

SEARCH 4 MOP
Section 12 - Cohort Visit - Retinopathy Imaging Protocol
Table of Contents

12. RETINOPATHY IMAGING	1
12.1. INTRODUCTION	1
12.2. EQUIPMENT AND SUPPLIES.....	1
12.2.1. <i>Equipment</i>	1
12.2.2. <i>Supplies</i>	2
12.3. EQUIPMENT SET-UP.....	2
12.3.1. <i>Daily Set-up Procedures</i>	2
12.3.2. <i>Camera Lens and Body Care</i>	3
12.3.3. <i>Instrument Table and Stools</i>	3
12.3.4. <i>Camera Malfunctions or Errors</i>	3
12.4. SUBJECT IMAGING OVERVIEW.....	4
12.4.1. <i>Subject Exclusion</i>	4
12.4.2. <i>Pre-examination Procedure</i>	5
12.4.2.1. <i>Subject/Guardian Explanation</i>	5
12.4.2.2. <i>Completing the SEARCH Image Inventory Batch Form</i>	6
12.5. EXAMINATION PROCEDURE	6
12.5.1. <i>Subject Positioning and ID Entry</i>	6
12.5.2. <i>Pupil Size and External Camera Alignment</i>	11
12.5.3. <i>Internal Eye Alignment</i>	12
12.5.4. <i>Alignment, Focus and Proper Fixation of Fundus Images</i>	13
12.5.5. <i>Finishing an Imaging Session</i>	14
12.5.6. <i>Turning Off the Laptop and Camera</i>	16
12.5.7. <i>Image Transfer Problems</i>	17
12.6. IMAGING CHALLENGES.....	18
12.6.1. <i>Small Pupils</i>	18
12.6.2. <i>Exposure Compensations for Dark or Light Retinas</i>	21

12.6.3. Common Problems Seen	22
12.7. IMAGE INVENTORY BATCH FORM (BATCH FORM).....	25
12.8. DIGITAL FILE HANGLING.....	25
12.9. PHOTOGRAPHER CERTIFICATION	25
12.9.1. Obtaining Certification.....	25
12.9.2. Sending Certification or Test Images	26
12.9.3. Certification of New Photographers after the Study Begins.....	26
12.10. QUALITY CONTROL.....	27
12.10.1. Image Quality.....	27
12.11. COMMUNICATION CHANNELS	27
12.12. ATTACHMENTS.....	28
12.12.1. Image Inventory Batch Form & Instructions.....	29
12.12.2. Photographer Certification Request Form	32
12.12.3. How to Save Images to the Local Export Folder.....	33
12.12.4. How to Edit a Subject	36
12.12.5. How to Delete an Imaging Session.....	37

12. Retinopathy Imaging

12.1. INTRODUCTION

SEARCH is an on-going, multi-center, epidemiological study consisting of a culturally diverse population of youth with diabetes. Initiated in 2000, SEARCH encompasses the major racial/ethnic groups in the U.S: non-Hispanic white (NHW), African-American (AA), Hispanic (H), Asian-Pacific Islander (API) and American Indian (AI). SEARCH was designed to estimate the prevalence and incidence of diabetes among youth, and to characterize diabetes-related health outcomes and their risk factors including barriers to care and quality of health care. For SEARCH 3, 2780 individuals participated and this same cohort (as well as a subset of participants who completed a 2012 Registry In Person Visit) will be followed for the SEARCH 4 Cohort Study. The SEARCH 4 Cohort Study will continue to address questions regarding the impact of diabetes on the health outcomes of affected youth.

One of the aims of the *SEARCH 4 Cohort Study* is to **establish, compare and contrast the burden (prevalence, incidence, progression and clustering) of acute and chronic complications of diabetes, and explore the responsible risk factors and pathways among youth and young adults with T1D and T2D**. We will measure key outcomes, including: retinopathy, nephropathy, cardiac autonomic (CAN) and peripheral neuropathy, arterial stiffness, cardiac damage, neurocognitive outcomes, as well as acute complications (hypoglycemia, diabetic ketoacidosis -DKA). We will explore a variety of risk factors and pathways, including: metabolic; inflammatory; **vascular**; behavioral; socio- economic; psycho-social and health-care factors. We hypothesize that: **1.1:** Youth with T2D have higher prevalence, incidence, faster rate of progression and different patterns of clustering of chronic complications, but lower burden of acute complications than youth with T1D, independent of age, sex, diabetes duration and race/ethnicity.

In order to assess the burden of retinopathy, the same protocol will be followed in this examination that occurred in the SEARCH 3 examination. Beginning around March 2016, retinal images of both eyes of the SEARCH 3 subjects will again be obtained using a Canon CR-1 Mark II fundus camera. The Ocular Epidemiology Reading Center (OERC) at the University of Wisconsin-Madison will again grade these images for presence and severity of diabetic retinopathy, macular edema, and retinal vessel caliber. In addition, a longitudinal review of the images will be completed to determine if there is any change (progression/regression) between SEARCH 3 and SEARCH 4 visits.

12.2. EQUIPMENT AND SUPPLIES

12.2.1. *Equipment*

A Canon CR-1 Mark II fundus camera equipped with a Canon EOS 50D (15.1 megapixels) camera back will utilize the Canon Retinal Image Control Software (RICS)

for this project. The fundus camera will be mounted on a motorized instrument table to allow maximum subject and photographer comfort and optimum camera alignment. Both photographer and subjects will have pneumatically adjustable stools. Subject stools will have a backrest.

12.2.2. *Supplies*

An inventory of supplies for each of the 10 study sites follows:

- (a) 1 box Long-grain Red Cross sterile lens cotton batting, (12 1/2" X 56" roll) (such as Kendall CURTIY Lakeside cotton roll (p/n 6030). It is nonsurgical bleached cotton and comes in one pound rolls.)
- (b) 1 bottle Lens cleaning alcohol (99% isopropyl alcohol, 8 oz/bottle)
- (c) 6 boxes Facial tissues (200/box)
- (d) 1 canister Compressed air with plastic delivery tip
- (e) 1 box Chinrest paper (500/box, p/n CO-AP)

Both the CURTIY Lakeside long-grain sterile lens cotton batting and the 99% isopropyl alcohol can be ordered and purchased at a Walgreens or CVS type pharmacy or on-line. The chinrest paper may be obtained from Synemed, Inc. 4562 E. Second Street, Benicia, CA 94510, 800/777-0650.

12.3. EQUIPMENT SET-UP

The fundus camera, set on the motorized instrument table, should be placed in a room that can be completely darkened during the imaging procedure. This is because no dilating drops will be used and we rely on the natural dilation of the pupil that occurs in the dark to perform the fundus imaging. The camera should be placed in the room so that the subject has easy access to the examination stool (with backrest) and so that the photographer has ready access to the room light switch. The computer screen and camera panel light provide enough illumination to allow the photographer to see and navigate and may need to be adjusted (not shining light onto the subjects eyes) to minimize pupil constriction.

The EOS camera should not be turned off. Please confirm that the function dial on the EOS camera is set to "M" (for Manual), the display screen is illuminated and that the camera on-off lever is in the "On" position before beginning photography. Please check that the camera is connected to the laptop and that the laptop is connected to the Internet to allow images to be transferred to the reading center (a wireless connection is acceptable).

12.3.1. *Daily Set-up Procedures*

The camera dust cover and lens cap should be removed at the beginning of the day and the lens inspected (see section 12.3.2) and cleaned, as necessary. Dust is the greatest enemy, producing the majority of artifacts on the images. When the camera is not in

use, the lens cap should be in place and the special dust cover should be placed over the camera.

12.3.2. *Camera Lens and Body Care*

Before each subject is imaged, the camera lens will be inspected and, if dusty, cleaned with an air bulb or canned air to remove loose debris. Should more extensive cleaning of the lens be required, the lens can be fogged with your breath or moistened with the 99% isopropylene alcohol. Cotton should then be used in a circular polishing motion until no dirt or oily film is visible on the lens when it is viewed from the front or when images are captured (see pages 30-31 in the Canon CR-1 Mark II Operation Manual). The body of the camera should be kept clean and free of dirt with a soft cloth and water or a common spray cleaner. The forehead rest may be cleaned between subjects with isopropyl alcohol pads. High humidity or temperatures must be avoided. Dusty conditions mean that the camera will need frequent cleaning.

For more assistance on lens cleaning, an on-line tutorial is available at <http://www.epi.ophth.wisc.edu/content/lens-cleaning-tutorial> or on the SEARCH website <https://www.searchfordiabetes.org>. Go to DASHBOARD (top menu) – OPERATIONS – Training to access the link.

12.3.3. *Instrument Table and Stools*

The instrument table and stools can be kept clean by wiping with a common spray cleaner and a soft cloth. Occasionally the castors on the table and stools may squeak, requiring a drop of light oil. The electric motor on the table requires no lubrication.

12.3.4. *Camera Malfunctions or Errors*

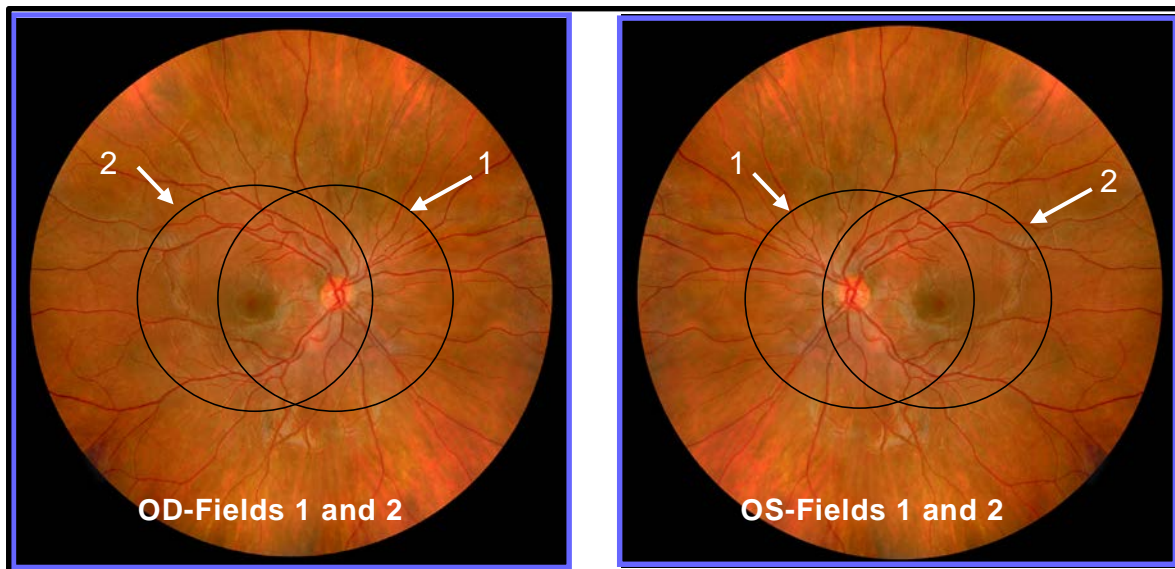
Since the camera requires virtually no other maintenance, any malfunction will need to be investigated first by the examiners at each center and, when necessary, via telephone with the OERC staff. Trouble-shooting tests can be performed in consultation with the OERC staff to diagnose some malfunctions. Because the photographer can see the digital images immediately after they are taken, the photographer may be able to detect and correct problems by retaking the image(s). This includes problems with a dirty objective lens, improperly focused images or missed images caused by a subject's blink, or other software/hardware malfunctions.

Some camera malfunctions or photographer errors may not be evident to clinic staff during imaging and will not be discovered until the digital images are reviewed at the OERC. This includes unusual image artifacts or problems related to the camera or software. For this reason, the images will be transmitted directly to the OERC after each subject is imaged. Note that the Inventory Batch Form must still be faxed or e-mailed to the OERC on an agreed upon timeframe, typically once per week. Additionally, a telephone should be available in the camera room so that the site photographers and the

OERC imaging consultants can speak should a malfunction be discovered during imaging or should the photographers have a problem or question needing immediate attention. For imaging questions, contact Lisa Grady at 608/263-0285. For computer questions or problems, contact Tony Fairbanks at 608/265-2625.

