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FILM PROCESSING QUALITY CONTROL

The ideal image receptor would be one which produces an immediate image with high diagnostic quality, the lowest possible radiation exposure to the patient, minimum labor requirements, low cost and no adverse effects on the environment. The silver halide film used for most imaging applications requires chemical processing to produce the visible image. Chemical processing is a major element which causes film to be less than the ideal receptor component as described above. Film processing in the clinical environment can contribute to:

- Delays in image availability
- Loss of image quality
- Unnecessary patient exposure
- Reduced productivity
- Increased cost
- Environmental contamination

Several of the clinical requirements listed above related to the two major operational goals of clinical processing. They are:

- Processing accuracy
- Processing consistency

Accurate processing is the level of processing which produces the design sensitivity and contrast characteristics of a film. This is achieved when the processing conditions in the clinical facility produce the same results as the processing used by the film manufacture. Accurate processing conditions are necessary in order to achieve an optimum level of processing.

After accurate processing is established it is necessary to maintain consistent processing over a period of time. This is achieved by means of an ongoing quality control program.

If processing conditions do not produce the intended film sensitivity, it then becomes necessary to increase the radiation exposure in order to obtain an adequately exposed image.

When film sensitivity fluctuates over a period of time, exposure errors will increase. This in turn, can increase the number of repeated examinations which results in additional and unnecessary exposure to the patient.

The principle problem with film development is that it is an unstable process which is subject to considerable variability. It is this variability in processing which contributes to:

- Reduced image quality.
- Unnecessary patient exposure

The primary requirement in the clinical facility is to control the processing variables in order to achieve and maintain optimum processing conditions.

The level or degree to which a film is processed is a continuum which depends on many of the variable processing parameters. The level of processing for a particular film generally falls within one of the following three ranges. The variables which affect the level of processing will be discussed later.

- Under-processing: Referring to a radiograph that is too light because too little x-radiation reached the image receptor. An under-processed film has two undesirable characteristics: a reduced sensitivity (speed) and a loss of contrast. The reduction in sensitivity can result in an “underexposed” film or the need for unnecessarily high exposure to produce an adequate film.

The under-processed film will be lighter than desirable for a diagnostic film and creating the need for a repeat film.

- Optimum processing: An optimum level of processing produces film characteristics in the clinical setting which match the design characteristics of the film. Optimum processing is the principal goal in the clinical facility.

The optimum level produces a diagnostic film from which a diagnosis can be made.

- Over-processing: Referring to a radiograph that is too dark because too much x-radiation reached the image receptor. Over-processing is somewhat more complex than under-processing. It generally increases the sensitivity (speed) of the film. This might appear to be an advantage in that exposure can be reduced. However, over-processing can produce overexposed films, especially when the processing is inconsistent. Over-processing also has an impact on the contrast characteristics of a film. In some cases, a moderate degree of over-processing decreases contrast because of the added density and fog.

The over-processed film will be darker than desirable for a diagnostic film and creating the need for a repeat film.

Consistent processing conditions: There are three basic actions in a QC program for maintaining consistent processing.

- Testing: The first step is to periodically test the processing. This is done by processing a film which has been exposed with a sensitometer and then measuring the resulting density values with a densitometer. The density values of specific exposure steps, and the contrast between steps, will vary with the level of processing. Selected density and contrast values are plotted on a control chart so that they can be compared on a day-to-day basis.

- Charting and analysis: All data collected must be plotted on control charts, including the actual data points, the date the data were collected and the corrective action taken, if any. The control charts must also have established limits showing the maximum acceptable range of variability for each factor. There are two conditions which will indicate a need for corrective actions. A continuing change in a density or contrast value in the same direction generally indicates an unstable processing condition which will often continue and eventually exceed the established limits. This type of gradual trend is typically associated with changes in the chemical activity. Abrupt changes in the density or contrast can result from factors such as a shift in temperature, some form of contamination, or an error when replacing chemicals. This requires more immediate corrective action.
- Corrective action: This requires a person who is knowledgeable in the technical aspects of processing. This person can be on the staff of the facility or the company providing the processor maintenance and service.

Medical facilities:

When evaluating the quality control sensitometry strip with the densitometer, remember that the data plotted is to determine whether the processor is operating properly first thing in the morning before processing any patient films. The density of the strips must be read and plotted immediately to determine whether any processor changes have occurred. It is inappropriate to process clinical films and then determine hours or days later that the film processor was not operating optimally. Likewise, it is inappropriate to pre-expose sensitometric strips hours or days in advance as they will suffer from latent image changes and will not be as sensitive as freshly exposed strips to changes in the processor.

Control charts provide an easy means of reviewing related data. Whenever a data point reaches or exceeds the control limits, the test should be repeated immediately. If the repeated measurement data still reach or exceed the control limits, then immediate corrective action is required. The out-of-control data point should be circled, the cause of the problem noted, and in-control data point plotted.

Control charts also allow for the detection of trends which indicate an unstable process. A trend is an upward or downward change in the measured data when three data points move in the same direction. The cause of the trends should be investigated.

If control limits are consistently exceeded, then it is necessary to improve the quality control procedures, or repair or replace the appropriate equipment DO NOT widen the control limits since the data are indicating that the process is “out of control” and corrective action is essential.

Dental Intraoral Facilities:

When evaluating the quality control “crabtree” processing device, remember that it is important that the data (number read) information be plotted to determine whether the processor is operating properly first thing in the morning before processing any patient films. The out-of-control data point numbers would be below 3 and above 5. By plotting on a chart an easy means of reviewing the related data for detection of trends which indicate an unstable process. A trend

is an upward movement (over 5) toward over-exposed films (dark) or downward movement (below 3) toward under-exposed films (light) or with 3 data points moving in those directions indicating the process is out-of-control and corrective action is essential.

Dental Extraoral Facilities:

When evaluating the quality control, step wedge processing device, remember that it is important that the data (step number) information be plotted to determine whether the processor is operating properly first thing in the morning prior to processing any patient films. The out-of-control data point numbers would be two steps on either side of the step marked as the daily standard. By plotting on a chart an easy means of reviewing the related data for detection of trends which indicate an unstable process. A trend would be an upward movement above the standard step indicating over-exposed (dark) film or a downward movement below the standard step indicating under-exposed (light) film or 3 data points (step numbers) moving in those directions indicating the process is out-of-control and corrective action is essential.