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Project Narrative

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**Development of an Information System
to Support Collaboration
for Population-Based Health Care
for Medicaid Beneficiaries**

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EXECUTIVE SUMMARY

This project is intended for the primary application area of Health and the secondary areas of Community Networking and Public Services. The goal of this project is to overcome barriers to sharing information among a consortium of government and private community-based care providers collaborating to support primary care case management for Medicaid beneficiaries in North Carolina. Enhanced communication and information exchange will improve the quality and efficiency of health care delivery and lower the utilization of inpatient and emergency care resources. A group of care providers in Durham County have organized a demonstration project known as the Durham County Health Network's Carolina Access II Care Management Plan to address the health care needs of the Medicaid population. This Network unites social services agencies, community-based clinicians, academically affiliated clinicians and the county's two major hospitals in a collaborative effort to provide quality, cost effective health care for Durham County's Medicaid beneficiaries. However, because this consortium crosses traditional institutional and practice boundaries, limited infrastructure exists to support this venture, particularly in the area of information systems. Efficient communication of information among care providers is critical to successful management of this population, but no commercially available information system will adequately support the specific needs of this project. Therefore, in order to facilitate the sharing of information among network partners, we propose to design, develop, implement and evaluate a secure, Web-based communication system that builds upon exiting information resources to support population-based health care for Medicaid beneficiaries in Durham County.

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PROJECT NARRATIVE

Project Definition

This application seeks funds essential to the development of an information and communication system capable of supporting a national demonstration project that unites a multidisciplinary consortium of government and private care providers to deliver health care more effectively to Medicaid beneficiaries in North Carolina. Effective delivery of efficient, cost effective, high quality health care to this population requires more services (e.g., social work and care management) than the traditional clinic/hospital-centric health care delivery model provides. Expanding the care team to include such services, however, creates new problems in coordinating care among multiple providers across multiple sites. Effective care coordination requires sharing client-specific information, communication among care providers and tracking of the types of services provided.

A consortium of government agencies and non-profit, private clinics and hospitals in Durham County, North Carolina, have organized a demonstration project (the Carolina Access II Managed Care Program) based on primary care case management to address the health care needs of a subset of the Medicaid population. This subset represents Medicaid beneficiaries who have selected a primary care provider at one of the consortium clinics (approximately 10,000 patients--50% of the Medicaid recipients in Durham County). The consortium, known as the Durham County Health Network (DCHN), includes the Durham County Health Department, the Durham County Department of Social Services, the Duke Family Medicine Center, Duke Children's Primary Care, Lincoln Community Health Center, Duke University Hospital, Durham Regional Hospital and the DCHN Care Management Team (see Community Involvement Section for a description of individual partners). This newly created consortium of care providers crosses traditional institutional and practice boundaries. Limited information infrastructure is in place to support the information needs for coordination of care across the DCHN. Through this application we propose to design, develop, implement and evaluate a novel information and communication system that supports the DCHN in the delivery of population-based health care for Medicaid beneficiaries. No commercial communication system is available that efficiently exchanges information across such a breadth of care providers and geographic locations. If successful, this care model and information system will be expanded to include Medicaid recipients and indigent patients throughout North Carolina.

The proposed system will be created in three phases over three years. The first phase will meet the immediate information needs of the Network by providing a centralized database of patient information (care management plans, initial enrollment health data), by tracking and monitoring where enrollees receive care, and by providing online interactive care management protocols. This Phase will require creation of a Web-based database that contains patient enrollment data and a care utilization tracking system. In Phase II, we will demonstrate the ability to enhance the core information on each patient by importing electronically stored data from two practice-specific databases. This phase involves development of two representative HL7 data exchange interfaces to support the transfer of information from existing systems into the shared data repository. Our goal for this phase is to define and demonstrate the principles for making data exchange possible through two representative interfaces rather than creating a comprehensive data repository. In phase III, tools will be developed to proactively assist with population-based disease management and preventive health services. Specifically, we propose to develop an intelligent agent that will be programmed with specific care rules to monitor the clinical database to detect lapses in care, e.g., failure of a patient with diabetes mellitus to have

an annual ophthalmologic examination.