12.4. SUBJECT IMAGING OVERVIEW

All subjects will have two 45-degree images taken of each eye with the right eye (right eye is OD, left eye is OS) being imaged first. The first image will be centered on the optic nerve and this is referred to as Field 1. The second image will be centered on the macula and will be referred to as Field 2. On rare occasions, when it may only be possible to obtain one image in an eye (as when the subject cannot tolerate the procedure or refuses multiple images) the image of Field 2 should be taken. A diagram of the location of the two fields can be seen below in Figure 1.



Images compliments of Richard Hackel

Figure 1

12.4.1. Subject Exclusion

The photographer will attempt imaging on all subjects, including some with poor visual acuity who may be unable to direct their gaze so that their optic nerve or macula is properly positioned on the camera monitor (as may be the case where both eyes are blind or when the subject is deaf and communication with them is impossible). In these cases, the photographer should get the best field definition possible.

The photographer should attempt imaging on those subjects who are physically disabled, to the point that they can be comfortably positioned at the camera. To facilitate this, the subject may remain in a wheelchair positioned before the motorized camera table

lowered to the appropriate height. Care should be taken when lowering the camera table to avoid pressing against the subject's legs.

If, in the photographer's judgment, no acceptable image can be taken of either eye, the subject will be excused from imaging and the reason for not collecting retinal images should be documented in the Data Management - Retinopathy Refusal Section on the SEARCH website (<https://www.searchfordiabetes.org>). Nothing needs to be filled out on the Inventory Batch Form if imaging is not completed for a subject.

12.4.2. Pre-examination Procedure

This SEARCH Retinopathy Imaging Protocol uses terminology from the Canon CR-1 Mark II Operation Manual and it is recommended that both documents be reviewed by each photographer before performing imaging.

Site staff is encouraged to practice taking retinal images to become familiar with the camera and software prior to the February 2016 GoToMeeting refresher training session.

12.4.2.1. Subject/Guardian Explanation

Imaging begins with a complete explanation of the procedure by the photographer. A color illustration may be useful to show what the retina looks like. It is important to reassure the subject that no retinal damage is caused by this procedure. The subject should know to expect several flashes. The pictures will include the macula (area of central vision) and it is normal to experience a blue or red tint to vision immediately following the flash. This disappears within 5-7 minutes. No dilation drops will be used for this examination, and the eyes will not be touched. A sample script of a typical retinal imaging explanation (suitable for use as written material for deaf or interested subjects) follows:

We will be taking several images of the inside of the back of both of your eyes (the retina) so we can study the blood vessels and look for any unusual changes. We will not be touching your eyes or be giving you any eye drops to take the pictures. Instead, you will be asked to sit in a darkened room before a special camera with your chin in a chin rest. We darken the room so that your pupils will dilate and we can align and focus the camera on your retina. During the aligning process you will only be aware of a green dot visible in the camera lens. We will ask you to follow the dot should we move it. Just before we take the images, we will ask you to blink your eyes and then open them really wide. The camera will flash a light from within the camera lens as each image is taken.

Just after the image is taken, you may see a blue or red circular spot before the eye that was just imaged. This will disappear within 5-7 minutes and causes no damage to the eye. Please remember that we are only taking images (not an x-ray) of a small portion of the back of your eyes and that this image will not substitute as an eye

examination. You will certainly be notified should we notice anything requiring immediate attention. Please continue to see your eye doctor on a regular basis for your complete eye examinations.

12.4.2.2. Completing the SEARCH Image Inventory Batch Form

At all sites, the photographer will complete the SEARCH Image Inventory Batch Form which includes two questions about vision history and concerns the subject's ophthalmic history. The form can be completed while the subject becomes sufficiently dilated to be imaged. Note that while the transmission of the images is automatic, the Inventory Batch Form must still be faxed or electronically sent to the OERC on an agreed upon timeframe, typically once per week. The form is sent automatically to the OERC once you select the “Submit” button at the bottom of the form. For additional details on how to complete the Image Inventory Batch Form, see section 12.12.1.

12.5. EXAMINATION PROCEDURE

12.5.1. *Subject Positioning and ID Entry*

Before the first subject of the day is imaged, the photographer prepares the camera by turning on the power switch on the camera unit and laptop computer. The Canon retinal software can be opened by double-clicking on the “Canon CR-1 Mark II” icon (Figure 2).



Figure 2

The User ID (search) and password (search) must be entered into the laptop (see Figure 3).



Figure 3

Prior to turning off the room light, the subject and photographer are seated on the appropriate sides of the retinal camera. The camera should be pulled fully back, away from the subject, so they don't bump the lens when they sit forward into the chinrest. The subject is positioned so that he/she is comfortable with their chin and forehead in the headrest (Figure 4). The table may be adjusted by raising or lowering the table with the button under the table. Adjustments to the camera height can be made by rotating the joystick clockwise or counterclockwise. Adjustments to the patient's eye height can be made by using the motorized chinrest button (up/down, Figure 5). Chin height should be adjusted so that the eyes are approximately level with the height adjustment mark located on the headrest post. Next, turn off the room light. The only light in the room should come from the laptop and the illumination light located on the back of the camera. After positioning, have the subject sit back and relax while their eyes dilate in the darkened room.

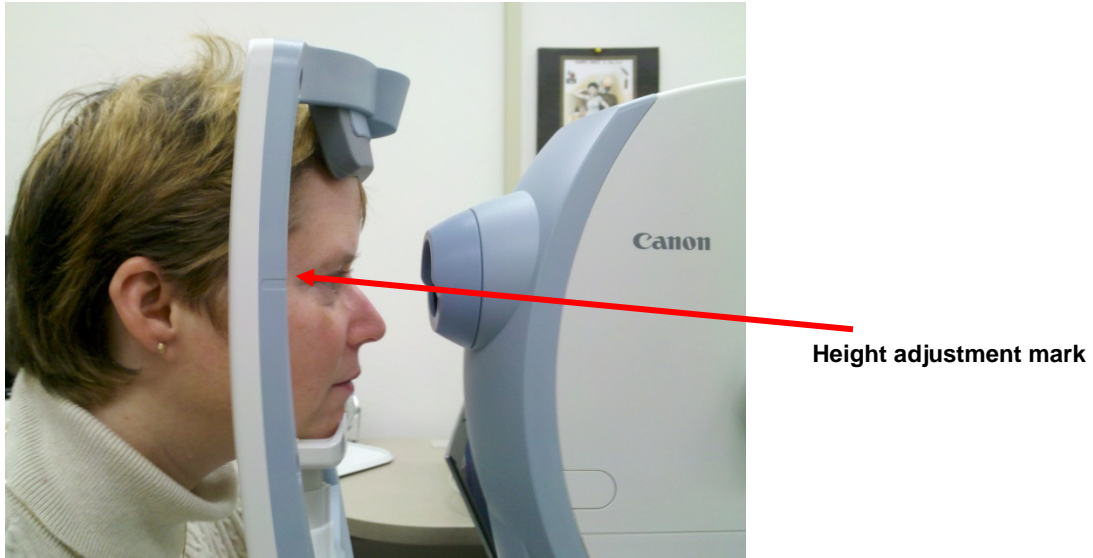


Figure 4

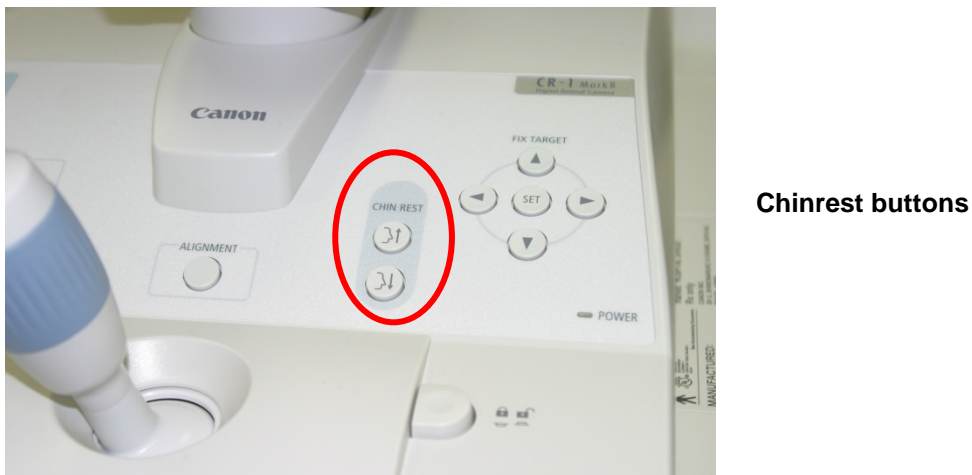


Figure 5

While the subject's eyes begin to dilate, the photographer begins the image capture procedure. The laptop screen should have the main camera software screen displayed on it (Figure 6).

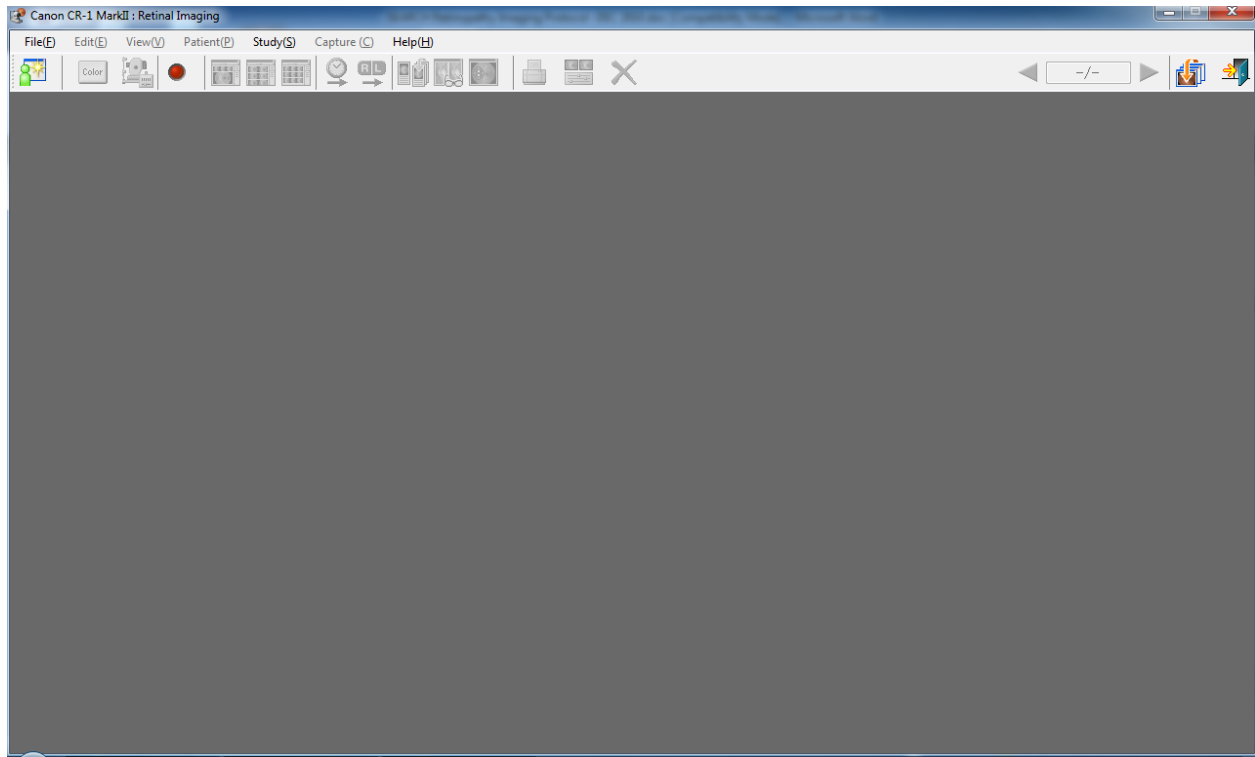


Figure 6

The photographer clicks on the “New” button (Figure 7):

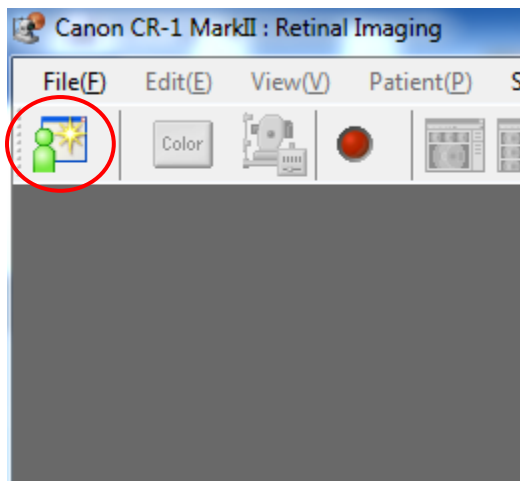


Figure 7

Next, the photographer enters the subject’s unique 8-digit subject ID number in the Patient ID text field (Figure 8). The OK button is clicked after the subject’s Patient ID is entered, and the software proceeds to the photography screen.

