SAR Controls

Usability for Safety

Johan van den Brink
Principal Scientist, Philips MRI
29 September 2017

innovation + you

PHILIPS

User Control & Feedback for RF deposition (SAR)

Standards Compliance

- **Operating Modes**
  - **Deliberate Action**
  - **Control Options**
  - **Visual Feedback**

Special Needs

- **Pregnancy**
- **Children**
- **Implants**

- **Limiting values**
- **Patient Registration UI**
- **Popup screens**
- **Sequence parameters**
- **ExamCard, PSA, Sequence Info**

- **Normal Mode suggested**
- **T/R Knee Coil**
- **ScanWise Implant**

Usability Engineering for validated safety and workflow solutions

PHILIPS

SAR: Standards Compliance (IEC60601-2-33 Ed3.2)

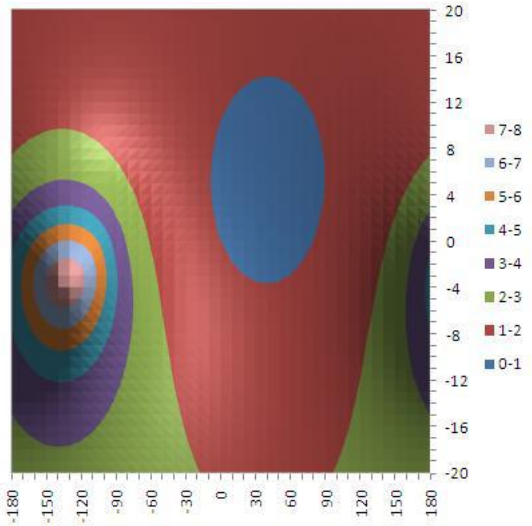
Output Limits are based on local SAR evaluation

- Virtual Human RF simulations provide local SAR and global SAR estimates
- Per-sequence exposure(*) is limited to the most restrictive SAR type(**), either:
  - Whole Body SAR
  - Head SAR
  - Local Torso SAR
  - Local Extremities SAR

	WB SAR	Head SAR	Local SAR		
Body Region	Body	Head	Head	Torso	Extremities
Operating Mode	W/kg				
NORMAL	2	3.2	10	10	20
FIRST LEVEL CONTROLLED	4	3.2	20	20	40

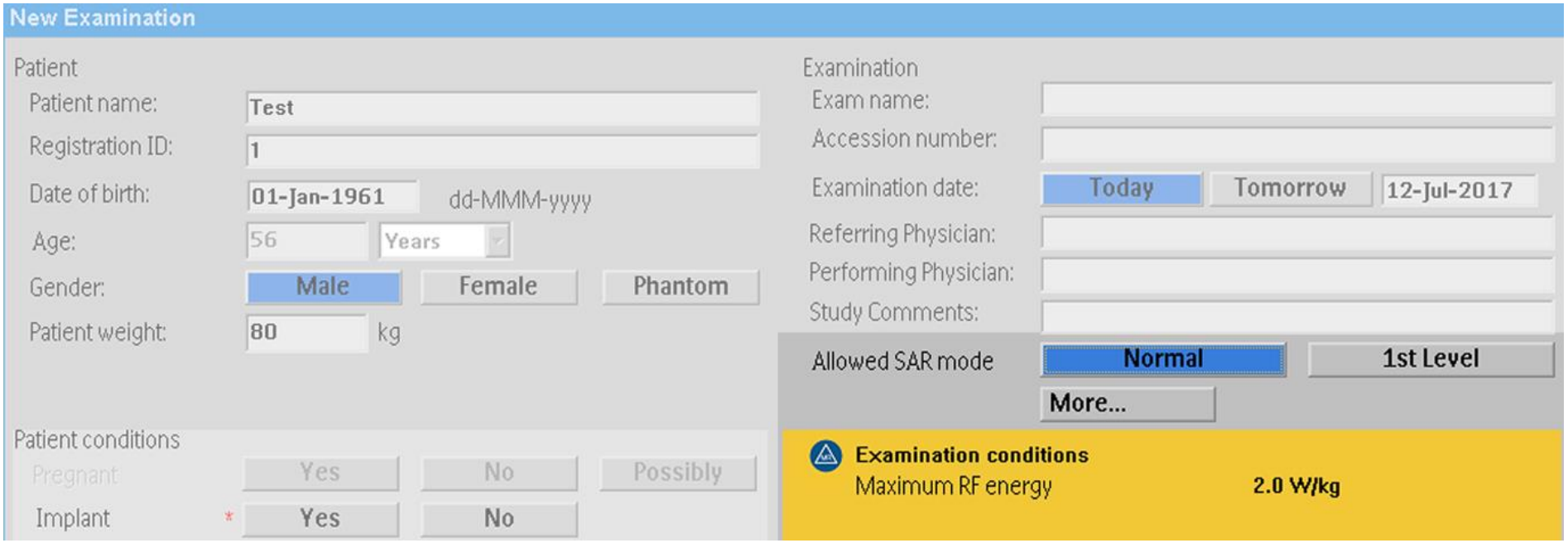
- MultiTransmit (RF shimming) SAR benefit/penalty applied as scale factor relative to Quadrature

- Whole Body SAR is displayed for the running sequence, and during sequence planning
- Total RF energy deposition, SED, is accumulated, forecasted, and displayed