Successful implementation of the proposed information system will enhance the efficiency of the care delivery process, lower the inappropriate utilization of healthcare resources and improve the quality of the care delivered. Improvements in the care delivery process will result in a decrease in the time elapsed from a trigger event (e.g., 2 emergency room visits within 90 days) to the initiation of case management and from enrollment in the program to completion of the required complete physical examination. Lower inappropriate utilization of healthcare resources will lead to fewer emergency room visits and fewer hospitalizations for ambulatory care sensitive conditions, (i.e., illnesses that can routinely be managed in the outpatient setting). Improvement in the quality of the care delivered will be demonstrated by improved HEDIS measures. Details of how these outcomes will be analyzed are outlined in the Evaluation Section.

This information system development project is a pioneering effort to create the information management resources that will be needed to coordinate the health care of populations on a community-wide basis. The system we propose to develop and the lessons learned through the development process will have significant ramifications for similar efforts across the country as health care shifts from disease-focused care of individuals in a hospital or clinic to the management of population health throughout a region.

Evaluation

The effectiveness of the proposed information and communication system for meeting needs for the DCHN will be evaluated according to the following hypotheses and data analysis methods. We hypothesize that implementation of this system will enhance the efficiency (hypotheses 1 and 2, Phase 1), lower the costs (hypothesis 3, Phase I), and improve the quality (hypothesis 4, Phase III) of health care delivery to the Medicaid beneficiaries served by the DCHN. This evaluation will be conducted as a comparison of the selected variables before and after the phased implementation of the proposed information system. (For hypotheses for which baseline data is available—#2, #3, #4—power calculations have been included in the Appendix.)

Hypothesis 1. Implementation of the proposed information system will significantly decrease the amount of time from trigger events (e.g., 2 emergency room visits within 90 days, 3 consecutive missed appointments) to the initiation of case management. *Dependent variable:* Date when case management is initiated. *Data source:* Case management care log. *Data Collection:* Pre-intervention data will be collected for the 6 months prior to implementation of Phase I of the system, and post-intervention data, for the same 6 months one year later (to avoid seasonal variation in care) after the Phase I system has been in regular use across the Network. *Data analysis:* Comparison time elapsed from a trigger event to initiation of case management before and after implementation of the system using a Cox Proportional Hazards model.

Hypothesis 2. Availability of the proposed information system will reduce the time between enrollment in the Medicaid program to the completion of a complete physical examination on the new enrollee by the designated primary care provider. *Dependent variable:* Date when complete physical examination is performed. *Data source:* Log of physical examinations for new enrollees. *Data Collection:* Data collection per hypothesis #1. *Data analysis:* Comparison of time elapsed between enrollment and the completion of a physical before and after implementation of Phase I of the information system using a Cox Proportional Hazards model.

Hypothesis 3. Implementation of the system will decrease emergency room utilization and hospitalization for ambulatory care sensitive conditions (e.g., asthma and diabetes mellitus). *Dependent variables:* Number of emergency room visits, number of hospital admissions. *Data source:* Medicaid claims data. *Data Collection:* Data collection per hypothesis #1. *Data*

analysis: Daily admission counts will be analyzed using an autoregressive Poisson model that includes terms for the intervention, day of week, holidays, and weather. The over-dispersion will be adjusted for using generalized estimating equations (GEE) methods.

Hypothesis 4. Availability of the system will improve selected HEDIS measures. *Dependent variables:* Immunization rates, number of well child visits during the first 15 months of life, percentage of 4 to 6 year-old children having an annual well child visit, percentage of pregnant women initiating prenatal care during the first trimester, percentage of women receiving 6-week post partum checkup, percentage of 16- to 64-year old women having clinical cancer screening (Pap smear) at least once every 3 years, percentage of diabetic patients having semiannual glycohemoglobin monitoring, and percentage of diabetic patients having annual retinal exam. *Data source:* Durham County Health Department HEDIS report. *Data Collection:* Baseline data will be collected for the 6 months prior to implementation of Phase III of the system and study data, for the same 6 months one year later after Phase III has been in routine use for 2-6 months. *Data analysis:* Incidence rates for HEDIS measures (before and after) will be tested using the methods described by Ahlbom [1993 (see Appendix for references)]. Rates based on small numbers of events (<20) will be tested using methods based on the Poisson distribution. Rates based on larger number of events will be tested using standard normal approximations.

