



Inside Philips Computed Tomography

DoseWise

Perfect image. Perfect sense.

PHILIPS

What's behind the perfect image

At Philips Medical Systems, we've spent the last 85 years designing innovative products that produce maximum diagnostic results with minimum risk to patients and clinicians.

One goal:

Deliver the lowest patient dose, without sacrificing diagnostic image quality.

One mission:

Healthcare without boundaries.

*Having confidence in your diagnosis...
is not enough.
Ensuring the safety of your system...
is critical.*



Safety

through design

At Philips, we hold a leadership position in reducing unnecessary patient exposure to radiation. This accomplishment stems from the intense focus on the design stage of our equipment. This stage is critical to the ultimate safety and reliability of a CT system.

Before each CT scanner is constructed, teams of researchers address considerations for the best tools and techniques to control radiation

exposure, while maximizing diagnostic results. Then, through a team of dedicated engineers, Philips ensures that the easiest way to operate its CT scanner is also the safest and most efficient.

Our devotion does not stop at the design process, as we continually strive to develop more dose efficient techniques and practices on each CT system we manufacture.



*Dose that is smart, uncompromised,
controlled, reduced.*



Manage **exposure** through DoseWise



Low dose, thin slice child shoulders with high image quality



Thin slice liver at 79mAs



Low dose, thin slice adult hips with high image quality

DoseWise

Philips' unique dose management program offers the right balance in optimizing image quality and dose. Through DoseWise, we seek to provide the most dose-efficient tools for diagnosis.

Philips is continually looking for ways to reduce risk while taking advantage of the benefits of using radiation. The result is a family of multislice CT scanners with the highest dose efficiency on the market.

Patients are exposed to significantly less radiation dose, without any compromise in image quality.

This efficient approach to dose management is encapsulated in Philips' DoseWise program. DoseWise is a philosophy, a set of principles and practices, that ensures the best possible outcomes with minimal risk to patients and staff.

It is based on the ALARA (As Low As Reasonably Achievable) principle, but is so much more. It includes creative thinking and smart solutions in three far-reaching strategic areas:

- **Smart Beam Management**
- **Less Radiation Time**
- **More Dosage Awareness**

How does DoseWise create a Smart Beam?

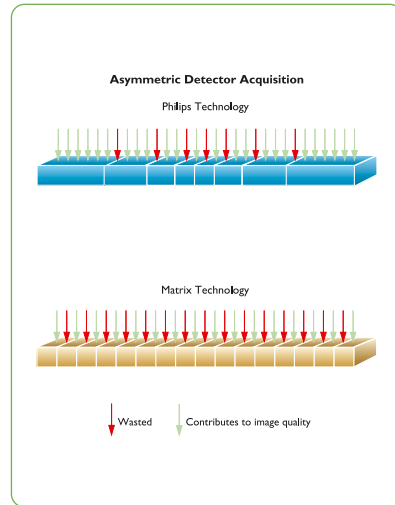
In Philips multislice CT scanners, specific Smart Beam innovations have been developed to block out X-rays that do not contribute to image quality. Through the use of Philips-exclusive Asymmetrix™ detectors, IntelliBeam™ filtration, and Tach™ technology, dose can be managed to limit the exposure specifically to the location of interest.

Asymmetrix detectors — efficient design technology with fewer gaps results in lower dose.

All Philips multislice CT scanners incorporate an asymmetric detector design, which boasts the highest quantum efficiency in the industry - 98% dose efficiency versus ~90% dose efficiency from matrix-style detector systems.

Philips Asymmetrix, variable wide-area detector array, minimizes the gaps associated with matrix detectors to capture more X-ray photons. Fewer gaps

between detectors result in better dose efficiency (nearly 10 percent better than matrix detectors). For example, systems designed for quad slice scanning utilize a detector configuration with eight elements in the z-axis and only seven gaps. When compared to traditional matrix detectors, this design uses more of the X-ray photons that pass through the patient, rather than wasting the dose in the many matrix detector gaps.





How does DoseWise create a Smart Beam?

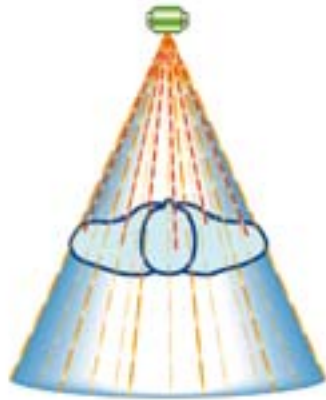
IntelliBeam filtration — prevents unnecessary dose through absorption of unwanted X-rays.

