Using Tablet PC's in Dental Practice Research: Technology, Cost Savings, and Direct Data Entry "On the Go"

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Abstract

Recent technological developments have greatly simplified data collection, recording, and transfer in studies relying on direct observation or survey methodology, reducing both cost of data collection and the time necessary to prepare data for analysis. The purpose of this communication is to describe how tablet PC computers can be used in data collection, thereby eliminating intermediate data collection steps and chances for error, and thus reducing overall cost. The data collection procedure used to illustrate this technology is a direct observation study of the factors associated with the delivery of preventive services by dentists and hygienists in their daily practice.

Key Words: research design, data collection, survey methodology, technology, observation, study methodology, electronic data processing

Recent technological developments have greatly simplified data collection, recording, and transfer in studies relying on direct observation or survey methodology, reducing both cost of data collection and the time necessary to prepare data for analysis. An example of how technology can be used to eliminate intermediate data collection steps, thus reducing cost and chance for error, is provided by the authors' experience using tablet computers as part of a direct observation study of dentists and hygienists in their daily practice.

The subject of the study is the identification of factors associated with the delivery of preventive services by dentists in general practice. The methodology includes a direct observation technique developed at UC Davis and utilized at Case Western Reserve University in a prior study of Family Medical Practice (1). Several instruments are used to collect information from patients and practitioners, including questionnaires, billing and chart data, and qualitative reports. Comparison of information gathered by different methods will indicate the least expensive and most accurate methods for collecting information about dental practice.

Approximately 5000 patient visits in 120 practices will be observed over the course of the study. Two teams of two dental hygienists each observe dentists and hygienists in each office for three days, with a fourth day for chart and billing audits. A third team member handles patient recruitment and human subject research compliance documentation and helps with chart abstractions. All team members maintain qualitative logs. The main observation tool for the encounter is the Davis Observation Code (DOC), a well-tested instrument used to record physician behavior, adapted to dental practice. Twenty-four *codeable* operational definitions for potential types of dentist/hygienist interactions with patients are recorded every 30 seconds during each patient visit. The DOC's modified for dental practice are called the "Dental DOC" and "Hygienist DOC." Other instruments include: a post-visit checklist; survey questionnaires for patients, dentists, and hygienists; a practice environment observation report; and a chart and billing audit for each visit.

All survey questionnaires were modified so that they can be scanned electronically and automatically converted into data files that are easily imported into common analytical software. The DOC's, the post-visit checklist, chart and billing audit, and practice environment survey are loaded on the tablet PC's, and data is entered directly into the specific instrument "on the go."

A new DOC is opened as the patient enters the operatory, and a "stoplight/clock" program is activated. When a practitioner enters, the observation process begins. Each 30-second interval is represented by a six-row by five-column "table" that contains all the specific DOC codes—with checkboxes adjacent to them—presented on the tablet PC in a scrolling fashion, one interval (or table) after another. Using the digital pen/stylus, the observer observes for 25 seconds, "checks" one or more code boxes for the current interval when the "record" prompt plays, then scrolls to the next table and begins the process again. At the end of the encounter, the observer closes the DOC, opens a post-visit checklist, and checks off the types of procedures performed during the visit. At this point, the observer can also jot down qualitative notes regarding characteristics of the overall encounter. Chart and billing audits are performed on the last day at the office, and the data is also directly entered into the tablet PC using the digital pen, on-screen key-

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board, or via the external, mobile keyboard. Observers and patient coordinators also use the handwriting and speech recognition software application to record other qualitative notes regarding patient visits.

Direct entry and the use of scannable survey questionnaires are made possible through the addition of SNAP software (Mercator Research Group, Ltd., Thornbury, Bristol, UK) that allows direct entry data collection using tablet computers, PDA's, or desktop computers. The tablet PC chosen was the Motion Computing Inc. model M1400. The M1400 has a magnesium alloy chassis, is approximately the size of a yellow note pad, and weighs about three pounds. All units have 20GB hard-drives and 512MB of RAM. Battery life is approximately 3.5 hours under normal usage, enough for a half-day's use. Additional batteries and a charger were purchased so that observers would have a full day's capacity of battery life. The tablets have Speak Anywhere™ technology (advanced voice input and recording for voice recognition). The operating system is Microsoft® Windows® XP Tablet PC Edition, including a full array of Microsoft® office software and other software specific to tablet PC use, e.g. OneNote, Windows Journal, and Sticky Notes. (As this article goes to press, Motion Computing and many other manufacturers offer a wide variety of new tablets and notebook/tablet combinations.)

Adapting the tablet PC for use in this study required little effort. The supplied digital pen/stylus and packaged software met most of the main needs of the study right out of the box. The "stop-light/time" software and one other application (Snap7™ survey software) were installed so that direct data entry could be used for all observation instruments. USB flash-drives were used for transferring raw survey files and collected data to and from a main desktop machine. In short, the tablet PC was ideal for the main application of the study, i.e., entering data directly in a mobile environment with very quick turn-around time for data examination, cleaning and processing.

There are a few limitations/disadvantages in using tablet PC's. First, while the machines used weighed in at 3.1 pounds, the research team hygienists expressed some awkwardness and physical difficulty when holding the devices for extended periods of time. These endurance- related problems seemed to dissipate after a period of one month. Second, certain lighting situations produced extensive glare on the computer screen, and required that the user hold the tablet in a more upright position than a traditional paper pad, which increased awkwardness and strain. Motion Computing does, however, offer an optional View Anywhere® Display that compensates for outdoor use and the glare associated with the high-intensity lighting used in many clinical situations.

Notwithstanding the above limitations, the study's assessment of the use of tablet PC's for *direct data entry* is very positive. The learning curve did not present problems for team members. Observers in the study were quite enthusiastic about learning to use the pen/stylus, the voice recognition application for qualitative note dictation, and Windows Journal software for jotting notes between patients. With 512MB of RAM, the machines managed all requirements to have multiple files and multiple applications running simultaneously. Additionally, substantial costs were eliminated from the project through the use of tablet PC's. Printing, scanning and bulk-paper storage costs were reduced, and need for a data entry clerk and a full time transcriptionist for qualitative data were eliminated. In the final analysis, authors of the study were very satisfied with the performance of tablet PC's use as direct data entry devices. Researchers from a broad spectrum of disciplines and substantive fields contemplating mobile data entry should seriously consider them, as they can be easily adapted to a wide range of purposes.

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References

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