In addition to the above quantifiable outcomes, user satisfaction with the system will be assessed following implementation of each phase of the system. Evaluation of the system will also serve to identify barriers hindering access to care (e.g., need for transportation to clinical appointments); to track in-office waiting times to be seen for appointments; and to monitor patterns of access to care based on race and ethnicity. This information will be used to direct the allocation of services and resources.

The proposed evaluation has the following limitations. First, it is difficult to separate the impact of the proposed information system from the overall care management program that is part of the Carolina Access II project. While the interventions that directly alter the delivery of care will largely be due to case management, the ability to effectively use case management will result from the enhanced communication and care tracking available through the information system. Thus, the overall improvements can be attributed to the information system. Second, the pre-post design of the evaluation is susceptible to biases arising from improvements in care that occur simultaneously with, but independent of, the information system implementation. As a result, we could falsely conclude that the detected care improvements resulted from the new information system. We will track emergency room visit rates, hospital admission rates and HEDIS measures for the Durham County Medicaid recipients not enrolled in the Carolina Access II program as an indicator of general changes in the care environment. Unfortunately, the care setting is not amenable to an evaluation method with a prospective control arm.

Dr. Lobach (see Appendix for biosketch) will supervise the project evaluation. He has conducted several research projects focused on assessing the impact of information technologies [Lobach and Hammond, 1997; Lobach, 1996]. Dr. Hasselblad (see Appendix for biosketch), a biostatistician, will assist Dr. Lobach with the data collection and analysis for the evaluation. He has worked with Dr. Lobach on several technology assessment projects in the past.

Significance

Increasingly, healthcare is becoming a shared, community-based responsibility involving diverse care providers, especially for traditionally under-served populations. Consequently, the information access and communication problems addressed in this application are common among many communities in which health care is delivered through multiple agencies. To

monitor the health of members and manage their care, collaborating providers need the ability to share information about members, especially their current conditions and recent treatment. Inadequate communication and data sharing between these care partners can lead to harmful care errors, (e.g., giving a medication to which a patient has a documented allergy), and unnecessary duplication of tests and procedures. The information must be immediately available, easily accessed, and appropriately safeguarded to assure confidentiality. Thus, the community-based information and communication system proposed in this application is a model for the type of information system that will be required to support health care delivery by multidisciplinary teams across traditional institutional boundaries.

Our approach to information sharing is novel in that we build upon existing information systems to create a common information resource using the Internet to coordinate care between public and private agencies that are not part of the same parent organization. In contrast, other projects directed at coordinating care for economically disadvantaged patients have either involved the implementation of a complete information system across a corporately linked care network (e.g., Medicaid managed care initiative in Arizona by Schaller Anderson Incorporated using QMACS from Quality Care Solutions, Inc.) or stand-alone PC-based systems [Chueh and Barnett, 1994]. Alternatively, they have used Web-based technology but focused primarily on the exchange of insurance transactions and other administrative data (e.g., Healthcon Corporation) instead of sharing clinical data or resource utilization by patients.

While these other systems demonstrate the value of sharing information, they lack either the flexibility, ubiquitous accessibility or clinical focus of the Web-based model we propose. Our approach is more practical for many communities because it does not require centralized control of the information systems of all the network partners. We recognize that partners' legacy information systems cannot be easily replaced because of other functions they may serve. Our goal is to demonstrate how time-sensitive information can be shared and care coordinated between public and private agencies without significant disruption to existing systems by overlaying a Web-based system on existing information resources.

