical facilities accomplish 2.3 million patient visits annually [12]. UMDNJ deployed Medicalogic's Logician EMR to the entire University in 1999. In 2007, UMDNJ Robert Wood Johnson Medical School (RWJMS) established a separate implementation of GE's Centricity system (GE purchased Medicalogic in January 2002) in a vendor-hosted environment as part of a comprehensive information

technology upgrade that included revenue cycle management. Currently, GE hosts the software and hardware operation of the EMR. At RWJMS, CDS is primarily in the form of condition-specific charting templates and ordering protocols referred to as CCC content because they are produced by a company called CCC (Clinical Content Consultants) that provides them to GE. However, Centricity also includes certain CDS features such as checking for drug-drug or drug-allergy interactions.

The Veterans Health Administration (VHA), part of the United States Department of Veterans Affairs, is a large-scale national provider of medical, surgical, and rehabilitative care to veterans and their family members or survivors. In 2008, nearly 5.5 million people received care through one of the 1,400 sites of the VHA. The VHA employs over 239,000 staff members, including 14,700 physicians, and provides care for over 60 million outpatient visits annually. Facilities include 154 medical centers and 909 ambulatory care and community-based clinics; VHA facilities are affiliated with 107 medical schools and 55 dental schools, and over 90,000 medical professional are trained in VA medical centers each year [13]. Nationally, the VHA is a leader in the use of health information technology. Created in the 1970s, the Veterans Health Information Systems and Technology Architecture (VISTA) has become one of the most advanced health information systems in the world. The VHA's Computerized Patient Record System (CPRS) is an integrated program that provides CDS in the form of reminders and also allows providers to order medications, laboratory tests, consultations, and document actions. VHA mandated implementation of CPRS throughout its national health care network over a decade ago. CDS is widely used at the VHA with an average daily use of the system including the entry of 1,048,832 orders as well as the creation of 762,383 new text documents [14]. In such a large system, the VHA has learned to balance national standard requirements for use with local customization and flexibility. This study specifically studied CDS in use at the Richard L. Roudebush Indianapolis VA Medical Center. The Indianapolis VA Medical Center also operates two community-based outpatient clinics located in Bloomington, Indiana and Terre Haute, Indiana. It serves 46,000 patients from VA facilities in Ft. Wayne and Marion, Indiana, and Danville, Illinois, yielding over 500,000 outpatient visits and over 6,700 inpatient episodes of care annually. The Indianapolis VA Medical Center is affiliated with the Indiana University School of Medicine.

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