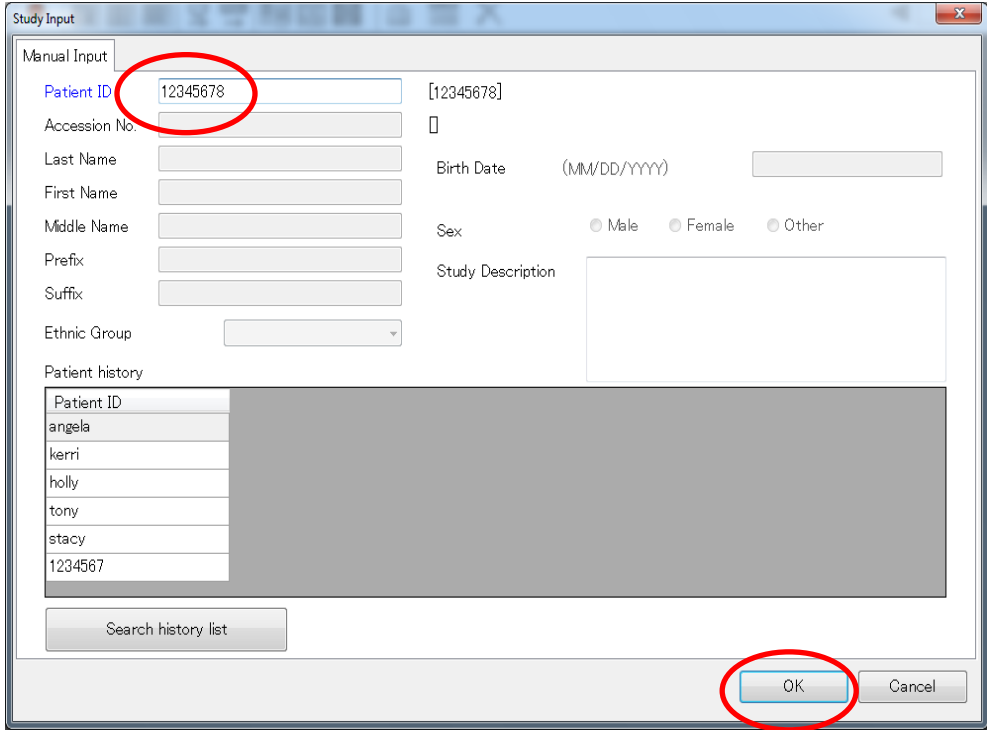


Figure 8

The camera is now ready to begin taking images (Figure 9).

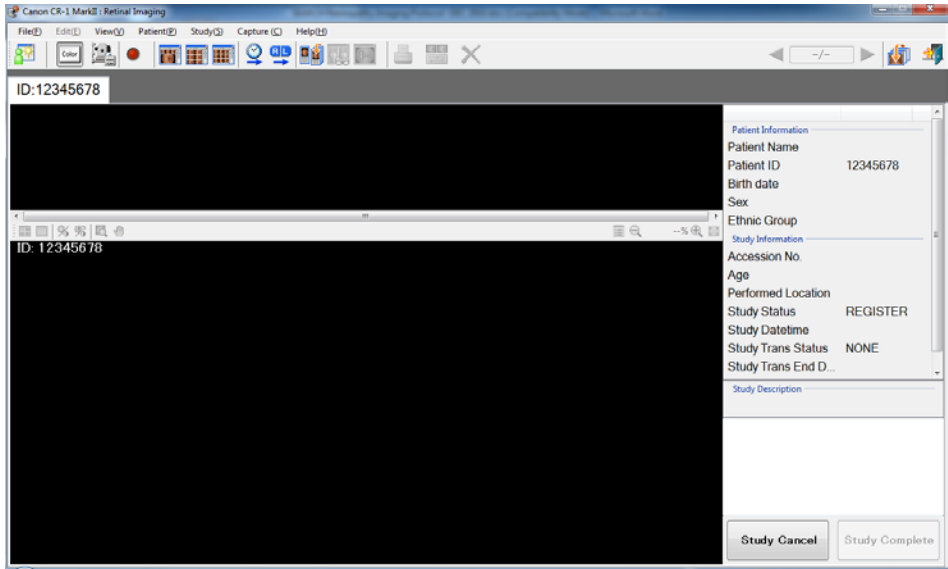
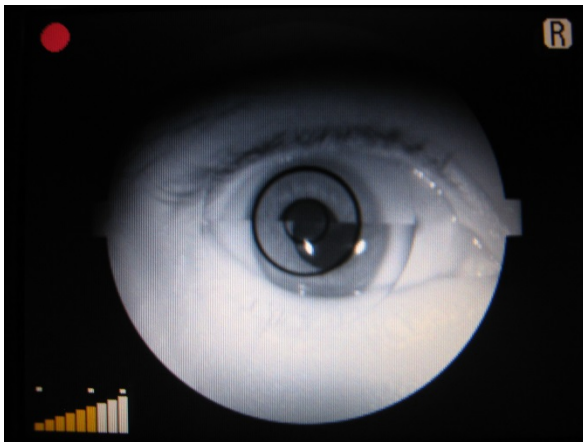
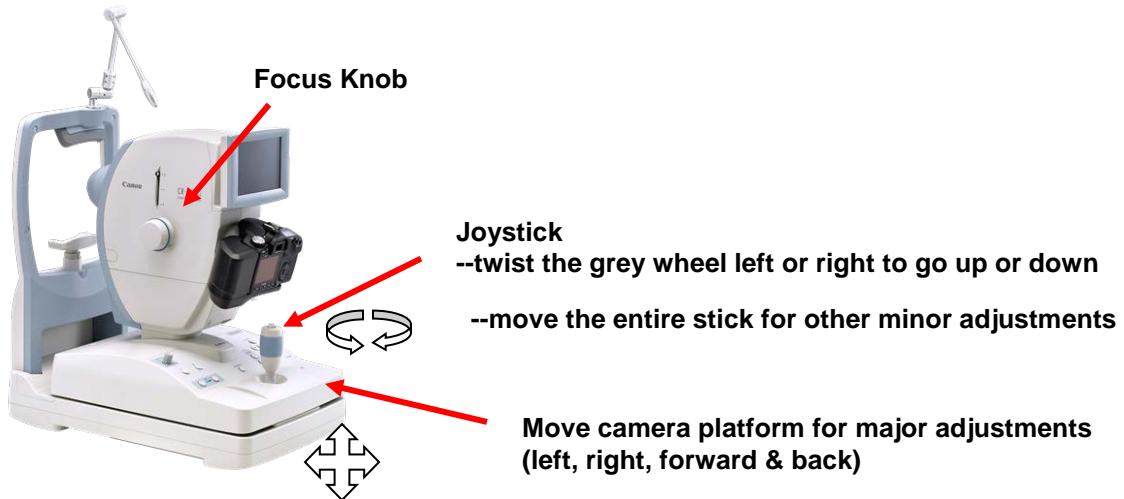


Figure 9

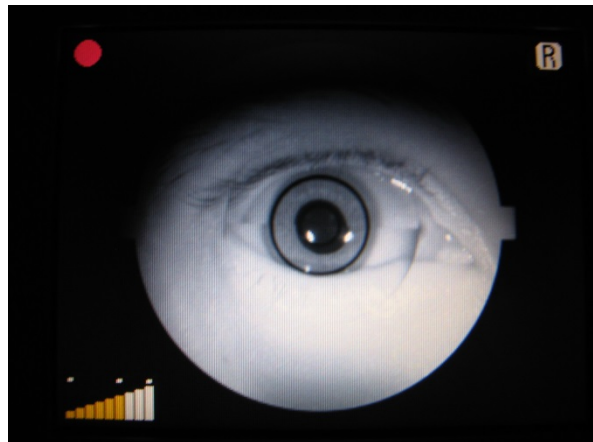
12.5.2. Pupil Size and External Camera Alignment

The first step to taking fundus images is to align the camera with the pupil. Once the subject is in the correct position behind the camera, move the camera platform in front of the eye to image. The pupil should appear on the camera monitor coincident with the central 4mm diameter circle. Adjust the vertical height if necessary to position the pupil in the circle by turning the joystick. The pupil will appear split (Figure 10) and will become round as the camera base is moved forward. Advance the base by sliding it with the left hand while holding the joystick back with the right hand. As the pupil becomes more round, adjust the focus knob to sharpen the image and make fine movements with the joystick until the image of the pupil is no longer split (it should appear as a perfect circle as seen in Figure 11). At this point, proper external alignment has been achieved. A pupil at least the size of the central 4mm circle on the monitor is required for adequate imaging (see Figure 11). If the eye does not dilate to at least 4mm after a 5-minute waiting period, the small pupil aperture (section 12.6.1) should be activated, and imaging attempted again. *The small pupil feature needs to be unselected when beginning imaging of the next eye where the pupil size may be adequate.*



Unaligned Pupil

Figure 10



Proper Pupil Alignment

Figure 11

12.5.3. Internal Eye Alignment

Once proper external positioning is complete, press the alignment button located in front of the joystick on the camera base to move into the posterior segment of the eye (Figure 12). The Photography Status Display dot will switch from red to green, the retina will become visible, and the photographer will see central white horizontal focus bars; a green fixation dot, working distance dots, and the Photography Status Display dot on the camera monitor (see Figure 13). If no working distance dots are seen, the joystick should be adjusted forward or backwards until they appear. The camera joystick is rotated to raise or lower the camera or is moved left or right to position the eye in the center of the viewing screen. The fixation target may be moved by adjusting the Fix Target buttons on the camera base (see Figure 12). The photographer will manually adjust the focus knob located on the left side of the camera and should confirm good focus by checking that the horizontal focus bars in Figure 13 are aligned and look like the image in Figure 13.



Alignment and fixation buttons

Figure 12

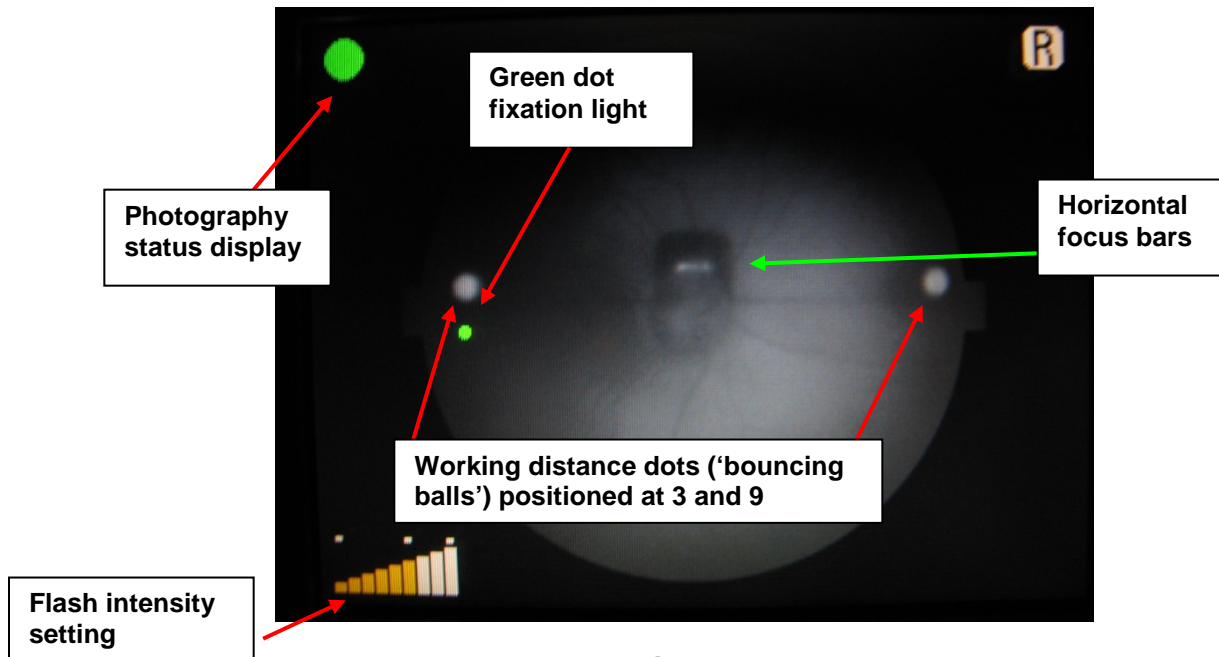


Figure 13

The focus bars are only visible when the diopter compensation lever is in the “0” position. This position is used for almost all subjects and allows imaging of eyes with a refractive error between -10 to +15 diopters. In subjects with extreme myopia or hyperopia (near or far sightedness) the diopter compensation lever will need to be set to either the “-” or “+” position and focus achieved by dialing the focus knob until the retinal vessels appear sharp on the video display monitor since no focus bars will be present. Obtaining a brighter retinal image by increasing the view light intensity can make it easier to see the vessels and obtain sharp focus.

