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# The Adaptation and Implementation of a Medical–Dental Electronic Health Record in an Academic Dental Center

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## Abstract

**Background** Several large health care systems in the United States have pioneered the integration of dentistry into their medical care delivery models. To date, no studies or case reports on combining medical information into the dental electronic health record within U.S. academic dental centers were found in the extant literature.

**Objective** This report details how we developed and implemented customized primary care elements into axiUm, a popular dental practice management software primarily used in dental schools, to facilitate medical–dental clinical integration. This work was undertaken to provide the infrastructure for nurse practitioners and dentists to deliver a holistic, integrated, person-centered approach to care.

**Methods** A multidisciplinary design team used the Centers for Disease Control and Prevention's *Framework for Patient-centered Health Risk Assessments*, an evidence-based framework to guide the adaptation of the existing axiUm dental record. The design featured individual data fields to source data, generate reports, and analyze information to improve clinical care and operations.

**Results** To date, medical information on more than 260 dental patients over 600 clinic visits has been documented in the adapted electronic health record.

**Conclusion** The customization capability of axiUm facilitated efficient and effective development and implementation processes. Training and user support were essential for effective implementation and led to further system refinements.

**Keywords**
- medical–dental
- axiUm
- electronic health record
- electronic dental record

## Background and Significance

Oral health is an integral part of total health and wellness, and achieving optimal oral health and wellness necessitates interprofessional collaboration and coordination among the health care team.[1] A common electronic health record (EHR) enhances care coordination and facilitates the exchange of clinical information among care providers.[2] Unfortunately, most medical and dental patient records exist in silos.[3] User-friendly access to dental information is critical to delivering a holistic care approach.[4] Several large health care systems in the United States have pioneered the integration of dentistry

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into their care delivery models.[5–7] To date, no studies or case reports on adapting an electronic dental record (EDR) for primary medical care within U.S. academic dental centers were found in the extant literature.

## Objective

The primary objective of this case report is to describe the development and implementation of customized primary care elements into axiUm, a popular dental practice management software primarily used in dental schools, to facilitate medical–dental clinical integration. Clinical integration refers to the coordination of person-centered, medical and dental care at chairside. This work was undertaken to provide the infrastructure for nurse practitioners (NPs) and dentists to deliver a holistic, person-centered approach to care at chairside, and facilitate effective communication and care coordination.

## Case Description

The Academic Dental Center (ADC) is a state-of-the-art dental care facility located within the School of Dental Medicine and situated in the Longwood medical area of Boston, MA. The ADC utilizes axiUm (Exan Group, Henry Schein, Melville, New York, United States) EDR, a Health Insurance Portability and Accountability-compliant, certified system that includes billing and practice management applications. The axiUm platform was designed to address the needs of educational institutions and over 90% of North American dental schools use axiUm.[8]

## Methods

A multidisciplinary design team was guided by three underlying principles. (1) Medical care components of the EHR are aligned with an evidence-based patient-centered framework for health promotion and disease prevention. (2) Medical health information is centralized for convenient, user-friendly access by all health care providers. (3) Data entry, clinical decision support, and medical coding/billing are priority areas for medical–dental clinical integration. The design team consulted with end-users to test the workflow and design of the changes.

## Development Process

The Centers for Disease Control and Prevention's Framework for *Patient-centered Health Risk Assessments*[9] informed the development process. Medical components of the EHR were derived from the Medicare Annual Wellness Visit (AWV).[10] Key components and elements of the AWV are listed in ►Table 1. Other important components were included such as patient referrals, appointments, treatment planning, provider alerts, problems lists, educational resources, progress notes, and medications.

Configuring a centralized location for medical information so that patient health information could be accessed quickly by all providers was a priority. An ideal location for the addition of medical information was identified within the *forms* tab of the EHR (►Fig. 1). New medical templates were created and embedded within this central location, including health risk assessment (►Fig. 2), depression screening, and fall risk assessment. A group of end-users tested the workflow of the new templates and recommended changes.

