**Feasibility Analysis of Implementing Digital Radiography**

for

Dr. J.M. Jameson, DDS

Owner of Dr. James Jameson Dentistry Inc.

by

Josy Jonas, RDH

English 301 Student

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**Introduction**

Dental radiography is an essential diagnostic tool in the assessment and diagnosis of our patient’s oral health. As you know, radiography has had significant advances in technology in the past several decades. Although traditional radiography is an adequate current technique, digital radiology is now considered the gold standard of dental radiology. Digital radiography is a method of integrating computer technology in taking, displaying, enhancing and storing radiographic images. Digital radiography has several clinical advantages for your practice, for patients, long term cost efficiency, and is better for the environment.

**Background information**

There are two types of image receptors used for intraoral and extraoral digital radiographic techniques, direct and indirect.

**Direct method**

The capture of X-ray photons is converted to a digital format image by a wireless or hardwired connection to a computer. A sensor is placed in the mouth and exposed with a regular x-ray tube head and appears within seconds on a monitor within the patients file (Shah, Nikhil and Logani 796).

**Indirect method**

The indirect method is a two-step process and similar to traditional radiography. The image is captured using a phosphor plate (PSP), the exposed plate is then placed into a laser processor attached to a computer. The image is digitized and displayed on a monitor (Shah, Nikhil and Logani 796).

**Purpose of the Report**

To explore the feasibility of converting to digital radiography in your practice.

**Methodology**

A short survey was designed to gather data on dental hygienist’s views and experiences with digital radiography. Estimations of time, training requirements, costs and revenue for digital radiography are calculated based upon email correspondences with sales representative, and a digital technology specialist from Henry Schein. The primary sources of data were supplemented with peer reviewed scientific journals for additional, relevant and supporting information.

To determine the feasibility of implementing digital radiography in your practice setting the following areas of inquiry were pursued:

* What are the benefits/implications of digital radiography to our patients?
* What are the practice benefits/implications of digital radiography?
* What environmental impact does traditional radiography have in comparison to digital radiography?
* What are the initial costs, and training requirements of digital radiography?
* What are the drawbacks of digital radiography?

This report analyzes information gathered from our dental assistant, dental hygienists, dental sales representatives, a digital technology specialist, as well as from the scientific literature. The analysis will examine the prospect of implementing digital radiography into your practice setting; what is required to make the change; and what are the significant benefits and drawbacks of digital radiography.

**Limitations**

A comparative price analysis would have perhaps yielded a less expensive option. However, due to the remote location of the practice, only one dental sales company pricing is available.

**Conclusions**

A workflow analysis showed that a combination of the indirect method and direct method technologies would be the most practical and economical solution.

**Data Analysis**

**Implications of digital radiography to your patients**

**Radiation Exposure**

Digital radiography systems reduce exposure to radiation by up to 80 % compared to traditional film systems (Shah, Nikhil and Logani 799). Our current film based radiography is safe, but digital radiography follows the ALARA principle (As Low As Reasonably Achievable). As you know, this safety principles’ mandate is intended to promote minimizing radiation exposure for both patients and staff.

**Enhanced communication**

Digital radiography facilitates increased communication with patients, with the images viewed immediately on a computer screen. The surveyed dental hygienists stated using digital radiography as an educational tool 75 % of the time. Oral health conditions are easier to understand by presenting visual aids. Digital radiography has the ability for images to be enhanced, and enlarged. Changes in restorations and extent of bone loss can be shown by superimposing images taken at different times.

**Time Saver**

Traditional radiographs require five to ten minutes of developing time, of the surveyed dental hygienists, 87.5% strongly agreed that digital radiography is a time- saver. It allowed them more time to focus on treatment and their patients.

**Practice implications of digital radiography**

**Film Storage**

Storage of data is on file servers, requires little space, and has an indefinite shelf-life. The advantage is that films are not used, therefore, there is no concern over film deterioration over time.

**Image Sharing**

Digital radiographs are quickly and easily transmitted to insurance companies, and other dental practices via email. This results in saved paper, and postage costs for the practice; and provides patients with better service, saving them time in travel and trips to specialist’s offices.

**Higher Quality of Care**

The ability to manipulate images produced from digital radiographs enhances diagnosis, and improves your ability to detect disease.

**Better image quality**

Traditional radiography has the disadvantage of obstructing the areas of interest because of superimposing overlying structures, it results in collapsing 3-D structural information onto a 2-D image. Digital radiography allows the diagnostician to view the area of interest in the third dimension (Shah, Nikhil and Logani 795).

**Increased productivity**

Images are produced in seconds with the use of digital radiography, while wait times for traditional processing can vary between six to nine minutes. During an endodontic procedure where multiple radiographs are necessary, the wait times result in loss of productivity. Four films are required during endodontic treatment, on average, you perform two endodontic procedures a day. A conservative estimation of wait times is forty-eight minutes per day. Forty-eight minutes multiplied by 4 work days = 192 minutes per week or 3 hours a week lost on wait times.