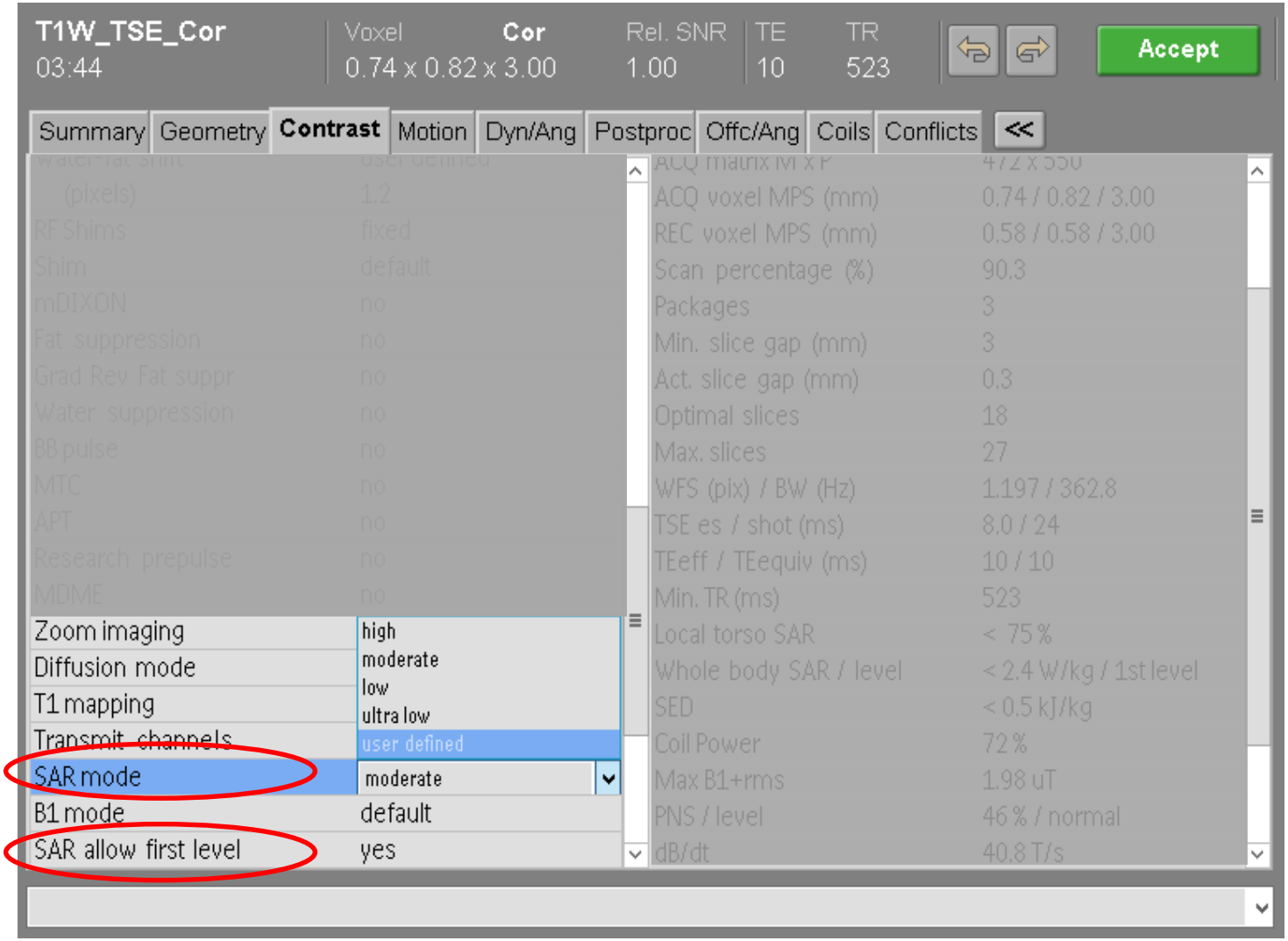


(*) The Short Term SAR 2x allowance is not implemented
(**) Partial Body SAR is shown by simulations to be redundant when limiting by local SAR