The feasibility of our proposed Web-based information system has been validated by the W3-EMRS project [Kohane *et al.*, 1996]. This project has demonstrated that data from distinctly different legacy databases can successfully be combined into a Web-based database across the Internet. We will build upon the W3-EMRS model to create the database and information transfer methods for our system. In contrast to the hospital-oriented W3-EMRS project, our community-based system has different communication and information needs. Our system will focus on the information needs related to care management and tracking and on the automated communication of this information to network partners. Our model is also distinct from the W3-EMRS project in that several of our partners are small community-based government agencies with limited information system resources. Thus, we will demonstrate how smaller organizations can be included in information sharing efforts. In order to capitalize on the lessons learned through the W3-EMRS project, we have retained one of the primary designers of the W3-EMRS system, Dr. Isaac Kohane, as a consultant on this project (see Appendix for consultant letter).

In this project, we will also develop new technology to facilitate population-based care management. Specifically, we will develop a decision support system (intelligent agent) to monitor the database for defined events and to communicate these events via the Internet to designated providers, e.g., notification of an emergency department visit sent to the care manager or an alert about entry of a note into the database by a care manager sent to the patient's PCP. We will also create an intelligent agent that communicates lapses of care to care providers.

Project Feasibility

We propose to design and develop a Web-based clinical information repository and care tracking/monitoring system in 3 Phases (See Appendix, Table 1, for the project timeline). A phased approach is necessary to allow rapid deployment of a basic system to support immediate information needs while also allowing development of a system to meet the more comprehensive communication needs of community-based population health management. In phase I, we will provide access to a core set of enrollee information, automate communication of selected information between Network members and implement care management plans online. In phase II, we will demonstrate the ability to import relevant electronically stored data from two individual databases maintained by Network sites to expand the amount of data available to Network providers. In Phase III, we will build tools to automate patient tracking and management to provide proactive community-based population health care (See Appendix, Figure 1, for the high-level system design). Our approach is based on currently available technology and requires relatively inexpensive and ubiquitous resources for access.

The three DCHN practices and the hospital emergency departments have in place computer systems for collecting and storing patient information; however, these systems are unique to each site and are not readily accessible to all providers serving the Carolina Access II members. All Network partners do have Internet access (see Appendix for Partners' Information System Resources). Thus, the information system proposed in this application must store and make available to all Network partners across the Internet a core body of information that is essential to the tracking and management of care of Carolina Access members.

System Requirements and Functionality. The proposed Web-based system will permit the storage, retrieval, and communication of this core body of care tracking and management information. This information includes care management plans, completion dates for preventive services, the intake medical history and risk assessment data, initial physical examination findings, enrollee demographics, and enrollee insurance status. (See Appendix, Table 2, for list of information users.) In addition, the system will provide a shared utilization log to track use of services across the Network. The information maintained in the utilization log will include date, time and location of contact; types of contact (ER visit, routine clinic visit, hospital admission, etc.); provider name and specialty; diagnoses addressed (ICD-9 codes); and procedures performed (CPT codes). For individuals identified as high utilizers, the system should also support a shared appointment log, that will track the dates, times and locations of scheduled appointments and the names and types of providers with whom the appointment is scheduled.

Care management protocols will be made available through the System for Interactive Electronic Guidelines with Feedback and Resources for Instructional and Educational Development (SIEGFRIED) that we developed previously to deliver clinical practice guidelines to the point of use [Lobach, *et al.*, 1998]. This system supports a generalized knowledge representation scheme that can accommodate any linear care algorithm. Thus, care protocols can be readily entered into this system and made available through a Web server.

Intelligent agent technology will be employed to facilitate communication among providers and to track lapses in care delivery. Provider-enrollee assignments will be known to the system along with the communication methods preferred by each provider. Provider-to-provider communication will be mediated by the agent to insure timely secure information delivery. Agents will also notify providers based on trigger events, such as modifications to the care plan, utilization of services by enrollees, missed appointments or overdue health maintenance and preventive care. Notification criteria (e.g., provider role, trigger event, delivery route) can all be

tailored. As additional data are added to the system (Phases II and III), disease-specific care parameters will also be monitored and added as trigger events.

