Electronic Health Records: A Valuable Tool for Dental School Strategic Planning


Abstract: The objective of this study was to investigate if electronic patient records have utility in dental school strategic planning. Electronic health records (EHRs) have been used by all predoctoral students and faculty members at Nova Southeastern University’s College of Dental Medicine (NSU-CDM) since 2006. The study analyzed patient demographic and caries risk assessment data from October 2006 to May 2011 extracted from the axiUm EHR database. The purpose was to determine if there was a relationship between high oral health care needs and patient demographics, including gender, age, and median income of the zip code where they reside in order to support dental school strategic planning including the locations of future satellite clinics. The results showed that about 51 percent of patients serviced by the Broward County-based NSU-CDM oral health care facilities have high oral health care needs and that about 60 percent of this population resides in zip codes where the average income is below the median income for the county ($41,691). The results suggest that EHR data can be used adjunctively by dental schools when proposing potential sites for satellite clinics and planning for future oral health care programming.

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The American Dental Education Association (ADEA) defines its mission as “to lead individuals and institutions of the dental education community to address contemporary issues influencing education, research, and the delivery of oral health care for the improvement of the health of the public.” ADEA’s strategic directions for 2011-14 regarding “Service” include the following “Key Priorities”: “Identify, develop, and promote educational pathways that prepare students for the full spectrum of roles performed by the dental, allied dental, and advanced dental workforce,” including “public service careers”; and “Identify, develop, and promote mechanisms by which academic dental institutions can contribute to solutions for addressing the access to care challenge to improve the health of the nation.” These priorities have been incorporated into the strategic plan at Nova Southeastern University College of Dental Medicine (NSU-CDM) and have evolved into a focus on developing programs and clinics that will increase access to dental care for vulnerable populations in the school’s neighboring communities.

Broward County, Florida, where NSU-CDM is located, has been identified by the Broward Regional Health Planning Council (BRHPC) as an area at risk for disparities of oral health care. According to data from the BRHPC, access to oral health care by Broward County residents is confounded by barriers at the personal, family, and community levels. The cost of care and inaccessibility to health care facilities were identified specifically as major limiting factors. In 2008, only 34.8 percent of residents whose income was at or below the Federal Poverty Level had received a dental check-up in the past year, compared to 78.4 percent of residents whose household income was two times higher than the Federal Poverty Level.

NSU-CDM’s primary clinical facility opened in 1997, and a satellite clinic in Broward County opened in July 2008. In 2010, a mobile dental van was obtained through a community partnership grant and has been used by the NSU-CDM Department of Community Dentistry to deliver basic health care services at community centers in the county. The goals of the satellite clinics are twofold: 1) to
provide students with opportunities to serve patients most in need of oral health care and 2) to remove the barriers faced by patients to oral health care access, which include transportation and financial issues. Based on these goals, we would expect that patients served by NSU-CDM would have high oral health care needs and would be disproportionately from lower income areas.

The purpose of this exploratory study was to determine if patients served at NSU-CDM clinics come from underserved areas (identified as in a low-income zip code area). In addition to better understanding the patients served, we theorized that this study would help identify additional opportunities for how our dental school could use electronic health records in future oral health care programming and satellite clinic planning.

## Methods

Data from NSU-CDM’s electronic health record (EHR), axiUm (Exan Group, Coquitlam, British Columbia, Canada), was used in this study. Data for all patients who were seen from October 2006 through May 2011 were included in the initial dataset, which was extracted via axiUm’s information manager reporting module, commonly referred to as “Infomanager.” Infomanager, which is included in the standard axiUm software package, allows users to create reports through custom searches and filters, by querying tables and fields that are stored in the electronic patient database.