12.5.4. Alignment, Focus and Proper Fixation of Fundus Images

The right eye is always imaged first beginning with Field 1, the optic disc positioned centrally, followed by Field 2, the macula positioned centrally.

Once alignment and focus are confirmed, the photographer will instruct the subject to blink once or twice just before the images are taken to insure a moist (and subsequently clearer) cornea. This will also safeguard against unwanted blinks at the moment of exposure. The photographer takes the image by pressing the shutter button located on the top of the camera joystick. Once the saving process is complete, the new image will appear in the lower part of the split screen on the laptop. The photographer will review the image for quality and may take another image if he/she believes a better quality image can be obtained or they may accept the image by simply taking the next image when the subject is ready and the pupil is adequately dilated. As additional images are taken, small thumbnail images will appear in the top part of the split screen above the

most recent image taken. Once an acceptable image is taken of Field 1, the photographer moves the fixation target to focus on Field 2 and repeats the above process.

When finished imaging the right eye, the photographer will repeat the same imaging process for the left eye, capturing Field 1 followed by Field 2.

The position of the fixation target is controlled using the Fix Target arrows (Figure 12) located on the right-hand side of the camera control panel. A summary of fixation target movement for each image is described below.

Right Eye disc image (Field 1): Using the fixation button, move the fixation dot 2 positions (press the arrow twice) to the left. The disc should be near the center of the camera monitor screen.

Right Eye macula image (Field 2): *The fixation dot returns to the default position after each image.* To take the macula image, move the fixation dot from the default position 1 position to the right. The disc will be at the extreme right of the view of the camera monitor screen.

Left Eye disc image (Field 1): Using the fixation button, move the fixation dot 2 positions to the right. The disc should be near the center of the camera monitor screen.

Left Eye macula image (Field 2): *The fixation dot returns to the default position after each image.* To take the macula image, move the fixation dot from the default position 1 position to the left. The disc will be at the extreme left of the view of the camera monitor screen.

12.5.5. Finishing an Imaging Session

At the time the photographer has completed the subject's imaging session; he/she will review all of the images in the contact strip and may reject any unwanted images at this time. This can be done by selecting the image to be rejected with the mouse and clicking on the "X" button at the top right corner of the screen (Figure 14).

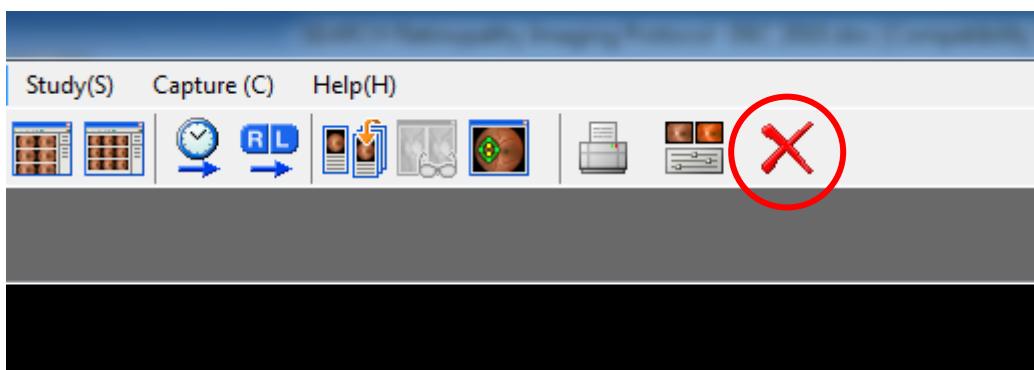


Figure 14

Clicking the red “X” button will mark the image as rejected. This can be seen by the presence of a red X in the lower right of the image in the contact strip (Figure 15). To undelete select the photo and select the “X” button again. It will remove the x from the photo.

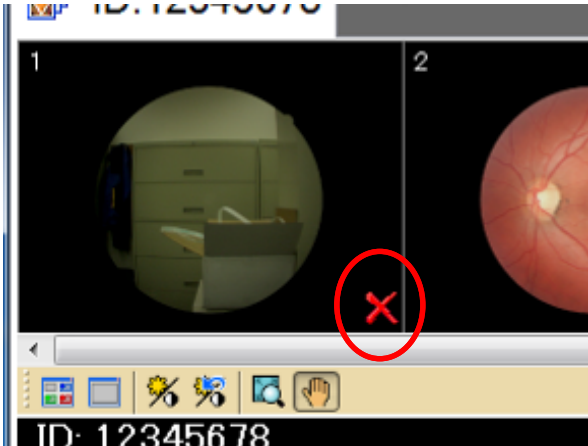


Figure 15

Once the photographer has determined that all images have been taken and is ready to transmit the images, they select the “Study Complete” button (Figure 16). *Note that if the other option is selected (Study Cancel), the images are not saved or sent and cannot be recaptured.*

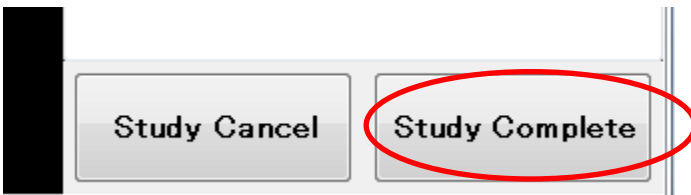


Figure 16

After confirming that imaging session is finished, select ‘ok’ (Figure 17) and the laptop will transmit the images directly to the OERC automatically. The images marked for rejection will not be transmitted.

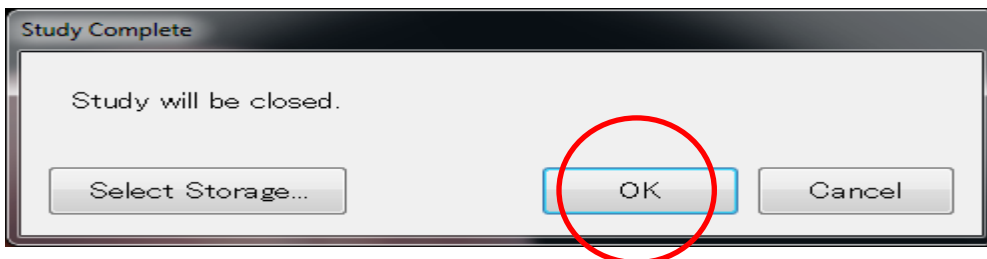


Figure 17

A spinning blue icon will appear in the upper right side of the camera software indicating that a image upload is in progress (Figure 18).



Figure 18

Note: If the images are test or training images, see attachment 12.12.3 for instructions on how to change the image storage location to the laptop’s export folder. This will prevent transmission of the test images to the OERC in Madison.

At this point, the photographer may start a new subject’s imaging session by repeating the steps stated above. Note: If the camera stays on and is inactive for >10 minutes awaiting the next subject, it will go into an energy saving “sleep” mode and the power lamp begins to blink. Using the software or sliding the camera base “awakens” the camera controls. If no other subjects will be seen, the photographer can turn the camera and laptop off.

12.5.6. Turning Off the Laptop and Camera

Once the imaging session is completed for the day, the laptop and camera should be shut down.

To shut down the laptop, the photographer first clicks the “Logout” button (Figure 19):

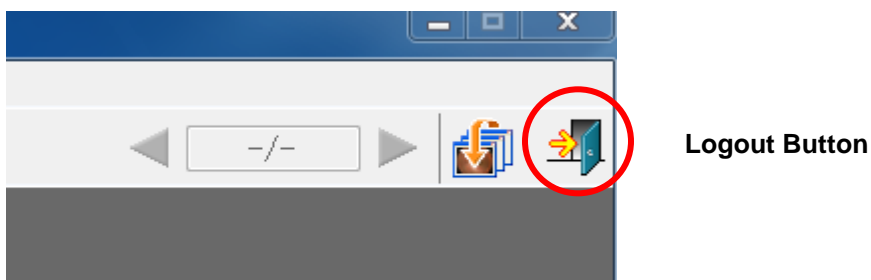


Figure 19

The laptop then returns to the camera software login screen. If there are any images still transferring to the OERC, the Exit button will be disabled and a progress indicator will display until it is finished (Figure 20).

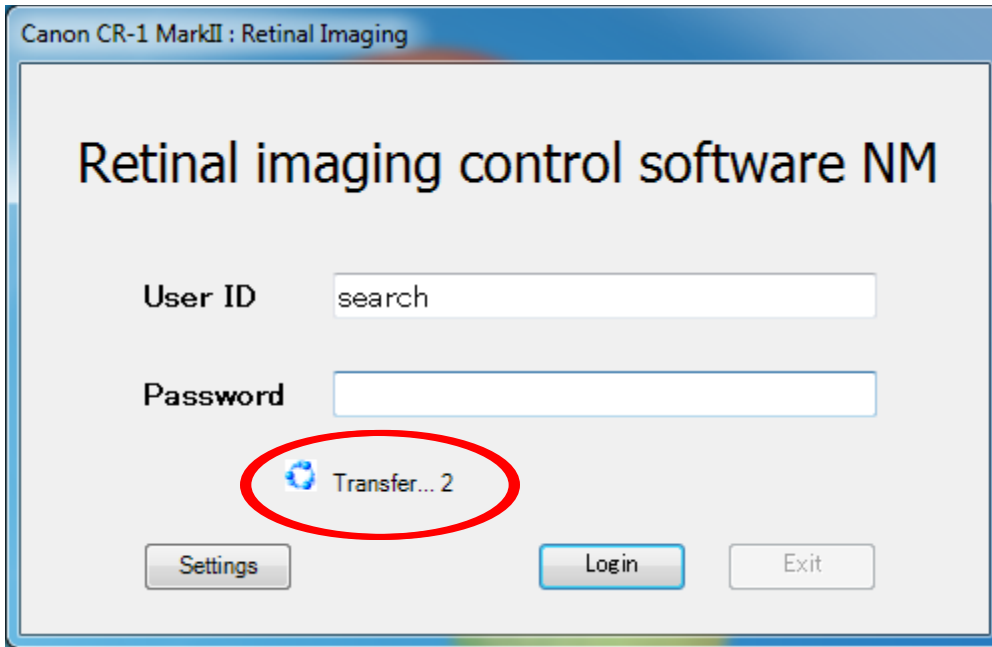


Figure 20

Once transfer is complete, press Exit and shut down the laptop by clicking the Start button in the lower left of the screen, and then selecting “Shut Down.”

Once the laptop is off, the fundus camera can be powered down by pressing the power switch located on the right-hand side.