A new security level was created in axiUm for the NP. Security levels are also configured so that users have access to only the information they need to perform the duties of their job. Data fields were programmed to generate alerts for providers, and data entry was configured into individual fields to facilitate data mining and reporting. For example, alerts were created to notify dental providers that their patient was past due for a primary care visit, and NP providers about due dates for dental cleaning and/or periodic oral examination. A free-text form was created for the documentation of progress notes. Specific clinical data fields (e.g., blood pressure, pulse, height, and weight) were duplicated in the nursing and dental history and assessment forms to ensure that dental student providers were developing competency in obtaining vital signs and pertinent health information.

A medication inventory list was created so that all providers could access patient's current medication list and view changes. The ADC uses *DrFirst* (https://www.drfirst.com), an e-prescribing solution that gives providers access to all medications that the patient has been prescribed in the United States, and a common method of connecting and communicating via a fast, secure, and reliable network. *DrFirst* automates new prescriptions and refill requests/responses and improves the overall efficiency of the prescription process. UpToDate, an evidence-based, electronic clinical decision support resource, was made available to the NP. Patient education materials and resources on common health topics, such as asthma, blood pressure, and smoking cessation, were added to the EHR.

Current Procedural Terminology (CPT) and International Statistical Classification of Diseases (ICD-10) diagnostic codes were configured into axiUm. The CPT codes activated for services rendered by the NP could be linked to ICD-10 codes for medical billing. A *super bill* or *charge slip*/*ticket* template (►Fig. 3) was created to capture the medical services offered and served as a prompt for NP providers to document billable services. Codes were derived from the American Medical Association's evaluation and management guidelines[11] and ICD-10CM diagnostic and procedures codes.[12] Bundled codes were created based on the components of the AWV.

## Implementation Process

Prior to implementation, usability and error testing were conducted to evaluate users' ease of documentation, form behavior, data mining, and reporting. After the system was designed and implemented in the axiUm test system, the new forms were presented to the design team. The design team tested workflows for errors and suggested enhancements to improve usability. The clinical applications director

**Table 1** Components of the Annual Wellness Visit

| Component | Specific elements |
|---|---|
| Health risk assessment | Collect the following information:<br>• Demographic data<br>• Self-assessment of health status<br>• Psychosocial risks<br>• Behavioral risks<br>• Activities of daily living (ADLs), including but not limited to: dressing, bathing, and walking<br>• Instrumental ADLs, including but not limited to: shopping: housekeeping, managing own medications, and handling finances |
| List of current providers and suppliers | Obtain a list of current providers and suppliers that regularly provide medical care to the patient |
| Medical/family history | Collect information about:<br>• Past medical/surgical history<br>• Current medications and supplements<br>• Family history<br>• History of alcohol, tobacco, and illicit drug use<br>• Diet<br>• Physical activities |
| Review risk factors for depression and other mood disorders | Obtain current or past experiences with depression and use any appropriate screening instrument for patients without a current diagnosis of depression |
| Review functional ability and level of safety | Use appropriate screening questions to address the following areas:<br>• ADLs<br>• Fall risk<br>• Hearing impairment<br>• Home safety |
| End-of-life planning | Provide verbal or written information about the patient's ability to prepare an advanced directive |
| Exam | • Height<br>• Weight<br>• Body mass index (BMI)<br>• Blood pressure<br>• Visual acuity screening<br>• Any other relevant factors |
| Educate, counsel, and refer for other preventive services | Include a written plan, such as a checklist, for the patient |

Source: Adapted from The ABCs of the Annual Wellness Visit, Medical Learning Network, 2014.

worked with axiUm developers to migrate all final documentation pathways and forms into the production system.

Providers received training through didactic sessions with hands-on demonstration. During the implementation period, we incorporated user feedback to fine-tune the system. Modifications were tested for improvement using plan-do-study-act (PDSA) cycles and reviewing customized data reports. To ensure ongoing quality improvement, custom reports were developed to query data on clinical outcomes. Results were analyzed monthly, shared with providers, and reported quarterly to the ADC Quality Committee.