**Environmental impact**

Some of the materials necessary to produce images with traditional radiography are detrimental to the environment. The chemical products used in the processing of the films contains silver thiosulfate, a toxic agent. This toxic agent can enter our water systems if disposal of dental office waste is not adequate. Another by-product of traditional radiography is the lead shields contained in individual film packages. Lead and silver compounds used in traditional radiography have detrimental health effects, and are persistent in the environment. The implementation of digital imaging within the dental office would eliminate the use of chemicals and detrimental by-products, presenting an eco-friendly alternative (Hiltz 62).

**Current Costs of Traditional Radiography**

The consumable costs of traditional radiography are ongoing and expensive. This includes film developer, fixer solution, films, film holders and waste management disposal of chemicals. Additionally, operating costs and labour costs need to be factored in to a cost benefit analysis.

The American Dental Association estimates the cost of a single traditional radiograph at approximately fifty-cents. On average, we take 30 films a day, the average cost $15/ day. We work four days a week and approximately 44 weeks a year. The costs for film averages to $2640/ year

**Labour costs**

Traditional radiography is more labour- intensive than digital radiography.

Processor maintenance is required once every other month. This takes our dental assistant 3 hours at $25/ hour

$75 X 6 times a year = $450

Processing films in the darkroom averages from 3 minutes for bite-wing radiographs to 10 minutes for a full mouth series. The labor cost for staff members to process, develop and mount 30 films a day is about $ 60.00.

Weekly cost is $240

Monthly cost is $ 960

Annual labour costs- $11, 010 includes developing, film mounting, and maintenance

Annual film costs- $2640

**DISADVANTAGES**

**Radiation exposure**

A study conducted by Berkhout et al. determined that because digital radiographs produce an image within seconds, dental professionals on average take more radiographs. Digital radiographs require 50-80% less radiation per exposure than film. Due to the increase in numbers of radiographs taken, the reduction in radiation dose is less than 25 % (Berkhout and Van der Stelt).

**Client comfort**

Digital sensors used in place of dental films are rigid and bulkier. This can cause patient discomfort for those that are prone to gagging, children, and patients with smaller mouths. Of the survey respondents 62.5% indicated that the large sensor size is a barrier to treatment.

**Infection control**

Sensors used for digital radiography remain a potential source of contamination. Since sensors cannot be sterilized, protective plastic barriers are used to prevent the spread of infection. Contamination of the sensor happens if there are defects in the barrier envelopes, and/or a break in the envelop because of a film holder, or if the sensor is touched with contaminated gloves (MacDonald and Waterfield).

**Financial**

Purchasing a digital radiography system is a considerable expense. Some of the fees associated with operating digital radiography, go beyond the initial purchase. There are annual warrantee fees on the equipment, and annual software support fees. Sensors and PSP plates are fragile and prone to damage if they are dropped or bent. Replacement sensors cost thousands of dollars to replace, while PSP plates replacement costs start at $40 depending on size.

**Equipment maintenance**

Problems with computers such as systems crashing and equipment does occur, 50% of the surveyed dental hygienists stated their equipment required maintenance 1-2 times over the past three years. Leading to disruptions in work flow, and potentially loss of productivity.

**How often have you encountered the need for maintenance of equipment in the past three years?**

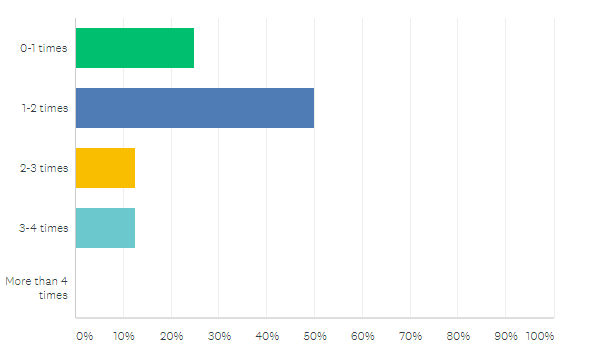


Figure 1. Required maintenance

**What are the initial costs, and training requirements of digital radiography?**

**What are the options?**

There are two types of image receptors used for intraoral and extraoral digital radiographic techniques, a direct and indirect method.

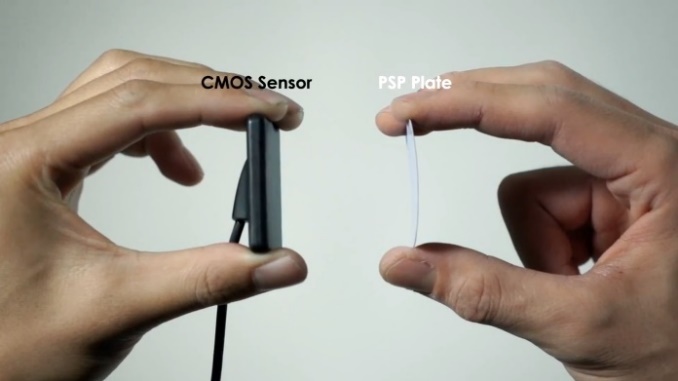


Figure 2. (Apixia) size difference between the sensor (direct method) and PSP plate (indirect method).