PHILIPS

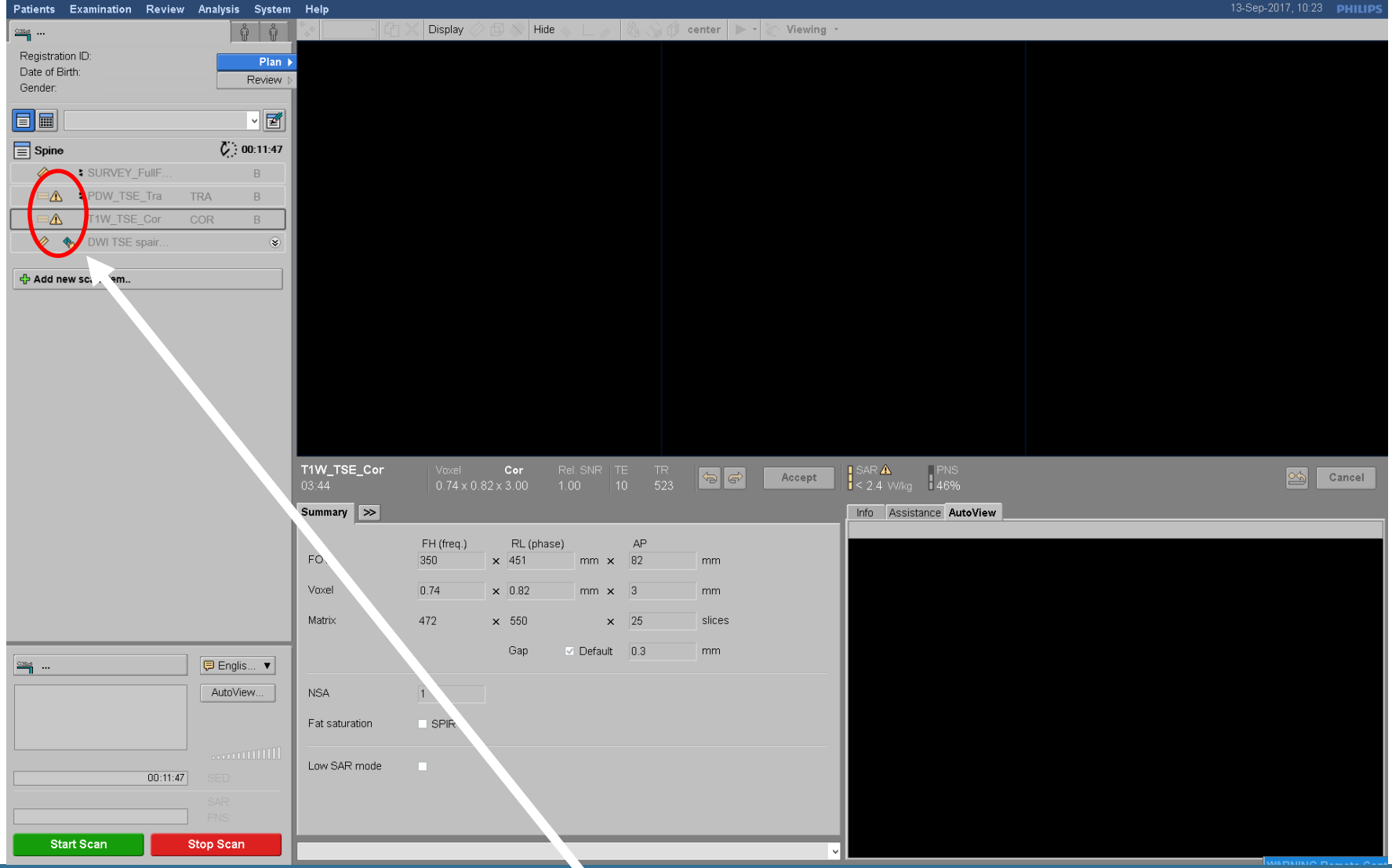


The Operating Mode (for SAR) can be selected at Patient Registration UI

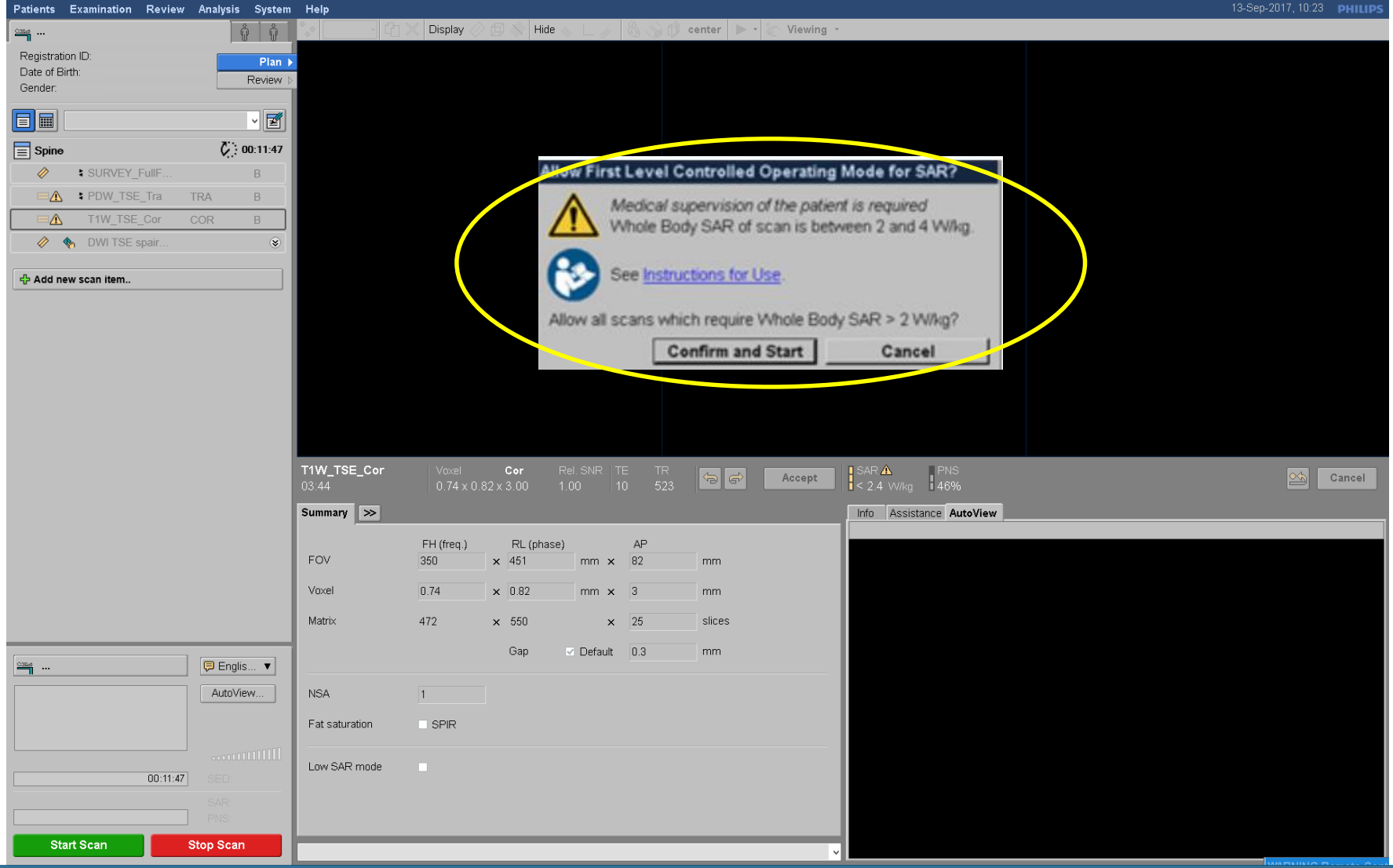


The Operating Mode (for SAR) can be selected for every individual scan, if First Level Controlled Mode was selected at Patient Registration