Variables selected for the study included caries risk assessment (CRA), patient age, gender, and zip code. Other demographic variables such as race, ethnicity, education level, and household income were either not complete or not available in the EHR database for the time period included in the study. The initial dataset was exported into Microsoft Excel for completeness. Patients who did not live in Broward County and patients who had incomplete information were removed from the final study file. The study file was then imported into IBM SPSS Version 20 statistics software package, where the median income level for the zip code, based on the U.S. Census Bureau, was mapped to each patient’s zip code of residence. Figure 1 details the data flow of the study’s patient information extracted from Infomanager to those patients who were included in the final study file.

Descriptive statistics were calculated to analyze the data by demographic variables of interest. Inferential statistics (Pearson’s chi square) were calculated in order to understand the relationship between caries risk and zip code median income level. The lowest income group (<$30,000) was the reference category. MapInfo was used to plot the location of NSU-CDM service sites, as well as the top ten zip codes by number of patients in order to better understand geographic service area by zip code median income levels.

For analysis, caries risk was dichotomized into high and low risk. High caries risk included those patients who had a CRA of high or very high during the study period. Low caries risk included
Results

There were 8,239 predoctoral NSU-CDM clinic patients who reside in Broward County identified with caries risk assessment data who visited NSU-CDM clinics from October 2006 to May 2011. Of these, 4,661 patient records (57 percent) were categorized as having an assessment of high for caries risk. The age and gender distribution of patients overall and by high and low caries risk are shown in Table 1. Based on the distribution of patients by demographic variables, patients who come to NSU are generally older, with 40 percent of patients over age fifty-five. The mean age of all patients in the study file was 50.8 (standard deviation=16.0). In terms of gender, there were slightly more female than male patients (52 versus 48 percent). Regarding high versus low caries risk among demographic groups, each age group except for children (up to eighteen years) had a higher proportion of patients with high versus low caries risk. However, male patients had a higher proportion of high caries risk (59 percent) than women (55 percent).

We compared median income level by caries risk assessment to determine if there was a significant relationship between lower income levels and higher caries risk. Results of the statistical testing are shown in Table 2 and Figure 2. The percentage of high caries risk decreased from 59 percent among patients from the lowest zip code income group (medium income <$30,000) to 53 percent among patients from zip codes with a medium income of $60,000 to $80,000. In the group of patients who resided in

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Table 1. Characteristics of total patients vs. high caries risk patients in predoctoral clinics, October 1, 2006, to May 31, 2011 (n=8,239)

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Total Cases</th>
<th>High Risk</th>
<th>Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percentage</td>
<td>Number</td>
</tr>
<tr>
<td>0-18</td>
<td>169</td>
<td>2%</td>
<td>81</td>
</tr>
<tr>
<td>19-25</td>
<td>291</td>
<td>4%</td>
<td>182</td>
</tr>
<tr>
<td>26-35</td>
<td>1,011</td>
<td>12%</td>
<td>570</td>
</tr>
<tr>
<td>36-45</td>
<td>1,431</td>
<td>17%</td>
<td>814</td>
</tr>
<tr>
<td>46-54</td>
<td>2,032</td>
<td>25%</td>
<td>1,161</td>
</tr>
<tr>
<td>55+</td>
<td>3,305</td>
<td>40%</td>
<td>1,853</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number</td>
<td>Percentage</td>
<td>Number</td>
</tr>
<tr>
<td>Female</td>
<td>4,285</td>
<td>52%</td>
<td>2,344</td>
</tr>
<tr>
<td>Male</td>
<td>3,920</td>
<td>48%</td>
<td>2,294</td>
</tr>
<tr>
<td>Transgender</td>
<td>3</td>
<td>&lt;1%</td>
<td>3</td>
</tr>
<tr>
<td>Unknown</td>
<td>31</td>
<td>&lt;1%</td>
<td>20</td>
</tr>
</tbody>
</table>

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AxiUm (form available from corresponding author)

IRB approval was obtained before the commencement of the study. The research protocol was reviewed at the center level and determined to be exempt from further IRB review based on the Common Rule of the Code of Federal Regulations (45 CFR 46) #2: research involving the use of an existing data archive.