To minimize the burden of electronic data entry, the system will be designed to run off a minimal set of enrollee and appointment data. The types of information collected in the system, the point of collection and the person responsible for entering/updating the information is listed in Appendix, Table 3. In particular, the effort required to maintain the database after enrollment will be minimal. After baseline data have been entered, only the service utilization log and updates of existing information will be required for the Phase I system. Data security is critical to the design of the system. We have included an information system security consultant on the project to review and recommend the most appropriate security measures for the system.

System Development. Phase I includes an extensive system analysis to define the requirements of the complete system, creation of the enrollee database and care utilization log, development of a rudimentary event monitor and notification system, and implementation of online care management algorithms. Phase I will conclude with detailed planning of Phase II.

The goal of Phase II is to show how the burden of data entry can be reduced and the information available in the system expanded through a demonstration system-interface project. This Phase will entail an analysis to select which data in two other systems are most critical for inclusion in the shared database and the creation of two representative interfaces needed to support electronic data transfer. The HL7 messaging standard will be for data transmission.

Phase III will include further expansion of the database and data entry forms to support entry of desired data that cannot be imported electronically. This phase will also include the development of intelligent agents to enhance proactive care monitoring (e.g. problem-specific care recommendations such as diabetes health maintenance recommendations) based on the increased availability of data in the system. In addition, the reminder/tracking system will be expanded to better support proactive population-based health management.

Operational Support. The ongoing operational support of the system will require limited data entry as described above and technical support for system software and hardware. A database manager/Webmaster will be retained to monitor system integrity, to ensure availability and security of the Web site, to maintain the registry of providers, preferred access modalities and contact numbers (e.g., phone, facsimile), and to assist with extracting data from the database for reports and analyses. A LAN manager will be available 24 hours a day for urgent issues related to system access and function. A programmer will be retained to develop enhancements and monitor the system. Through all three phases, project staff will provide intensive training, technical assistance and support for Network partners.

The Project Team and Implementation. The primary project team consists of medical informaticians, software developers, community health experts and support personnel. The team has significant past experience in the development of Web-based information system solutions for health care and experience with providing community and public health services. The project will be monitored by the DCHN Information Services Committee, which includes representatives from all of the Network partners.

Principal Investigator for the project will be David F. Lobach, MD, PhD, MS. Dr. Lobach is a medical informatician and clinician. As he has done in previous projects, he will supervise the design, development, implementation and evaluation of the system.

Susan D. Epstein, MPA, is a Co-Investigator. Ms. Epstein is Director of the Division of Community Health, a new division devoted to collaborative and innovative programs in primary care. This Division coordinated the initiative to establish the Durham Community Health

Network and led the planning for the Carolina Access II demonstration project. The Division maintains supervisory authority for the DCHN's Carolina Access II Program with Ms. Epstein serving as Acting Administrator of the project.

Jean Rabold, MBA will serve as Project Director. Ms. Rabold has a background in information systems and was the project manager for the National Library of Medicine IAIMS grant. She is currently working with Dr. Lobach as a project manager on a project designed to implement a Web-based clinical guideline server.

Michelle Lyn, MBA, MHA, will coordinate the development of the information content for the project and serve as the project liaison for all of the community partners. Ms. Lyn currently works with the Carolina Access II Implementation Committees of Clinical Services, Information Services, and Operations to create clinical protocols and communication pathways necessary to managing the care of the Durham County Carolina Access II population.

Community Involvement

Community-based partnerships are foundational to this project. Our proposed information system is designed to overcome longstanding barriers between Network partners. These partners include: *Duke Family Medicine*: A large family-practice clinic staffed by Duke faculty and residents, providing care to a large Medicaid and indigent population as well as to insured patients. *Duke Children's Primary Care*: A large pediatric practice staffed by Duke faculty and residents, also serving a large Medicaid and indigent population. *Lincoln Community Health Center*: A federally financed community health center, serving a large low-income population (61% are uninsured; the balance are Medicare/Medicaid). *Durham County Department of Social Services*: Administers "welfare" programs and Medicaid; provides protective services for abused/neglected and chronically ill children and adults, almost all low-income. *Durham County Health Department*: Provides communicable disease control and chronic disease detection and management; environmental health services and regulation; and personal health care services to low-income people (primarily young women and children). Working together with Duke and Durham Regional Hospitals these partners have developed school clinics, disease management for pediatric asthma, and urgent care services (see Appendix for details of projects).