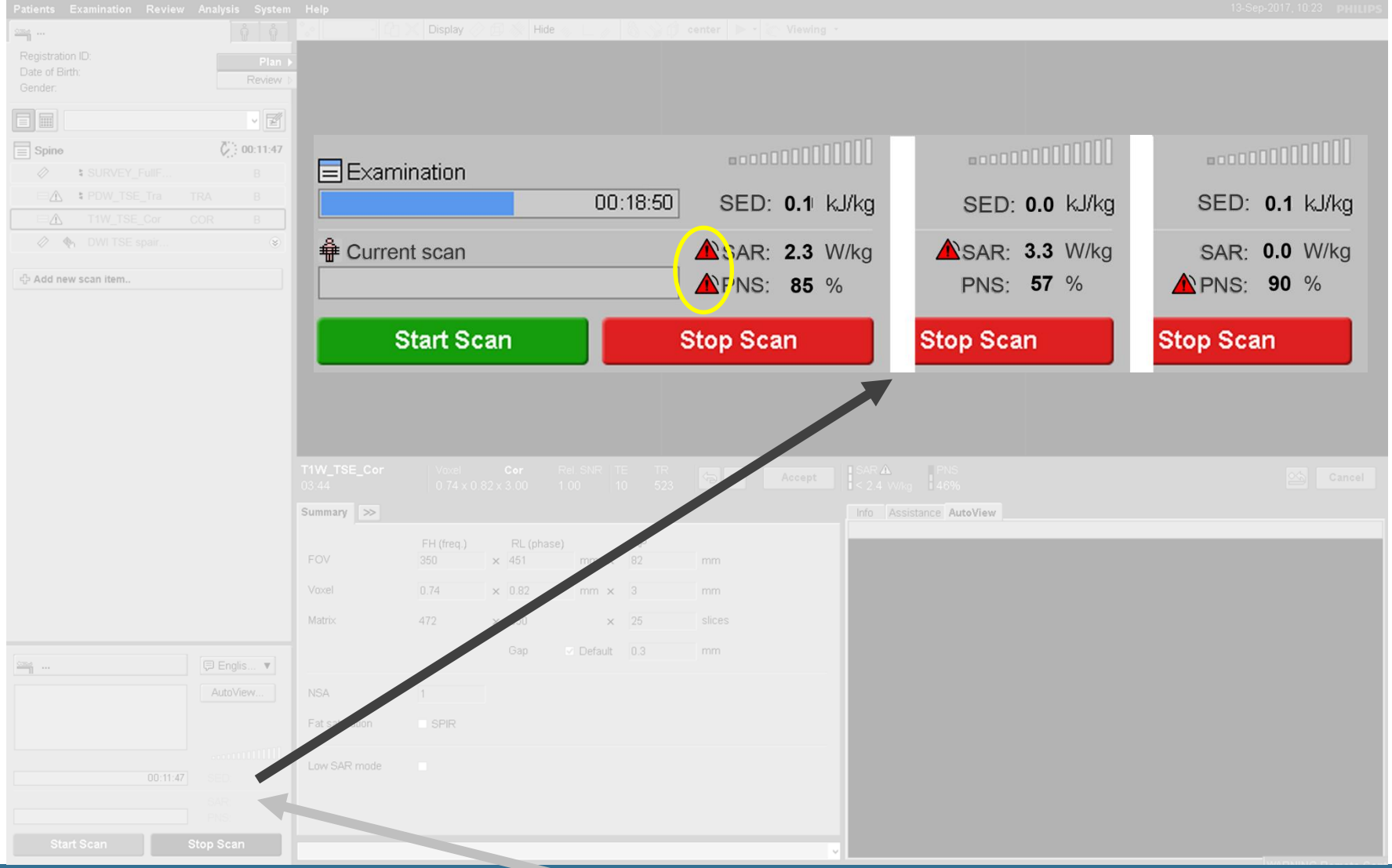
Fractional SAR values can be entered when “user defined” is selected



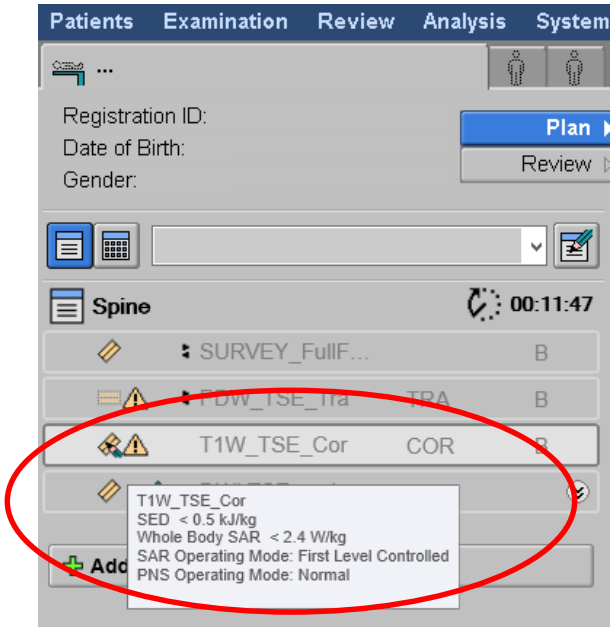
First Level Controlled Mode is indicated for every planned sequence