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those patients who had a caries risk assessment of medium or low during the study period. Each patient was included as a unique record in the study file. The highest caries risk score for each patient at any point during the study period was used to place the patient in either the high or low caries risk category. Caries risk assessment was selected as a data item because it identifies patients with increased oral health needs. At NSU-CDM, an oral disease risk assessment is conducted on each predoctoral patient at the initial evaluation and then at least once a year as part of his or her annual periodic exam. The assessment reviews and updates the patient’s medical history and reassesses his or her oral health status. Based on an evaluation of risk indicators, risk factors, and protective factors, caries risk is assessed according to guidelines reported by Featherstone et al. Criteria for high caries risk patients at NSU-CDM include the presence of at least one active cavitated lesion. Very high caries risk includes patients who present with multiple smooth surface lesions and/or root caries. Current caries diagnosis and the patient’s risk for development of new cavious lesions (caries risk assessment) are determined and documented by answers to specific questions on the NSU-CDM Oral Disease Risk Assessment form in axiUm (form available from corresponding author).

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that, among the Broward County population overall, 59 percent of residents lived in zip codes where the average income was below the median of $41,691. Overall, 51 percent of patients seen at NSU-CDM over the study period lived in Broward County zip codes where the average income was below the median income level.

To understand if the NSU-CDM main clinic and satellites are located in lower income areas, thereby suggesting that NSU-CDM was providing health care services in areas where there were higher oral health care needs, we plotted the clinics on the zip code map (Figure 4). From this map, we saw that the NSU-CDM main Davie clinic is located in the highest income zip codes ($80,000-$100,481), the high caries risk proportion was 55 percent. To test the relationship statistically, we compared each income group to the reference category (median income <$30,000). Results showed that patients living in zip codes where the median income was between $60,000 and $80,000 had a statistically lower rate of high caries risk than patients in the lowest income group (p=0.01).

To further determine if NSU-CDM serves more low-income patients relative to the county overall, we dichotomized the medium income categories into “median income above” and “median income below” based on the patient’s zip code and the zip codes’ overall median income grouping and compared this to the overall county population. Figure 3 shows

Table 2. High risk caries assessment by zip code median income level of oral health patients in NSU clinics, October 1, 2006, to May 31, 2011 (n=8,239)

<table>
<thead>
<tr>
<th>Low Risk</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>Percentage</td>
</tr>
<tr>
<td>&lt;$30,000</td>
<td>421</td>
</tr>
<tr>
<td>$30,000-41,691</td>
<td>1,646</td>
</tr>
<tr>
<td>$41,692-$60,000</td>
<td>1,022</td>
</tr>
<tr>
<td>$60,001-$80,000</td>
<td>345</td>
</tr>
<tr>
<td>$80,001-$100,481</td>
<td>144</td>
</tr>
</tbody>
</table>

*Significant at p<0.05, Pearson chi-square.

Figure 2. Distribution of very high/high (High) and moderate/low (Low) caries risk patients in NSU clinics by income group: October 1, 2005 to May 31, 2011 (n=8,239)
porting dental education, EHRs have been recognized for their potential to support reduced costs, improved health outcomes, epidemiologic surveillance, and research.\textsuperscript{7-10} Widespread adoption and interoperability between clinical systems would allow for sharing of de-identified patient data on a very large scale. Some of the benefits from an integrated health information technology system may not be realized until this has been achieved.\textsuperscript{8,11-14} One potential opportunity currently being explored by NSU-CDM is using axiUm in program planning for new outreach programs that can contribute to reducing health disparities in our community.