## Discussion

Customized primary care EHR templates were successfully implemented to facilitate medical–dental clinical integration. To date, medical information on more than 260 dental patients over 600 clinic visits has been documented in the EHR. The outcome was a replicable electronic infrastructure to support the clinical integration of primary care medical services in an academic dental center. We recognize that the outcome is not an integrated EHR, and agree that to fully support person-centered care, we need robust, integrated and interoperable EHRs to move into the dental care arena.[13]

To the best of our knowledge, this is the first dental education program to configure the axiUm platform for medical–dental clinical integration. The integration of oral health and medical/wellness services within U.S. academic dental clinics is gaining momentum,[14–17] particularly in the context of advancing interprofessional education, person-centered care, and collaborative practice competencies.[18] Since axiUm is widely used in most dental schools, this report contributes to advancing these efforts in U.S. dental education by providing academic dental schools with a feasible and affordable solution.

Several key factors contributed to a successful implementation. We found that a multidisciplinary team approach was a primary success characteristic. A high-performing

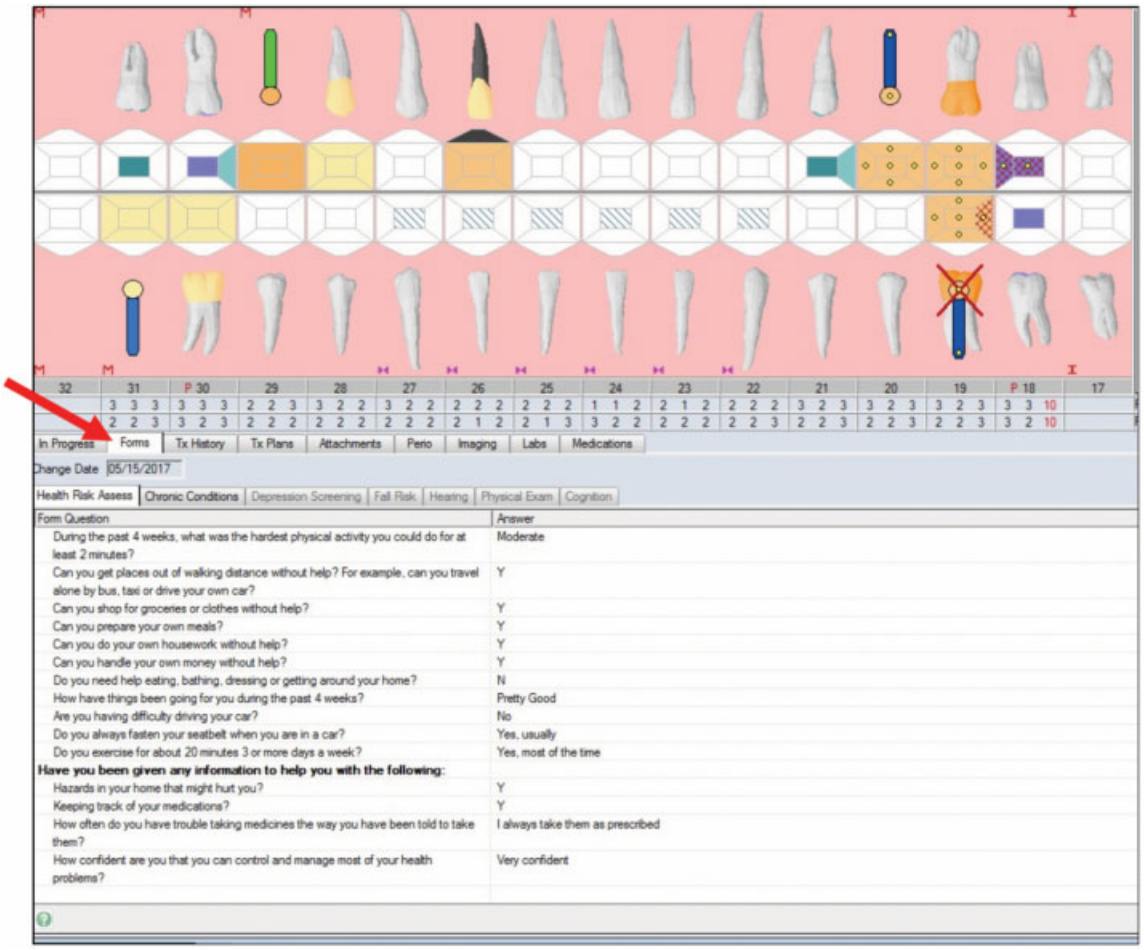


**Fig. 1** The existing *forms* tab was identified as the location for the addition of medical information.

multidisciplinary team is characterized by collaboration, recognition of individual roles, and contributions to a shared purpose.[19] It was important to have professional, managerial, administrative, and front-line support staff on the team. Our initial step was to establish consensus and ensure commitment[20] around our strategic goal—to improve oral-systemic health for older adults living with chronic health conditions. The team agreed on the need for incorporating primary medical information into the EDR to support our integrated, person-centered care model. We reviewed existing workflow processes and mapped new process flowcharts to support the innovative care delivery model. High-level leadership and organizational support was critical.[20] Our team reported to a strategic advisory group comprised of nursing and dental school deans and directors. The leadership remained steadfast in supporting our purpose, providing resources to achieve our goals, and empowering team autonomy with accountability.[19] The impact of executive leadership support was immeasurable in terms of professional stakeholder buy-in, particularly with community primary care providers. Engaging primary care providers and specialists in the community was important to facilitate referrals and coordinate comprehensive care. An important phase of the project was usability testing. We first conducted a usability heuristic evaluation with a small group of evaluators. Heuristic evaluation is a systematic examination to identify usability problems in the user interface design so that they can be addressed in an iterative design process.