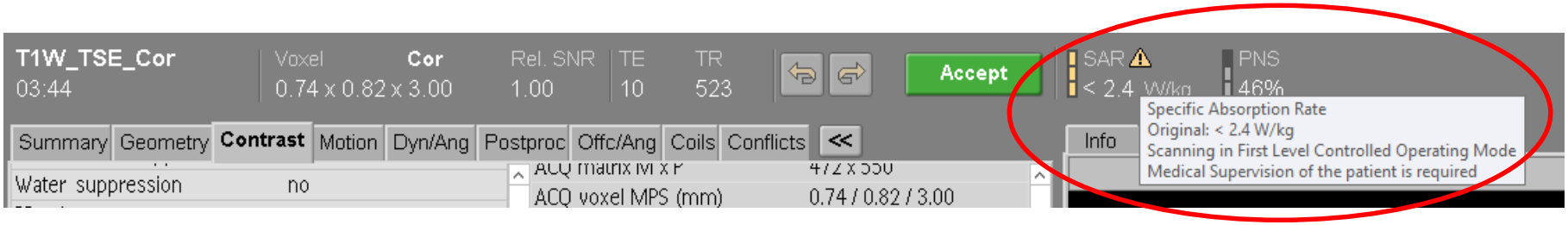


If Examination allows First Level Controlled Mode ,
a deliberate action is required at first sequence where SAR > 2 W/kg

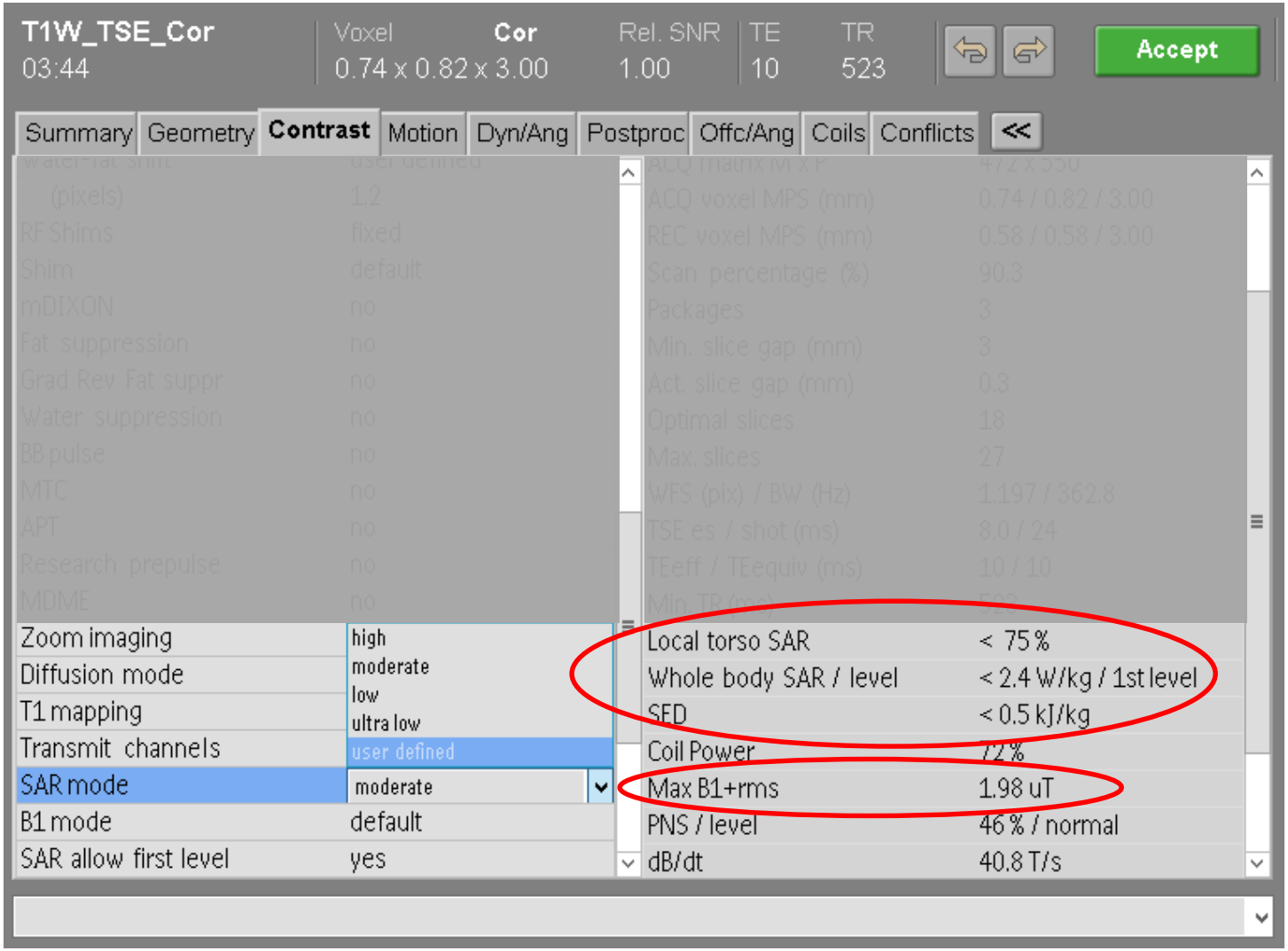


First Level Controlled Mode is indicated for the running sequence as “alarm”





Tooltips provide details for relevant exposure parameters and Operating Mode for planned sequences



Feedback on SAR, SED and B_1^+rms is provided for every individual sequence in the expert parameter editor view

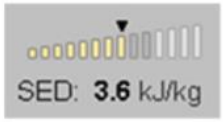
Help

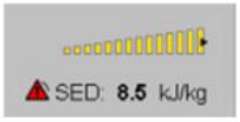
Back Forward Home

Contents Index Search Favorites

Type in the keyword to find:

(T-wave artifact
´Snap-to-table´
2D Spectroscopic Imaging
2D-PCA
3 Point Planscan
3D APT
3D ASL
3D Brain VIEW
3D Breast VIEW
3D Free Breathing
3D Inflow MRA
3D k-space (elliptical) shutter
3D Mode, display planning
3D MSK VIEW
3D Nerve View
4CH-scan
DSMR
4D-THRIVE
4D-TRAK
4D-TRAK XD
4D-TRANCE
Abdomen examination
Positioning
About ...
Accessories
Angiography Package
Pediatric Package
Acoustic Hood
ACQ voxel MPS
Acquisition mode





Safety ▸ Safety during scanning ▸ Exposure to EMF ▸ Specific Absorption Rate (SAR) ▸ Specific Energy Dose (SED)

Specific Energy Dose (SED)

During an MRI examination, RF energy is transferred to the body, potentially resulting in warming sensations. The patient temperature rise is proportional to the total energy delivered to the patient (SED, expressed as kJ/kg). It is determined by the SAR and scan duration. SAR is the rate of delivered energy expressed in Watts/kg, represented as W/kg. Limiting the amount of RF energy (SED) delivered to the patient, limits the temperature rise in the patient.

Specific Energy Dose is a comfort measure and provides feedback on the RF energy delivered to the patient. In general, a delivered SED value > 3.5 kJ/kg may be uncomfortable for some patients. The Philips recommended maximum for SED is 7.0 kJ/kg. Patient comfort during scanning is affected by the condition of the patient and must be taken into account. A rise in body temperature can be a hazard to a patient with impaired thermoregulation. Recommended maximum SED for this group is 3 kJ/kg although preferably SED is kept below 2 kJ/kg. Serious discomfort is reported by healthy volunteers at values greater than 7.0 - 8.5 kJ/kg.

NOTE Adequate patient cooling (for example by using in-bore patient ventilation and making sure examination room temperature is within the specified range) is necessary in order to keep patient comfort within desired limits. Also see Clothing and environmental conditions.

Display of SED on the console

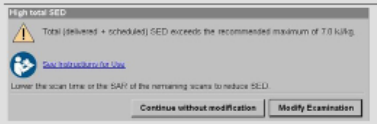
The SED is visible in the Patient Status Area above the **Stop Scan** button (see figures below). The SED bar has a scale of 0.0 to 7.0 kJ/kg. The bar shows the scheduled SED in light grey and the delivered SED in dark grey. Once the delivered SED exceeds 3.5 kJ/kg the color changes to yellow.

Information about SED is also available during planning. The SED of each scan is available on the info page.

Delivered SED	The SED of the completed scans including the SED of the currently running scan.
Scheduled SED	The SED of the scans that are scheduled for the examination.
Total SED	The total amount of the delivered and scheduled SED.

1. SED display in Patient Status Area. SED not yet applicable since no scans are selected. 2. Light grey: total scheduled SED for this examination, dark grey: delivered SED of 1.0 kJ/kg. 3. Delivered SED exceeds 3.5 kJ/kg, bar color changes to yellow. 4. SED bar with alarm symbol and black arrow at the right side to indicate that the delivered SED exceeds 7.0 kJ/kg.

Once the total SED exceeds 7.0 kJ/kg, a pop-up appears:



High total SED (High total SED)
Total (delivered + scheduled) SED exceeds the recommended maximum of 7.0 kJ/kg.
See Instructions for Use
Lower the scan time or the SAR of the remaining scans to reduce the SED.
Continue without modification (Continue without modification)
Modify examination (Modify examination)

1. Click **Continue without modification (Continue without modification)** to start the examination as scheduled.
2. Click **Modify examination (Modify examination)** to lower the scan time or the SAR of the scheduled scans before continuing the examination so that total SED is lower for the patient.

Once delivered SED exceeds 7.0 kJ/kg:

- A pop-up informs you that recommended SED maximum value will be exceeded with the next scan.

Help text provides guidance on (a.o.) SED, and how the user is informed on its accumulation

User Control & Feedback for RF deposition (SAR)

Standards Compliance

- **Operating Modes**
  - **Deliberate Action**
  - **Control Options**
  - **Visual Feedback**