When we began this study, we expected that patients served by NSU-CDM would have high oral health care needs and would disproportionately be from lower income areas. We were interested in understanding if NSU-CDM, true to its mission, serves patients most in need. Our findings suggest that patients from lower income areas do, in general, have higher oral health care needs, as evidenced by a high or very high caries risk assessment. Our findings also suggest that while NSU-CDM clearly serves a juncture of four zip codes: one of which (33314) was in the $30,000 to $41,461 income range and three of which had median household incomes above the median for Broward County. The satellite clinic and two of the three locations for the mobile van were located in zip codes below the median average, while one of the van’s locations was in a zip code in the $41,692 to $60,000 income group. We also plotted the top ten zip codes in terms of number of patients overall in the study in order to spatially view the top zip codes of patients relative to the clinic, satellite, and mobile van locations. There were 2,951 patients from the top ten zip codes, who accounted for 36 percent of the total number of patients (n=8,239). Of these, 66 percent (n=1,935) were from zip codes with a median income below the median income for the county.

Discussion

Improvement in access and quality of care is being facilitated at NSU-CDM through implementation of the axiUm EHR system. In addition to supporting dental education, EHRs have been recognized for their potential to support reduced costs, improved health outcomes, epidemiologic surveillance, and research.\textsuperscript{7-10} Widespread adoption and interoperability between clinical systems would allow for sharing of de-identified patient data on a very large scale. Some of the benefits from an integrated health information technology system may not be realized until this has been achieved.\textsuperscript{8,11-14} One potential opportunity currently being explored by NSU-CDM is using axiUm in program planning for new outreach programs that can contribute to reducing health disparities in our community.

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our mission of providing services to underserved populations. With regard to strategic planning, there is potential for NSU-CDM to direct new efforts toward expanding our community outreach programs, which utilize third-party reimbursement. This will give more students an opportunity to care for underserved populations as well as provide needed oral public services to communities in need.

Concerning limitations of our study, one of the shortcomings of our axiUm data set is that race and ethnicity statistics for our patients were not collected until 2010. We relied on zip codes for mean income level because we do not financially qualify our patients nor do we accept third party payment in our main predoctoral clinic. The Broward satellite clinic is U.S. Health Resources and Services Administration grant-funded and as such was the impetus for us to begin collecting race and ethnicity data. It would have been interesting to test if income level and/or race/ethnicity are an effect measure modifier. For example, do specific ethnic groups with low median incomes have an increased caries risk assessment? Although beyond the emphasis of this study, demographics of high-needs population, perhaps we are not maximizing our potential impact into high caries risk areas. We found that, overall, only 51 percent of patients cared for at NSU-CDM predoctoral clinics are from zip codes below the medium income, compared to 59 percent of the county (in terms of population by zip code) who live in zip codes where the income is below the medium. Our primary predoctoral clinic, situated on the main Davie, Florida, campus of Nova Southeastern University, is exclusively fee-for-service, which likely accounts for this finding. At the beginning of this study, we also theorized that our investigation would help identify additional opportunities for how the EHR could be used for future oral health care programming and satellite clinic planning. Understanding the proportion of patients by caries risk assessment and by other demographic factors provided us a greater opportunity to understand our patient population. In addition, plotting the NSU-CDM sites and the top ten zip codes on the Broward County map by median income group provided evidence of a need to consider future planning in lower income zip codes in order to support...
both gender and age can also be analyzed through EHRs, and identified relationships can provide additional opportunities for dental school community planning.

**Conclusion**

EHRs are anticipated to significantly reduce cost and improve population health outcomes. The push to encourage widespread adoption of electronic recordkeeping has been promoted as beneficial to improving the quality of health care by decreasing medical errors and also for the ability to investigate health care trends and outcomes.\(^1\) This study helps to highlight an additional creative use of EHRs. Results obtained from our study validate strategies that can add to current and future program planning in dental colleges. One of the most useful findings of this study was the flexibility of extracting, manipulating, aggregating, and plotting data stored within the EHR. In the study, it became clear that EHR data present numerous opportunities for future program planning and research.

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**REFERENCES**