12.5.7. Image Transfer Problems

If there is ever an issue related to image transmission to the OERC in Madison, the camera software will display an alert in the upper-right corner:



Alert Notification

Figure 21

To attempt to resend the images, the photographer can click the “Log out” button. The following screen will be displayed (Figure 22):

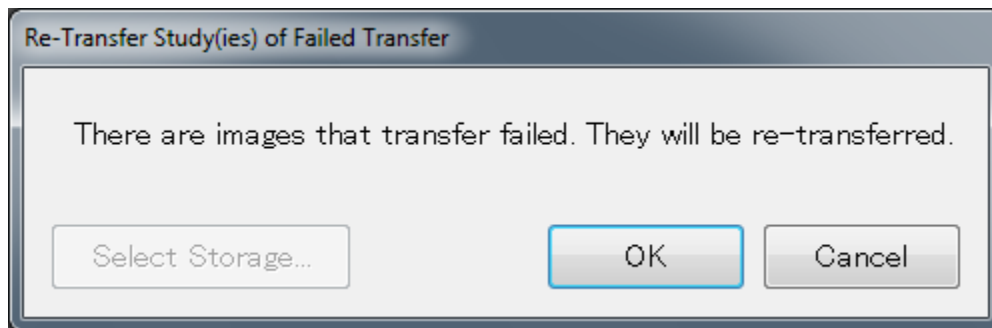


Figure 22

If the images still do not send successfully, the next time the camera software is opened it will again try to re-transmit the images.

12.6. IMAGING CHALLENGES

Acceptable Length of an Imaging Session

A difficult imaging session is as frustrating and exhausting for the subject as it is for the photographer. Try to get the best images you can, but be aware of how the subject is tolerating the procedure. An imaging session shouldn't take more than twenty minutes. Get the distance dots in focus and snap the image as quickly as possible. It is better to take a few images (deleting those of poor quality) than to draw out the process of capturing any one image. Time is of the essence for difficult sessions, so have the most experienced photographer available to work with the more challenging subjects.

12.6.1. *Small Pupils*

The photographer will experience much more difficulty in attempting imaging through small (less than 4mm) pupils because the entire camera light does not enter through the smaller pupil. This usually results in uneven illumination (seen as dark shadows) on the monitor. In this situation, the photographer must make careful camera adjustments to position the shadows as far away from the optic nerve in the Field 1 image and away from the macula on the image of Field 2.

A small percentage of subjects' eyes will not dilate to the minimum 4mm required for adequate imaging. Certain medication may prevent any dilation and the pupil size observed on the monitor may be 2-3mm which is inadequate for the photographer to appreciate all retinal landmarks on the viewing monitor. In this case, it is recommended that the photographer activate the small pupil button and decrease the flash level 3 bars (Figure 23). This function adjusts the illumination to concentrate more of the retinal illumination into a smaller area providing more even illumination to the center of the

field while sacrificing illumination at the field perimeter (Figures 24-25). If after introducing the small pupil function only one focus line is visible, it may be necessary to adjust the camera position either vertically or horizontally to bring the second line into view or to allow visualization of each line segment individually. In these cases, the photographer may need to adjust focus by estimating when the 2 lines would be aligned so that accurate focus can be set. However, there may be circumstances that prevent the second line from appearing, even when these camera adjustments are made. In these cases, the photographer should increase the viewing light briefly to better illuminate the retinal vessels and focus on the vessels. Sharp focus is confirmed by reviewing the captured retinal image on the computer, adjusting focus and retaking the image as necessary to achieve a sharp image.

Ask subjects with small pupils to try to look through the target, and not directly at it-focusing the eyes on the near target light may constrict the pupils.



**Small Pupil & Flash
Intensity Buttons**

Figure 23



Image taken without the small pupil button selected on an eye with 4mm dilation

Figure 24



Image taken with small pupil button selected on an eye with 4mm dilation.

Figure 25

If no retinal landmarks are visible and the camera is in small pupil mode, (often the case with <2 mm diameter pupils), the photographer should adjust the camera slightly to position the corneal reflection dots slightly above or below their optimum position. This

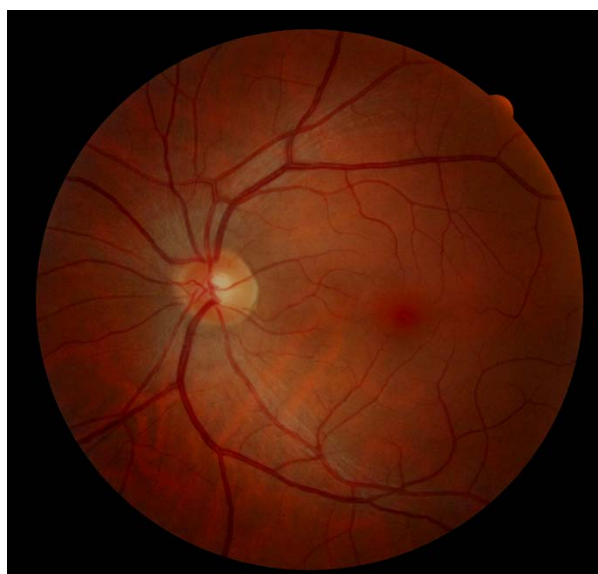
technique allows a portion of the illumination light, which falls on the iris when the pupil is small, to enter the eye. If any retinal landmarks become visible with this technique, photography should be attempted. However, if no retinal landmarks are visible, no image should be taken and the subject is excused from imaging. This information is then documented in the Data Management - Retinopathy Refusal Section on the SEARCH website (<https://www.searchfordiabetes.org>).

12.6.2. Exposure Compensations for Dark or Light Retinas

The flash setting should be adjusted as needed to produce images with good exposure. **The recommended flash intensity setting is 6 bars for this study.** Flash output can be increased or decreased by pressing the flash intensity buttons located on the camera base. More bars increase flash output and produce brighter images while fewer bars decrease flash output and produce darker images. More than a one bar increase or decrease in flash intensity may be needed. Retinal imaging through media opacities or of darkly pigmented retinas (African American or Asian) will require increased flash output to avoid under-exposed images. Imaging of lightly pigmented retinas (blonde, albino or Scandinavian) may require decreased flash output to avoid over-exposed pictures. The photographer should check the color saturation of the first image taken of each subject, and adjust the flash if necessary before proceeding. An example of under and over exposed images is shown below in Figure 26. **Note that whenever the flash setting is changed or if the camera is turned off, the camera does NOT go back to the default setting of 6 bars. The flash must be manually reset to avoid over or underexposure of subsequent images.**



Over-exposed image
(decrease the flash setting)



Under-exposed image
(increase the flash setting)

Figure 26

12.6.3. *Common Problems Seen*

Many of the arcs and other issues seen in imaging are due to poor subject positioning - the subject is too far away or not centered. The subject should always be positioned before the camera is moved.

a. Poor subject positioning (Figure 27)

Camera is too far away from the subject. Notice the arcs and general haze around the images.

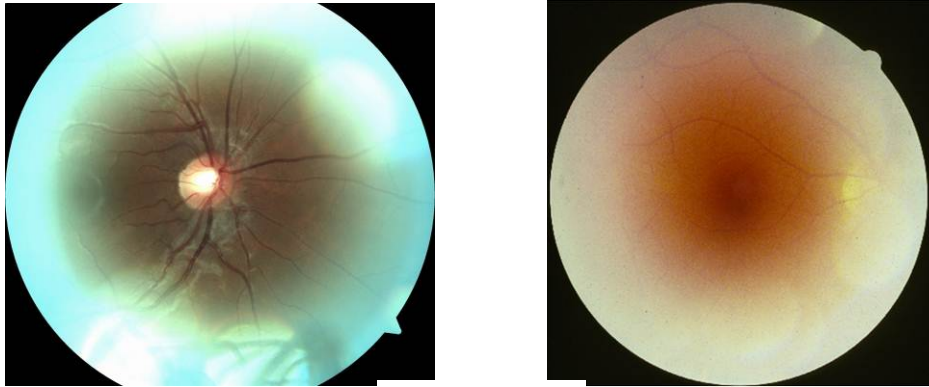
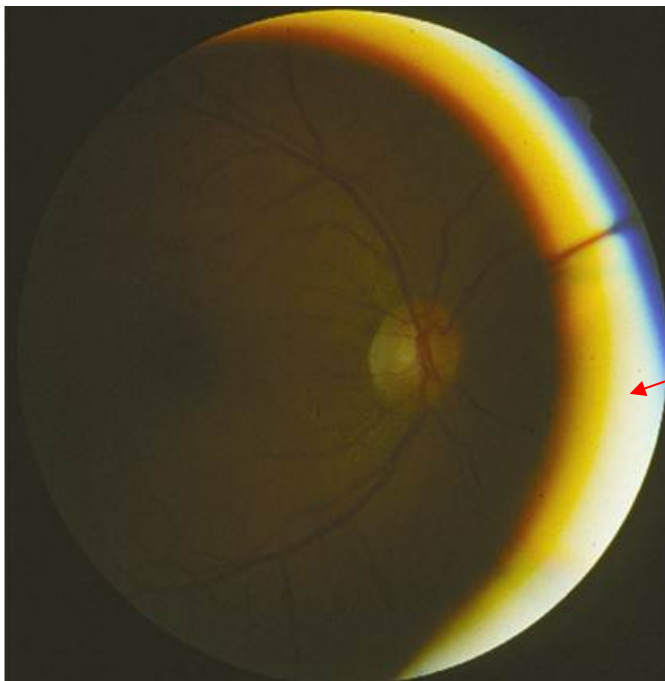


Figure 27

b. Poor camera positioning (Figure 28)

Camera is too far right or left. In this example, move the camera away from the crescent (to the left) to remove the crescent.



Note that the image is not a true F1 or F2. There is also a crescent artifact.

Figure 28

c. Eye lashes and excessive blinking (Figures 29-30)

Eyelashes are commonly seen in images due to the subject anticipating the image, they are photophobic, or the subject can have particularly long lashes. It is important to let the subject know that they can blink. In some cases, subjects may have to hold their own lids open with their fingers or have another person do it for them. Be aware that this is not comfortable for the subject and that the cornea will dry out very quickly. Obtain proper focus before having the subject holding their lids open, and then take the picture as quickly as possible.

Eyelashes

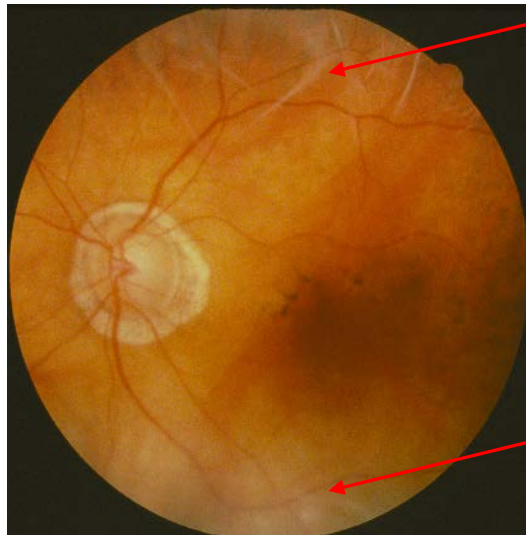


Figure 29

Blinks (Upper eyelid)

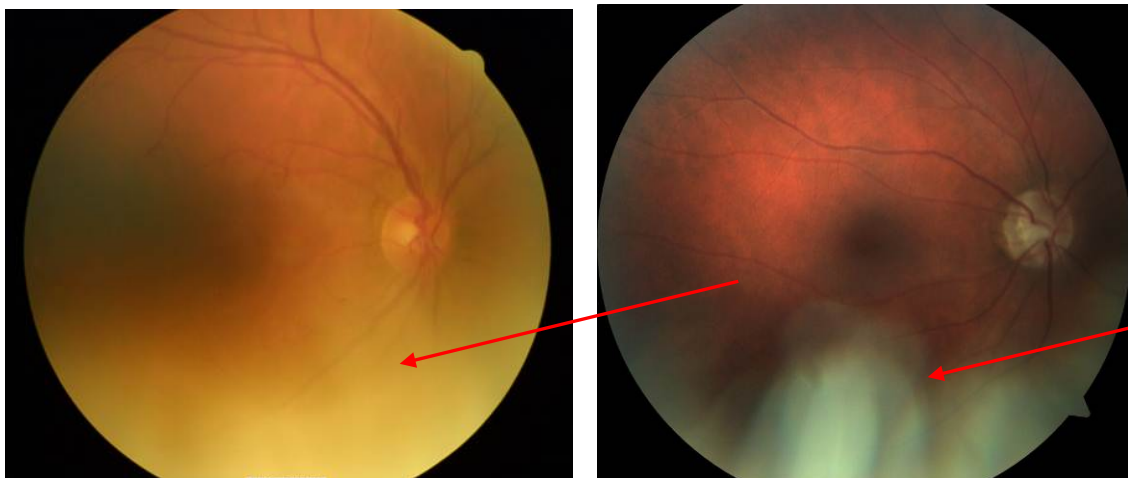


Figure 30

d. Dust & Smudges on the camera lens (Figures 31-32)