Special Needs

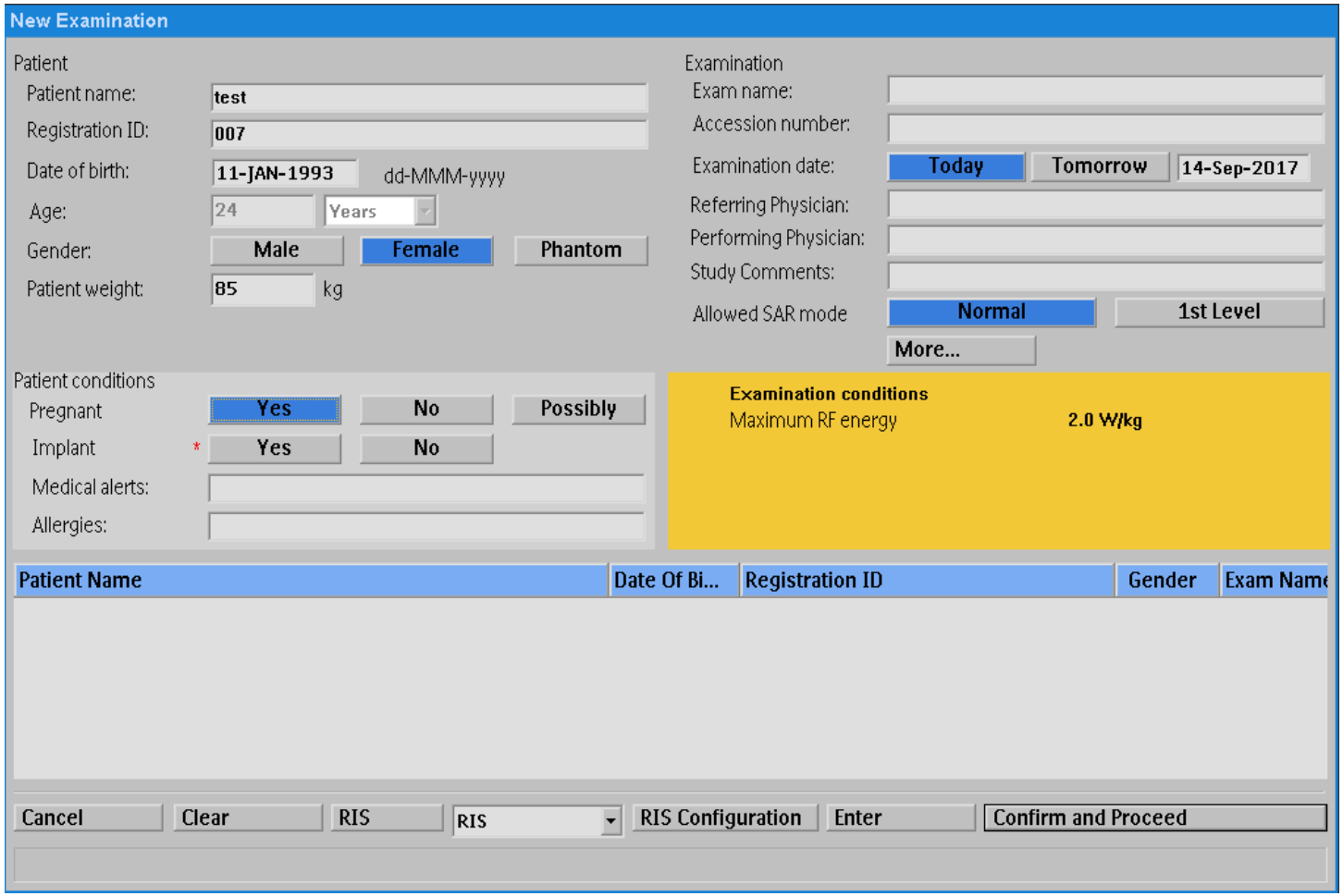
- **Pregnancy**
- **Children**
- **Implants**

- **Limiting values**
- **Patient Registration UI**
- **Popup screens**
- **Sequence parameters**
- **ExamCard, PSA, Sequence Info**

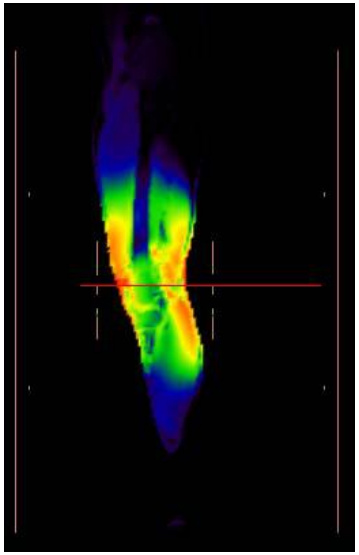
- **Normal Mode suggested**
- **T/R Knee Coil**
- **ScanWise Implant**

Usability Engineering for validated safety and workflow solutions

PHILIPS



Normal Mode is advised for Pregnant women – field can be pre-filled through HIS/RIS interface. Medical decision can allow First Level.



SAR parameters for the T/R Knee coil are for the knee, not for babies

ScanWise Implant

A key to confidence with MR Conditional implants

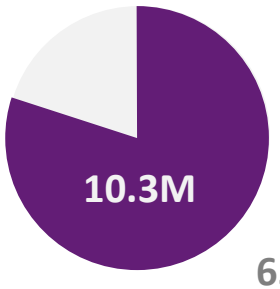
innovation you

PHILIPS

Facts

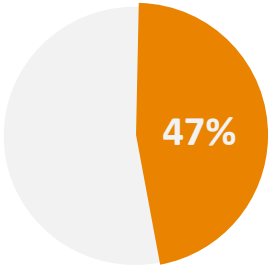
Population with implant is mainly older adults[1]

All ages

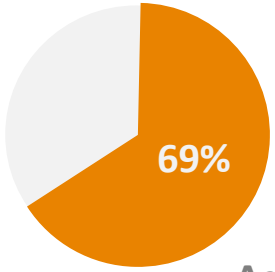


65+

Population with implants



Age 30



Age 70

Likelihood of needing an MRI within the next 10 years[2]

1 Data on file. Based on Millennium Research Group – RPUS21LJ15, RPUS20SP15, RPGL12CR14.
2 Based on Barmer GEK Arztreport 2011.

PHILIPS

MR Conditional scanning

Today's challenges

MR Conditional[1]
- Magnetic components
- Electrically conductive
- Radio frequency reactive

Conditional values given by the implant manufacturer

- Field strength?
- Static field Gradient?
- SAR?
- dB/dt?

- Can you enter the condition values as **specified** by the manufacturer?
- How many **screens and tabs** do you have to go through?
- Can you be sure your MR system **adheres to the conditional values for all scans and pre-scans**?