[21] Next, we conducted end-user testing with NPs and dental providers in the dental center which led to further system refinements. This step provided valuable information about the use of and problems with the templates. Training and end-user support were vital for effective implementation. Initial training was tailored for the individual roles of NPs and dentist providers.[20] Interprofessional training was conducted in the dental center work environment and included hands-on practice. We recognized the need for continuous training as new students enter their respective programs yearly. It was essential to continuously monitor and evaluate EHR refinements and changes in workflow processes. Our priority was to acquire user feedback and respond to problems timely.[20] We followed a model for improvement for testing ideas using PDSA cycles to rapidly reach our goals.[19]

Notable implementation challenges included axiUm's lack of interoperability and medical decision support functionalities. The existing axiUm system at ADC does not have the interoperability to exchange patients' health care information with outside medical providers and specialists. Therefore, the NP requested copies of patients' medical records and exchanges pertinent health information

In Progress | Forms | Tx History | Tx Plans | Attachments | Perio | Labs | Medications

Change Date 06/28/2018

Health Risk Assess | Chronic Conditions | Depression Screening | Fall Risk | Hearing | Physical Exam | Cognition

| Form Question | Answer |
|---|---|
| **HEALTH RISK ASSESSMENT** | |
| **The first nine questions must be taken from the Medical History Form.** | |
| **Blood Pressure** | |
| Systolic Blood Pressure: | 120 |
| Diastolic Blood Pressure: | 80 |
| Pulse: | 68 |
| **Height and Weight Assessment** | |
| Feet: | 6 |
| Inches: | 0 |
| Height: (Inches) | 72 |
| Weight: (lbs) | 200 |
| BMI: | 27.1 |
| Respirations: | 16 |
| Smoking: | N |
| Alchohol: | N |
| During the past 4 weeks, would you say your health is? | Excellent |
| During the past 4 weeks, how much have you been bothered by emotional problems such as feeling anxious, depressed, irritable, sad or downhearted and blue? | Slightly |
| During the past 4 weeks, has your physical and emotional health limited your social activities with family, friends, neighbors or groups? | Moderately |

**Fig. 2** Health risk assessment template.

directly over the phone or using facsimile transmission. In addition, the existing axiUm system was not programmed with medical decision support functionality. To address this challenge, access to UpToDate, an evidence-based, electronic clinical decision support resource, was made available to the NP.

A major lesson learned was the need to budget sufficient time to plan with end-users and collaborate with axiUm developers. We learned that axiUm developers or an experienced Crystal Reports writer was needed to develop custom forms. We recommend that dental schools start working with axiUm developers on the first day of planning so that the design team has the opportunity to understand the limitations and customizability options of the software.