At times, the photographer will notice the same artifact in the same place on all the images taken. This is usually dust or a smudge and can be immediately remedied by cleaning the lens with the appropriate lens cleaning supplies. ***Please refer to section 12.3.2 for details on cleaning the lens.***

Dust

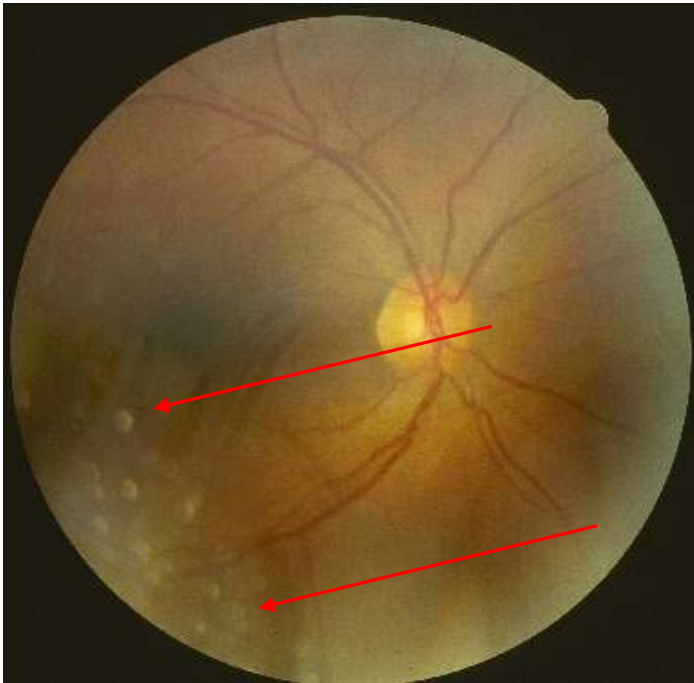


Figure 31

Smudges

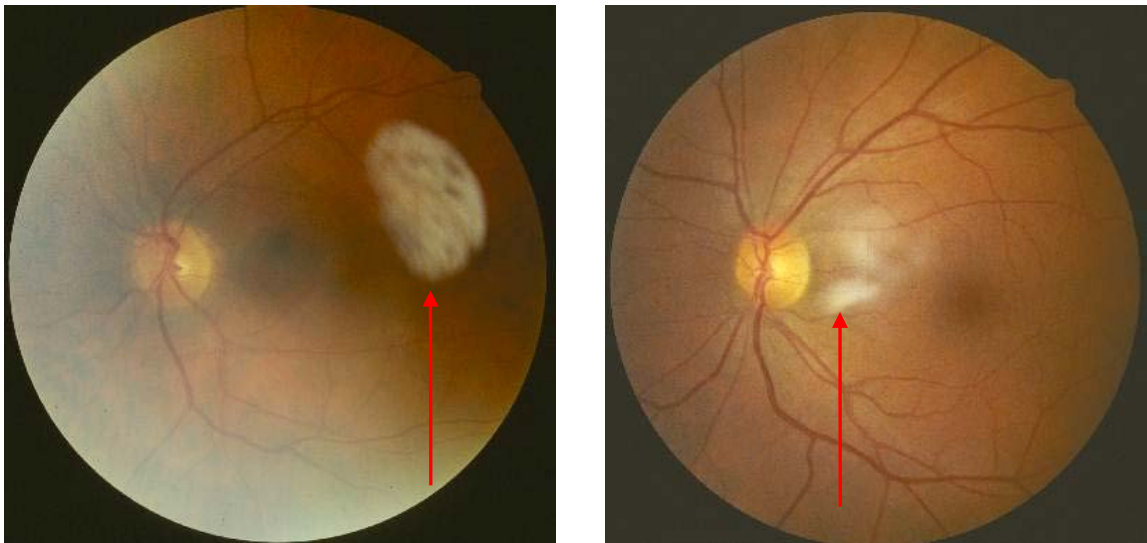


Figure 32

12.7. IMAGE INVENTORY BATCH FORM (BATCH FORM)

All SEARCH Image Inventory Batch Forms (Batch Form) will need to be faxed or electronically sent to the OERC (typically once per week), since the form does not automatically accompany the images that are transmitted immediately. Each photographer will be responsible for filling out their portion of the Batch Form for each subject. The Batch Forms will be numbered sequentially (Inventory Batch No.) per site. The date the images are taken will be recorded on the Batch Form, as well as the name of the person sending the Batch Form. Comments or problems with the images taken or other deviations from protocol should be recorded in the comments box on the Batch Form. See Attachment 12.1 for a copy of the Batch Form as well as instructions on how to fill out the pdf form. The OERC study coordinator will confirm that the images were received via e-mail to the person sending the form, as well as the site's Project Manager, generally within 72 hours.

Note that when no images are taken within the week, an empty Batch Form does not need to be sent.

12.8. DIGITAL FILE HANGLING

Each subject's images are transmitted automatically after their imaging session (see section 12.5.5 for details). The images are uploaded (transmitted) directly to the OERC automatically.

12.9. PHOTOGRAPHER CERTIFICATION

12.9.1. *Obtaining Certification*

Photographers previously certified from the SEARCH 3 visit will not need to be recertified for this visit. Each new photographer taking fundus images will need to be certified using this camera before taking images for the study. A brief GoToMeeting refresher training session will be provided for all photographers by the OERC in February 2016. After this training, all photographers may practice taking images and new photographers may prepare image sets for submission to the OERC for certification if they feel comfortable. Regardless of certification status, all photographers may submit images requesting feedback on photo quality after the refresher training. The Photographer Certification Request form will be used for photo quality purposes. Rather than using CERT1ABC as listed below for certification images, each person will use TESTXXXX as the 8-digit subject ID number (e.g., TEST1DAS = first test person for Debbie Standiford and TEST2DAS is the second etc.). OERC staff will contact the photographers directly providing helpful photo quality feedback.

For new photographers, certification begins with the completion of the Photographer Certification Request Form (Attachment 12.12.2). This form will be used in lieu of the SEARCH Image Inventory Batch Form and will be submitted along with 20 images from 5 non-study volunteers (each person will have 4 images: 2-right eyes that include a

Field 1 and a Field 2 image and 2-left eyes that include a Field 1 and Field 2 image). These images must show proper field definition (Fields 1 and 2 of each eye, 20 images total), proper exposure, alignment, and focus. Photography certification subjects will be given a unique 8-digit subject ID number (CERTXXXX). The ID will begin with CERT, the number next will be a number listed from one through 5 (more numbers can be used if needed or if retakes are necessary), and the last 3 digits will be the photographer's 3 digit initials (e.g., CERT1ABC is the first certification person imaged for this photographer and CERT2ABC is the second person etc.). A photographer becomes fully certified after submitting satisfactory quality images of 20 images (as specified above), the form is signed by the photographer and sent to the Coordinating Center at the OERC, and the OERC signed certification form is returned back to the photographer. The OERC will confirm certification by e-mailing the OERC signed certification form back to each photographer with a copy to each site's coordinator. In cases where compromised image quality prevents certification, the OERC staff will contact the photographers directly providing helpful feedback and requesting the submission of additional images to resolve a problem and complete certification.

Please select subjects who dilate well so that the small pupil setting will not be needed for certification images.

12.9.2. Sending Certification or Test Images

Photographers should be familiar with the standard imaging protocol as documented above. Images taken for certification purposes should only be transferred to the OERC once the photographer has taken all 20 images. Therefore, when taking certification or test images, the photographer should store images from each certification or test subject in the local export folder until the complete 20 image set is obtained (see Attachment 12.12.3 for details).

When ready to transmit finalized certification images, follow the instructions in Attachment 12.3 to recall the existing images. However, instead of changing the storage to the local folder, the photographer shall just press OK to automatically send the images to the OERC.

The certification images will be transmitted to the OERC (see Section 12.5.5 for procedure) for review.

12.9.3. Certification of New Photographers after the Study Begins

As additional personnel need training to become certified, a certified photographer at that site will provide complete instruction. Copies of all training materials and manuals will be available on the SEARCH website (<https://www.searchfordiabetes.org>) to login and go to DASHBOARD under Operations -- Training. The trainee photographer will

practice on volunteers and, when ready, prepare and submit 20 images (5 subjects, Field 1 and Field 2 for both eyes) for consideration for certification.

12.10. QUALITY CONTROL

12.10.1. *Image Quality*

Photographers will provide the first assessment of image quality, a big advantage of digital imaging. This “on the spot” review of images allows for the immediate assessment of image quality and the opportunity to retake the images before the subject leaves the camera imaging area. Additionally, reading center staff will continuously monitor image quality throughout the study. Initially, all images will be reviewed by OERC staff and feedback will be provided to the photographers in cases that warrant critique. A telephone call or e-mail will be used, detailing problems and suggesting improvements. Once the study is underway, image quality reports will be generated by the OERC based on photograph graders' evaluations of all images and sent to the Coordinating Center as well as each site Project Manager for distribution. In cases where problems with image quality persist, additional training may be recommended in the form of a webinar or site visit.

12.11. COMMUNICATION CHANNELS

It is vital that proper and frequently used channels of communication be established for the effective exchange of questions and information between all staff members. The following is a listing of names, addresses, and telephone numbers to facilitate this exchange:

Ocular Epidemiology Reading Center
610 North Walnut Street, 4th Floor WARF
Madison, WI 53726-2336

Lisa Grady Study Coordinator	(608) 263-0285 grady@epi.ophth.wisc.edu
Stacy Meuer Senior Grader	(608) 263-8835 meuers@epi.ophth.wisc.edu
Tony Fairbanks IT Coordinator	(608) 265-2625 fairbanks@epi.ophth.wisc.edu
Ronald Klein, MD, MPH Co-Director OERC	(608) 263-7758 kleinr@epi.ophth.wisc.edu
Barbara EK Klein, MD, MPH Co-Director OERC	(608) 263-0276 kleinb@epi.ophth.wisc.edu
Synemed, Inc. Service Dept	(800) 777-0650 Order parts and installation direct

Canon Service

(800) 970-7227
Service requests after installation

12.12. ATTACHMENTS

12.12.1. Image Inventory Batch Form & Instructions



Image Inventory Batch Form

This form must be completed whenever subject images are transmitted to the OERC.
Each inventory batch is to have a unique number and is to be numbered in numerical sequence (e.g., 001, 002, etc.)
Once images have been successfully transmitted, on a weekly basis fax or e-mail form to:

Lisa Grady Ocular Epidemiology Reading Center (608) 265-0285 grady@epi.ophth.wisc.edu FAX (608) 265-5799																	
Site:	Person Preparing Batch	Inventory Batch No.					OERC Date Received:	OERC Date Inventoried:	Date confirmation Sent:								
Comments:																	
Vision History																	
Do you have an optometrist or ophthalmologist that you go to? Have you ever had laser treatment to the retina, the back of your eye, because of diabetic retinopathy?																	
Subject ID Number		Date (MM/DD/YY)	Tech Initials	Pupil (mm)	SP Used?	Flash Setting	Eye (Circle)	Fields (Circle)	0	1	8	9	0	1	2	3	8
									No	Yes	Don't Know	Refused	No	Yes-OD Only	Yes-OS only	Yes-both eyes	Don't know
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
									<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Submit

Quick Instructions for Filling Out the Fillable PDF Form (use the tab button or mouse to navigate between cells)