Partner Roles. Based on the early success of past collaborative programs, the community partners competed to become one of the demonstration sites for the Carolina Access II program. The program is part of a HCFA 1115 waiver to allow the State of North Carolina to employ an innovative plan for sharing information, services, and care to provide more effective management of the Medicaid population. The State intends to expand this model statewide.

Partner Contributions. All partners staff the Executive Board, Steering Committee, and all standing subcommittees, including a committee on Information Services. The design specifications for the proposed DCHN information system have been reviewed with the partners through their information technology staff and agency administrators, with input and review by clinicians and staff of all partner organizations. All partners will contribute staff time to develop and support network activities and associated office and overhead to the program. (See budget for details on financial contributions and Appendix for letters from Network partners).

Partner Benefits. The three practices will benefit by having better patient compliance due to outreach and follow-up services delivered by the Network. The Health Department will benefit from improved health status indicators for the County, since their success is based, in good part, on the health of their population. The Department of Social Services, which administers Medicaid locally for the state, will benefit from reduced cost to serve Medicaid patients who will utilize less expensive primary care, rather than Emergency Departments.

Maintaining the Partnership. Relationships with government-assisted community health organizations in Durham County are of pivotal importance to Duke University Medical Center's commitment to improve the health care for all members of the local community. This commitment is exemplified by Duke's longstanding support of Lincoln Community Health Center. Because of their controlling interest in both hospitals in Durham County, Duke is very invested in enhancing the efficiency and quality of indigent health care in Durham County.

Support for End Users. System end users include primary care physicians at Duke Family Medicine, Duke Pediatrics and Lincoln Community Health Center; practice managers, nursing supervisors, and appointment and reception staff; Department of Social Services social workers; Health Department maternity care coordinators and nutritionists; the DCHN administrator; DCHN social workers, health educator, nutritionist, and community health workers; Division of Community Health director, health care market analyst, and staff assistant. Training for end users will focus mainly on how to access and use the new interface for the system and how to interpret information on the screens. The User Analyst, LAN Administrator and Programmer will provide on-going technical support.

Reducing Disparities

This project will lessen disparities primarily by making information accessible to care providers managing the Carolina Access II population, which is largely minority. For example, documentation of immunizations given at the Durham Health Department has traditionally not been available to clinicians at the Duke Children's Clinic.

Secondarily, this project will reduce disparities in health care delivery for this population. We expect that implementation of the system will improve the efficiency of service utilization and the quality of care delivery by increasing communication between providers and by prompting intervention when inappropriate or unnecessary use of health care services are detected. Disease mapping studies have shown that >70% of emergency department visits and >65% of admissions for asthma or diabetes come from economically disadvantaged patients from 4 of the County's 15 Zip code areas. These statistics support the community-based, geographically focused approach of the Carolina Access II project.

Documentation and Dissemination

Documentation of the project's progress will consist of agendas and minutes from the monthly meetings; minutes from working group meetings; monthly updated timelines; and copies of pertinent e-mail communications, faxes and memos. Samples of reports generated for patient tracking, utilization reports and state-mandated reports will be maintained. Schema of the different information system databases and of the main information repository will be provided. Copies of web pages produced to communicate among the different sites will be provided. The minutes from the working meetings and monthly team project updates will chronicle the life of the project. Project documents and progress summaries will be periodically posted on a Web site along with update information about the status of the system.

The results of this project will be disseminated through publications and presentations. Specifically, Dr. Lobach will present information about this project at national meetings (American Medical Informatics Association Fall Symposium and HIMMS) and publish results from the study in informatics journals (*Journal of the American Medical Informatics Association*) and general clinical journals (*The American Journal of Medicine*). Ms. Epstein will present this project at national public health meetings (American Association of Public Health) and publish findings from this work in the public health journals (*American J. of Public Health*).