The customization capability of axiUm facilitated efficient and effective development and implementation processes. This capability allowed the school's axiUm administrator to modify the software application without permission from the developer. Our decision to design individual data fields allowed us to source data, generate reports, and analyze information to improve clinical care and operations. Interprofessional communication was facilitated by the existing internal messaging feature, axiUm messenger, which enabled NPs and dental providers to communicate and exchange patient information timely, accurately, and effectively. The medical–dental EHR is available to all health care providers in the ADC. Our next step is to test the medical coding/billing infrastructure for medical claims submission and payer reimbursement.

## Clinical Relevance Statement

The successful adaptation of axiUm to include primary care templates presents an opportunity for other academic dental centers to replicate and customize the dental EHR to facilitate similar medical–dental clinical integration. Dental patients will benefit from clinical integration through improved care coordination and communication between medical and dental providers. Dental students and other health care professional students will be prepared with competencies for clinical integration, including interprofessional collaboration, communication, care coordination, and clinical informatics skills.

| CODE | | CODE | |
|---|---|---|---|
| | **OFFICE VISITS - NEW PATIENTS** | | **ICD 10 DIAGNOSES CODE** |
| 99201 | LEVEL 1. BRIEF: 10 min | E11.9 | Type 2 diabetes mellitus without complications |
| 99202 | LEVEL 2. LIMITED: 20 min | I10 | Essential (primary) hypertension |
| 99203 | LEVEL 3. EXPANDED: 30 min | E66.3 | Overweight |
| 99204 | LEVEL 4. COMPREHENSIVE: 45 min | E66.9 | Obesity, unspecified |
| 99205 | LEVEL 5. COMPREHENSIVE: 60 min | F32.9 | Major depressive disorder, single episode, unspecified |
| | **PREVENTIVE EXAM - NEW PATIENTS** | F41.8 | Other specified anxiety disorders |
| G0438 | MEDICARE, Annual Wellness Visit, Initial | Z00.00 | Encounter for general adult medical exam w/o abnormal findings |
| G0439 | MEDICARE, Annual Wellness Visit, Subsequent | | |
| 99387 | PREVENTIVE MEDICINE, 65+ | Z00.01 | Encounter for general adult medical exam w/abnormal findings |
| | **OFFICE VISITS - EST. PATIENTS** | R03.0 | Elevated blood pressure reading w/o Dx of HTN |
| 99211 | LEVEL 1. BRIEF: 5 min | Z00.01 | Encounter for general adult medical exam w/abnormal findings |
| 99212 | LEVEL 2. LIMITED: 10 min | M13.80 | Other specified arthritis, unspecified site |
| 99213 | LEVEL 3. EXPANDED: 15 min | Z01.30 | Encounter for exam of blood pressure w/o abnormal findings |
| 99214 | LEVEL 4. COMPREHENSIVE: 25 min | Z01.31 | Encounter for exam of blood pressure w/abnormal findings |
| 99215 | LEVEL 5. COMPREHENSIVE: 40 min | Z13.1 | Encounter for screening for diabetes mellitus |
| | **PREVENTIVE EXAM - EST. PATIENTS** | R63.4 | Abnormal weight loss |
| 99397 | PREVENTIVE MEDICINE, 65+ | R63.5 | Abnormal weight gain |
| | **COUNSELING** | Z63.79 | Other stressful life events affecting family and household |
| 99401 | PREVENTIVE COUNSELING: 15 MIN | R53.82 | Chronic fatigue, unspecified |
| 99402 | PREVENTIVE COUNSELING: 30 MIN | R86.19 | Personal history of other infectious/parasitic disease |
| 99403 | PREVENTIVE COUNSELING: 45 MIN | Z86.73 | Personal history of transient ischemic attack (TIA) |
| 99406 | MEDICARE, smoking and tobacco-use cessation counseling visit, intermediate | Z91.81 | History of falling |
| | | Z95.1 | Presence of aortocoronary bypass graft |

**Fig. 3** Sample superbill.

### Protection of Human and Animal Subjects

No human/animal subjects were involved in the project.

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### Conflict of Interest

None declared.

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