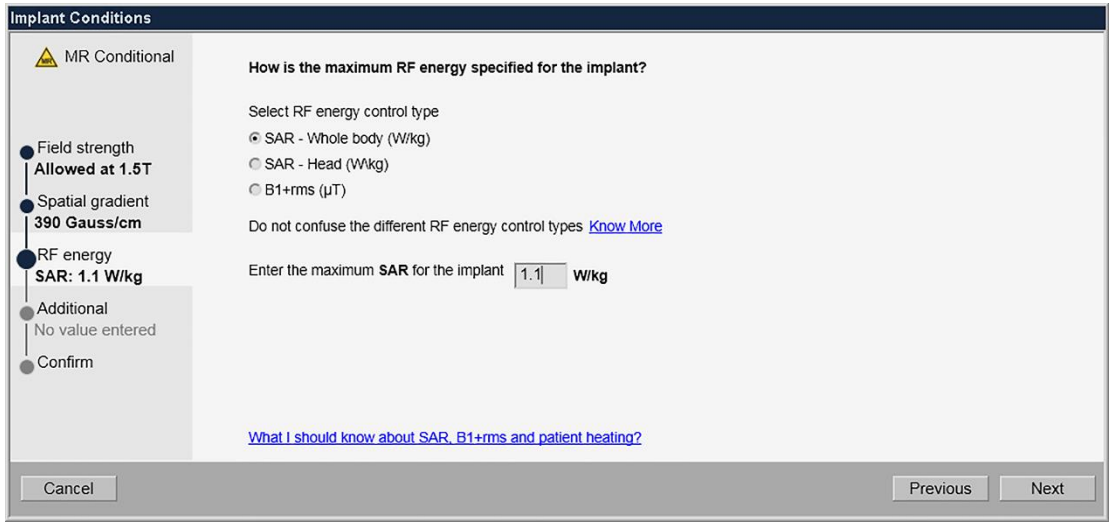
1 ASMT F2503; IEC 62570.

PHILIPS

ScanWise Implant guides you

Simplify your scanning process for patients with MR Conditional implants

Enter the maximum SAR value, or B1+rms as specified by the implant manufacturer

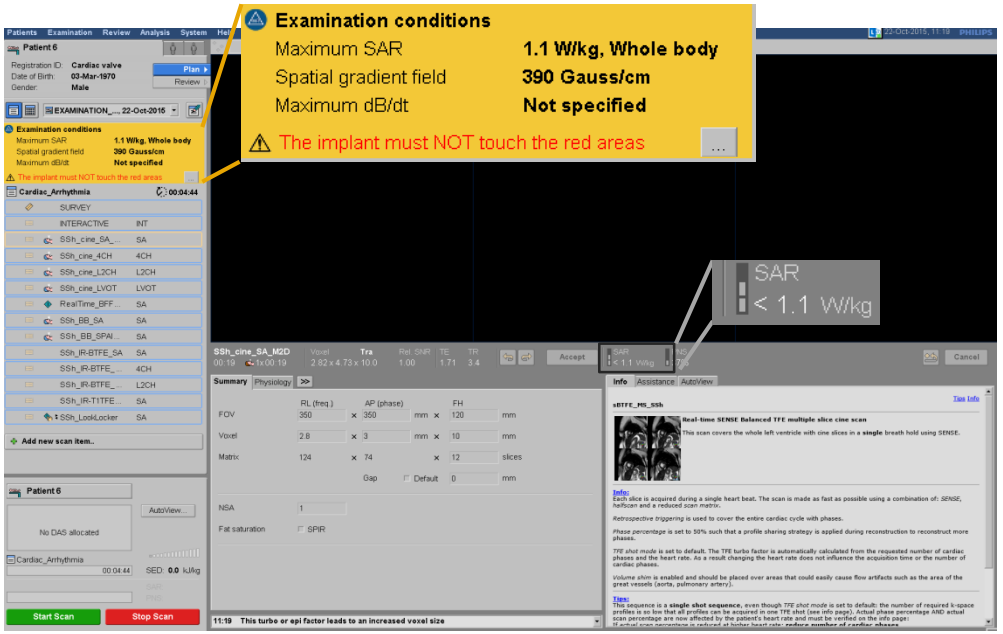


PHILIPS

ScanWise Implant guides you

Easy set-up of scanning parameters
Enter the condition values of the implant manufacturer, for all scans just once

Your MR system automatically applies these values for the entire examination

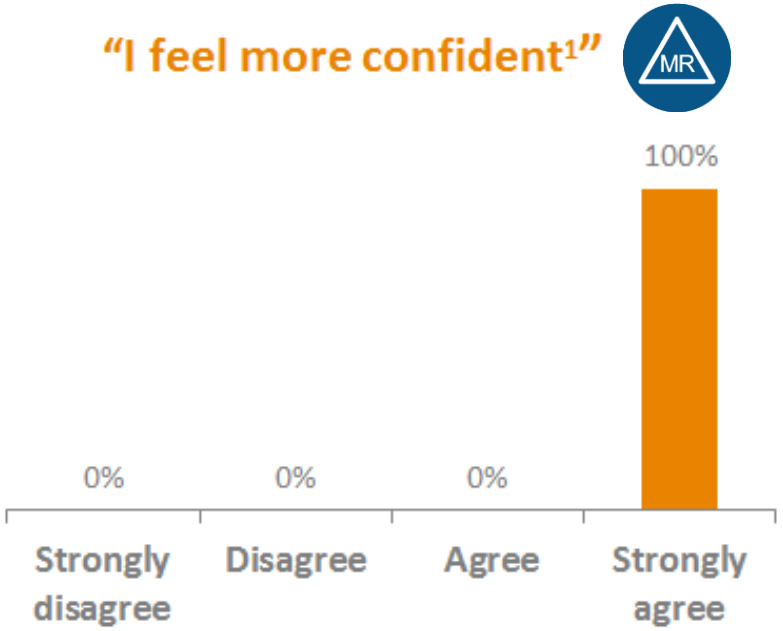


PHILIPS

ScanWise Implant guides you

To scan with confidence

- No side calculations, no guess work
- Confidence for well trained radiographers of all experience levels



Summative test & customer evaluation, N= 19. Data on file.

PHILIPS


PHILIPS