- A. Only those cells that need to be filled out by the site are accessible in the fillable pdf form.
1. Site - select from drop down or manually type in
 2. Person preparing the batch form (name of the person actually sending the form)
 3. Inventory Batch Number - type in the sequential number assigned at the site
 4. Comments section - type in any time there is a discrepancy from protocol or a problem with the imaging session
 5. Subject ID Number - type in 8 digit number assigned to the subject by SEARCH
 6. Date - type in the date the images are taken (MM/DD/YYYY, 02/05/2011)
 7. Tech Initials - type in photographer's 3-digit initials (i.e. ABC) who is taking that subject's images
 8. Pupil (mm) - type the size of the pupil in whole millimeters at time the first image is captured
 9. SP Used? - was the small pupil aperture used (use the space bar to check the box for 'yes' or leave blank for 'no')
 10. Flash setting - type the flash setting number used at the time of the first image is taken of each eye
 11. Eye (circle) - use the space bar to use check marks for whether OD (right) and OS (left) eyes were taken (circle OD or OS if faxing the form).
 12. Fields (circle) - use the space bar to check whether field 1 or field 2 were taken (circle the fields if faxing the form)
 13. First question for vision history is asked and the appropriate box is checked (only 1 answer allowed)
 14. Second question for vision history is asked and the appropriate box is checked (only 1 answer allowed)
- B. **If you are NOT sending the form and want to save the data**, select the tab "File" and then select "Save As" and name your batch file "Batch XXX" and save it to your desktop. After saving the form, you may exit out of the form by going back to the File tab and selecting "Exit". Once you save the batch form to your desktop, you may recall it by double clicking on it. If you want to add to it, continue with the next person's data. If you want to send it, select the "Submit" button.
- C. **If you are sending the form at the end of the week or otherwise agreed upon timeframe**, you may select the 'Submit' button on the bottom right part of the form. PLEASE DO NOT SEND THIS FORM AFTER EACH PERSON.
- D. Once the form is sent, close Adobe Reader. The computer will prompt you for a name to save the form under-enter the current date and batch number. Save the file into a folder on

the Desktop called “Sent Forms”. To view a specific form, go in the Sent Forms folder and select the appropriate Batch XXX document.

- E. A new inventory form can be started by selecting the SEARCH Image Inventory Batch Form icon on the desktop again.

Instructions for Filling Out the Inventory Form Manually (Print the form out)

- A. Write the appropriate information in the following cells on the form:
 1. Site - write in your state abbreviation and city if your site has more than one camera
 2. Person preparing the batch form (name of person actually sending the form and images)
 3. Inventory Batch Number - write in the sequential number assigned at the site
 4. Comments section - write in any time there is a discrepancy from protocol or a problem with the imaging session
 5. Subject ID Number - write in 8 digit number assigned to the subject by SEARCH
 6. Date - write in the date the images are taken (MM/DD/YYYY, 02/05/2001)
 7. Tech Initials - write in photographer’s 3-digit initials who is taking that subject’s images
 8. Pupil (mm) - write the size of the pupil in whole millimeters at time the first image is captured
 9. SP Used? - was the small aperture used? Check the box for ‘yes’ leave blank for ‘no’
 10. Flash setting - flash setting used at the time of the first image is taken of each eye
 11. Eye (circle) - circle OD (right) and OS (left) eye if they were taken
 12. Fields (circle) - circle whether field 1 or field 2 were taken
 13. First question for vision history is asked and the appropriate box is checked (only 1 answer allowed)
 14. Second question for vision history is asked and the appropriate box is checked (only 1 answer allowed)

- B. Fax the form to the OERC 608/265-5799 and keep the hard copy for your records.

12.12.2. *Photographer Certification Request Form*



**Photographer Certification Request Form
SEARCH Study**

Institution Name:				Site Manager:			
Photographer's Name:				Phone:			
				E-Mail:			
<i><u>Quality Assurance Statement</u></i>							
I have read the protocols listed below, and I understand and agree to abide by the design and procedures of the trial.							
<i>Study Protocol: SEARCH Retinopathy Imaging Protocol</i>							
<i>Color Ophthalmic Photography Protocol: SEARCH Non-stereo Digital Fundus Photography Protocol – Standard Field 1, Modified Field 2.</i>							
_____				_____			
<i>Signature</i>				<i>Date</i>			
The following photographs are being submitted for consideration of my certification as a fundus photographer for:							
The SEARCH Study							
Subject ID Number				Photo Date	Eye	Photograph <i>(circle fields present)</i>	Fields
				____/____/____ Month Day Year <i>(e.g., Nov.)</i>	OD OS	Digital Image: Digital Image:	1 2 1 2
				____/____/____ Month Day Year <i>(e.g., Nov.)</i>	OD OS	Digital Image: Digital Image:	1 2 1 2
				____/____/____ Month Day Year <i>(e.g., Nov.)</i>	OD OS	Digital Image: Digital Image:	1 2 1 2
				____/____/____ Month Day Year <i>(e.g., Nov.)</i>	OD OS	Digital Image: Digital Image:	1 2 1 2
				____/____/____ Month Day Year <i>(e.g., Nov.)</i>	OD OS	Digital Image: Digital Image:	1 2 1 2

Fax completed form to: 608-265-5799

Once the above certification images are complete, recall the subjects saved on the camera and transmit them (all 5 subjects electronically to the OERC, see protocol). Please do not send partial sets for certification unless asked to do so. This form is to be used in lieu of the Image Inventory Batch Form.

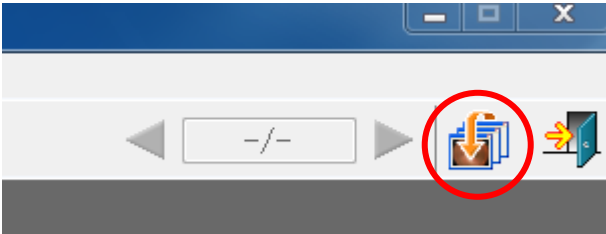
For Reading Center use only	Certification Approved: ____/____/____ Month Day Year <i>(e.g., Nov.)</i>
Reviewer's Signature _____	

P:\SEARCHForms\SEARCH Photographer Certification Request Form-revised.doc

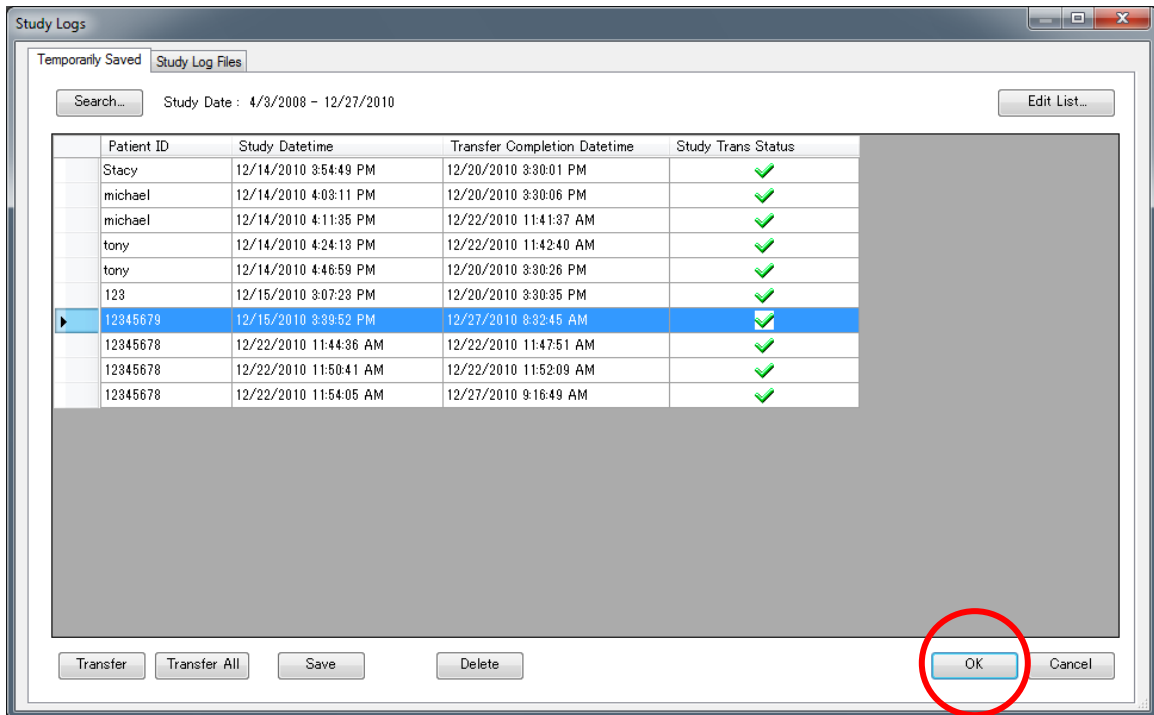
12.12.3. How to Save Images to the Local Export Folder

If a participant wants to have a copy of their images, they can be recalled using the software on the laptop and then copied to a CD or flash drive.

The photographer selects the “Study Logs” button from the main screen:

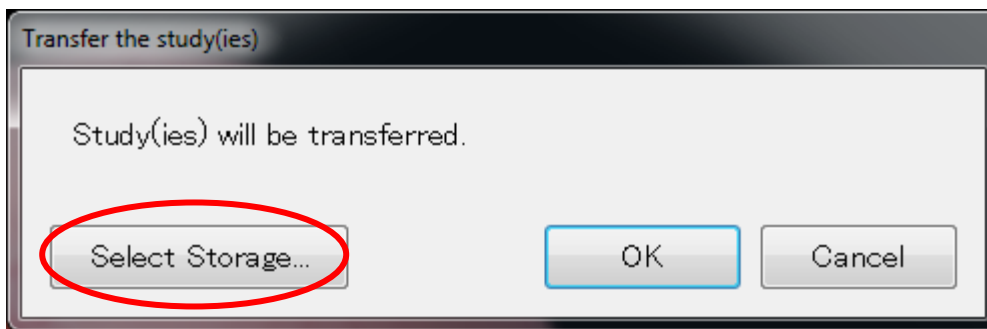
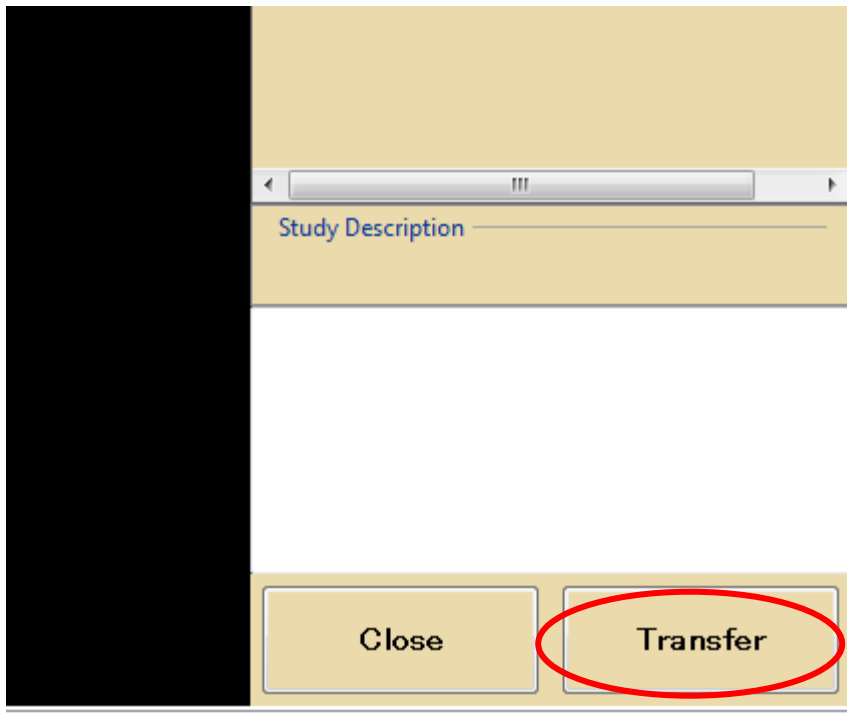


And then chooses the existing visit that they wish to export:

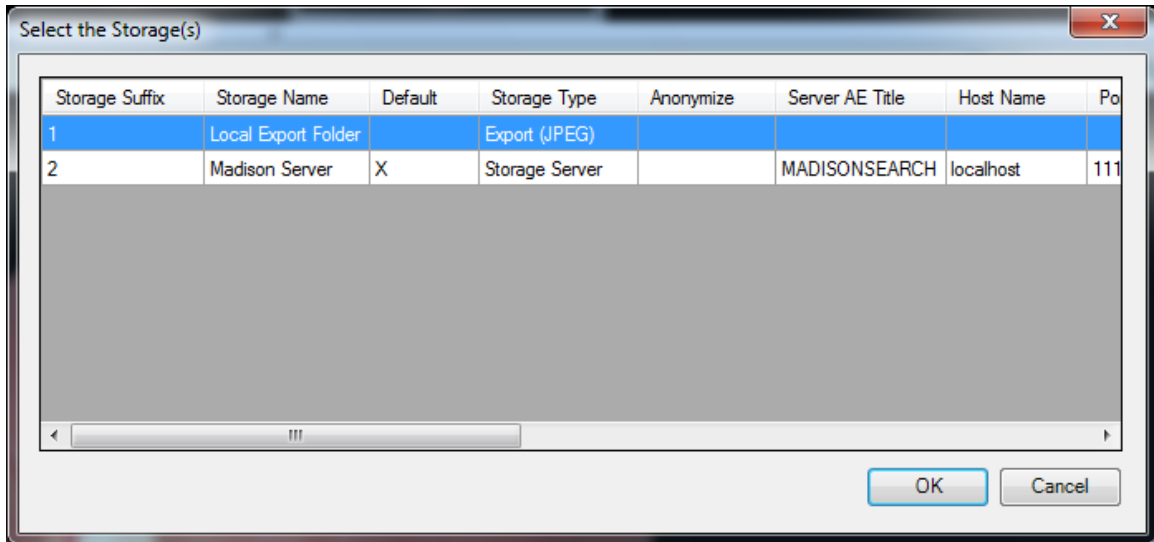


Selecting “OK” will bring up a review of the existing images.

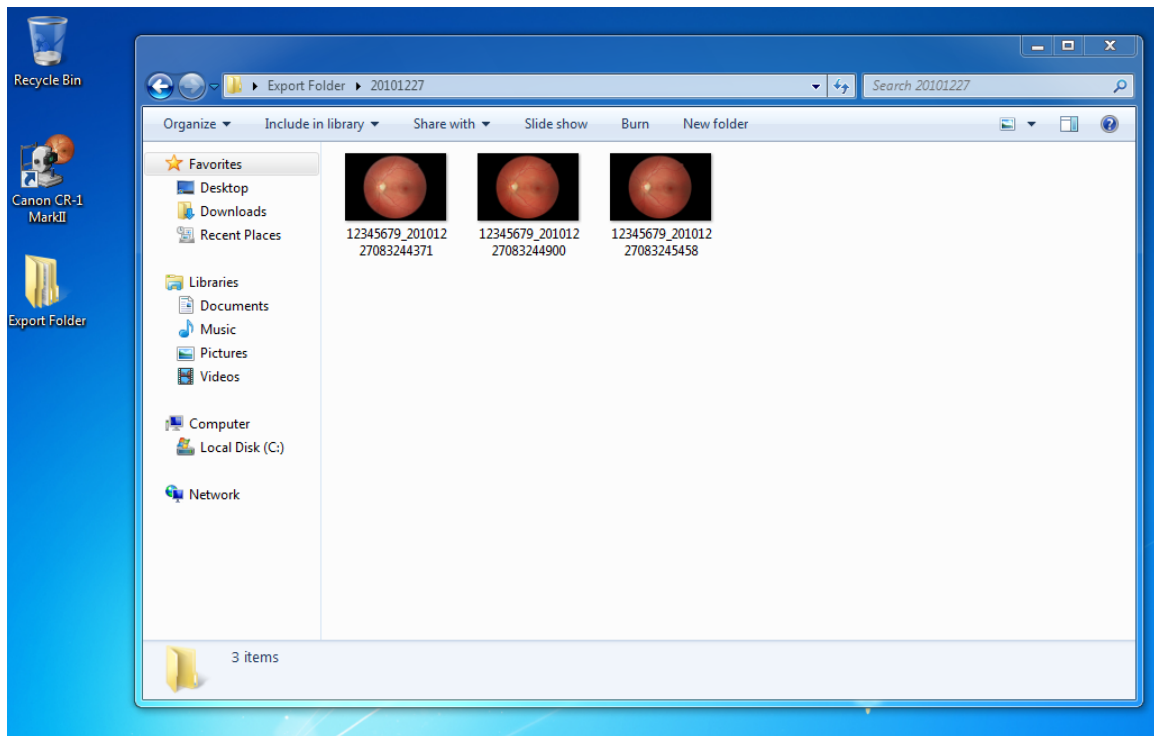
The photographer then presses the “Transfer” button, which will bring up the transfer window.



The photographer then clicks the “Select Storage...” button, and changes the selection from “Madison Server” to “Local Export Folder”, and presses OK.

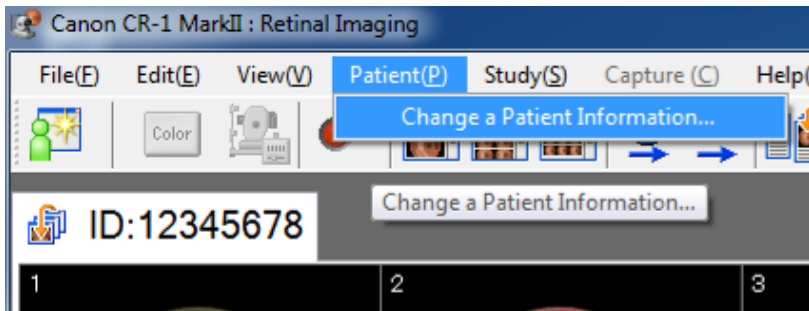


This will send a copy of the images to the folder located on the Desktop screen of the laptop called “Export Folder”, organized by export date. At this point, the photographer may copy the files to a CD or flash drive as needed. The photographer should then delete the exported files from the Export Folder.



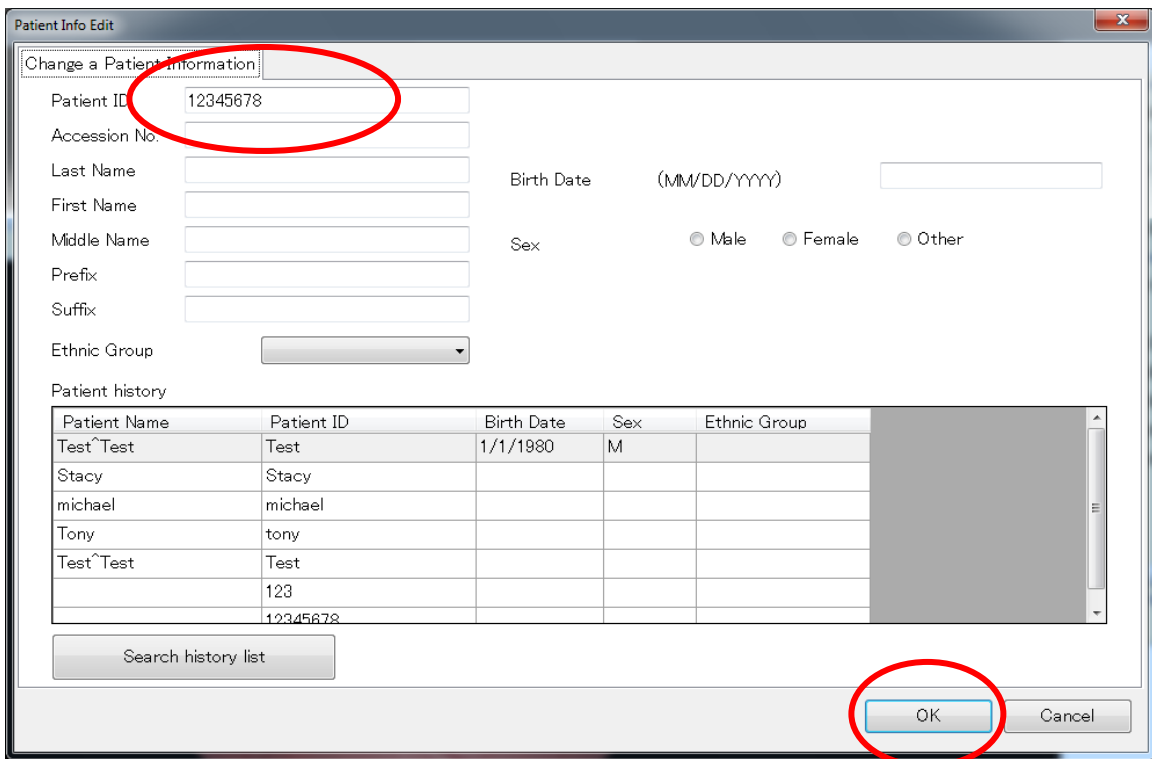
12.12.4. How to Edit a Subject

The photographer may edit the subject's 8-digit ID during photography by selecting the "Patient" menu and the selecting "Change a Patient Information"



It brings up this screen.

Enter the subject's ID that you want to change and then enter the correct ID. Select "OK".



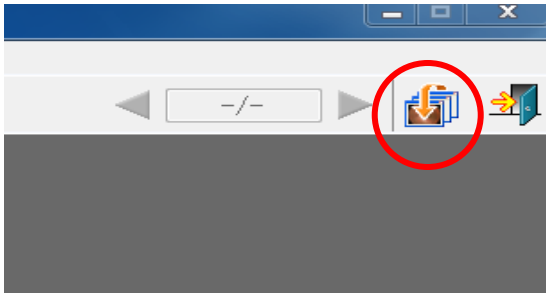
The subject ID has been successfully changed.

Note that if images or the Inventory Form were sent with the incorrect ID, the OERC may change the ID on their end and the photos and form do not need to be resent. An

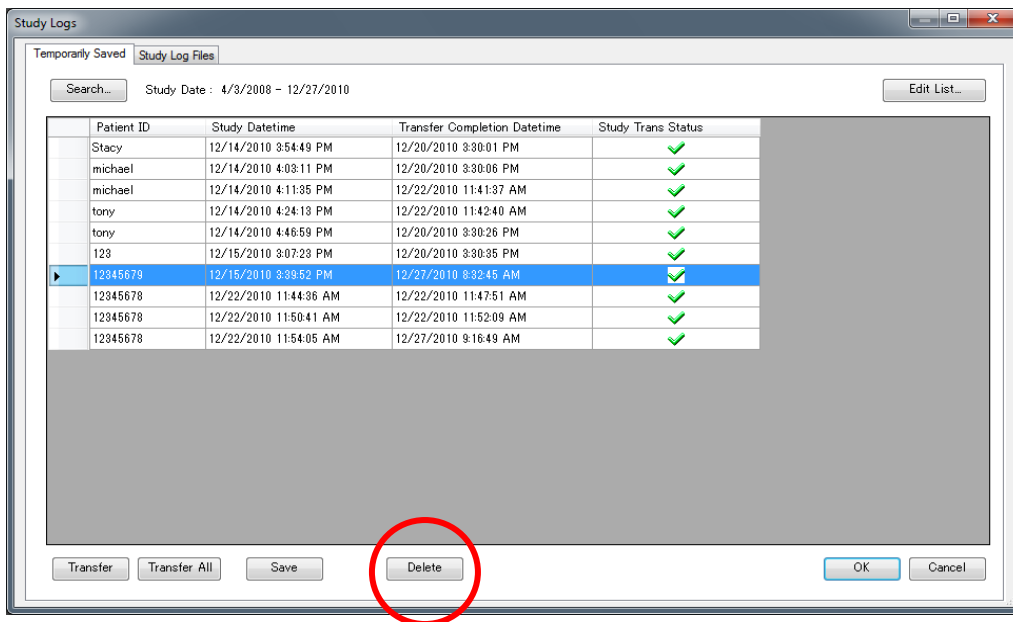
email or phone call to the data manager communicating the change is required. All changes should be documented at the site too.

12.12.5. How to Delete an Imaging Session

The photographer selects the “Study Logs” button from the main screen:



And then chooses the existing visit that they wish to delete, and presses the “Delete” button:



Confirm deletion by selecting “OK”.