**Direct method**

The capture of X-ray photons is converted to a digital format image by a wireless or hardwired connection to a computer. A sensor is placed in the mouth and exposed with a regular tube head and appears within seconds on a monitor in the patients file (Petrikowski).

**Advantages of direct method**

* Image is produced within seconds- ideal for endodontics and emergency situations
* Saves time
* Increased productivity
* Superior image quality over indirect method

**Disadvantages of direct method**

* Most expensive option
* Steeper learning curve
* Inactive area on sensor plate, leads to lack of information
* Bulkier sensor
* Computer in every operatory
* The thickness and rigidity of the sensor may not allow for adequate placement

**Indirect method**

The indirect method is a two-step process and similar to traditional radiography. The image is captured using a phosphor plate, the plate is placed into a laser processor attached to a computer. The image is digitized in the computer and displayed on a monitor (Petrikowski).

**Advantages of indirect method**

* Easiest to learn
* Least expensive option
* Wireless, plates can be taken from operatory to operatory
* Computers not necessary in every operatory
* Imaging plates are thinner than sensor’s and comparable to film sizes
* More comfortable for patients
* Entire plate captures image
* Reusable plates

**Disadvantages of indirect method**

* Processing times vary from 30 seconds up to two minutes
* PSP plates can be damaged from bending or surface scratches
* PSP plates are reusable but do wear and need to be replaced
* Image quality degrades over the number of uses each plate has
* Image quality is not as good as direct method, with sensors

**Training requirements**

Training will be provided at no charge from a certified trainer. Training is relatively easy and can be completed in two to three hours.

**Conclusion-** Although the initial costs of implementing digital radiography are high, the monetary benefits in the long run have been highlighted. The non-monetary benefits such as oral health promotion, environmental impact and practice reputation are invaluable.

**Summary of Findings –** Cost benefit analysis to be completed

**Interpretation of Findings**

**Recommendations –** Based on the collected data, please consider the following recommendations;

1. Digital radiography is economically feasible because, if we compare ongoing costs of traditional radiography, you would have it paid off in…
2. P.501 before we make any decisions about this product, I recommend a full-scale market analysis

* Discuss digital radiography options with more than one dental sales company, to evaluate the various options and get the best rate
* Consider an indirect method in the hygiene operatory, and direct method in DDS operatory. This mixed method meets the practices needs, and is the most cost effective

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**Appendix A: Projected Costs**

**Direct Method**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Description** | **Quantity** | **Regular Price** | **Special Price** | **Extended Price** |
| Dexis Platinum Sensor with three years extended warranty | 1 | $16,949 | $14,045 | $14,045 |
| Software bundle including DexRay, DexNet, DexImage, DexTwain, DexIntegrator and in-office training (may not need all modules) | 1 | $8,327 | $7,681 | $7,681 |
| Subtotal without taxes |  | $25,276 | $21,726 | $21,726 |

**Additional fees**

Computer hardware costs vary considerably, we would require two computers with the direct method. The computer purchase information from Henry Schein is included in the appendices section.

Value line - $1,130- $2,535

Premium line -$1,375- $3,510

Yearly warranty fees

**Indirect Method**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Description** | **Quantity** | **Regular Price** | **Special Price** | **Extended Price** |
| Scan-x Swift phosphor plate system | 1 | $10,048 | $9,071 | $9,071 |
| Safecom Imaging Software | 1 | $5,900 | $5,500 | $5,500 |
| Safecom Imaging Support (payable yearly) | 1 | $600 | $600 | $600 |
| Subtotal without taxes |  | $16,548 | $15,171 | $15,171 |

**Additional fees**

Computer hardware costs vary considerably, we would require one computer with the indirect method. The computer purchase information from Henry Schein is included in the appendices section.

Value line - $1,130- $2,535

Premium line -$1,375- $3,510

No yearly warranty fees

**Appendix B: Survey Questionnaire**

1. How would you rate the learning curve when you first started using digital radiography?
2. What is your level of satisfaction with the use of digital radiography?
3. How likely are you to recommend digital radiography?
4. In your own opinion, which radiographic technique do you prefer?
5. In your opinion do you think patients are more compliant with treatment recommendations due to the visual enhancement features digital radiography offers?
6. Dental team professionals benefit from lessened exposure to radiation with digital radiography. What is your level of concern regarding exposure to radiation?
7. One of the noted disadvantages of digital radiography is the size of the sensor used, does this pose a barrier to use and/or treatment?
8. One of the noted advantages of digital radiography is time efficiency (no developing time) What is your level of agreement with this claim?
9. Do you use your patients digital radiographic images as an educational tool?
10. How often have you encountered the need for maintenance of equipment, in the past three years?