Development of the Philips wedge-shaped titanium filter, IntelliBeam, has resulted in the prevention of unnecessary dose, even before X-rays leave the tube housing.

Through the scanner's intelligent design, a hard X-ray beam (central HVL of 8.5mm of aluminum at 120 kVp) is delivered after soft X-rays that contribute little to the signal reaching the detectors are filtered. IntelliBeam filtration provides lower doses to infants and young children than other wedge designs.

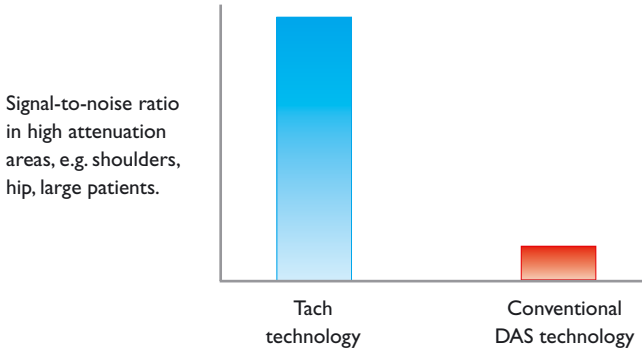


Non-contributing X-rays Absorbed with IntelliBeam Filter



Non-contributing X-rays Reach Patient without IntelliBeam Filter

Signal Comparison of Tach Chip vs. Conventional DAS



Signals that would otherwise be drowned out by noise are detectable with Tach. As a result, Tach extends the range of applications/anatomy examined with diagnostic image quality.

Tach technology — direct-to-digital signal maintains high image quality with lower dose protocols.

Philips-patented Tach technology is an application-specific integrated circuit (ASIC) that directly converts the X-ray signal from the detector into a clear digital signal for consistent high image quality, while maximizing dose efficiency.

Mounted directly to the detector module, the Tach chip replaces conventional analog-to-digital conversion, removing electronic noise and providing a clearer image. This clearer image allows for reduced dose, without compromising diagnostic quality.

Philips-patented
Tach technology
computer chip



Less radiation

DoseRight™ automatic current selection — prospective calculation of appropriate dose, while maintaining constant image quality.

Through Philips' DoseRight innovations, the best technique for each exam can be calculated automatically, before the exam begins. This ensures delivery of the lowest possible dose at the optimum image quality.

With the DoseRight current selection tool, you can customize your image quality according to the noise level you prefer. Based on the planning scan, DoseRight automatically suggests the lowest mAs settings throughout the exam to maintain constant image quality at low dose. The result is consistently high quality images tailored to your diagnostic preferences.

DoseRight dose modulation — automatically adapts tube current based on anatomy for potential dose reduction of up to 50 percent.

DoseRight dose modulation is a method that offers potential for dose reduction of up to 50 percent versus current techniques for certain exams.

Anatomically-targeted dose modulation automatically distributes or controls tube current, increasing the signal over larger areas of anatomy (shoulders, hips, etc.) and decreasing signal over small or air-filled areas (extremities, pediatrics, lungs, etc.). This automatic signal adjustment delivers both dose and noise level reduction, without a loss of resolution or overall image quality.

Reduced radiation exposure through automatic calculation.



More awareness

Creating More Awareness for CT dose management is perhaps the most important element of DoseWise. Because CT is responsible for the majority of radiation dose delivered during diagnostic examinations, it is important to weigh the benefits and risks of CT on a case-by-case basis.

Once CT is prescribed, there are many ways you can minimize accumulated dose - simply by adapting the beam during the exam or by turning it off the moment it's not necessary. Additionally,

Philips scanners have been automated to provide information and advice before, during and after the exam.

DoseWise gives you more awareness with real-time information on dose levels, as well as the convenient controls to adjust them.

Through Philips-exclusive design elements - dedicated pediatric protocols, dose display and Continuous CT™ (CCT) - DoseWise gives you easy-to-read, at-a-glance information, keeping you aware of dose levels at all times.



*Real-time information
on dose levels.*

Dedicated pediatric protocols — a Philips-exclusive, dedicated pediatric calibration phantom for specific dose protocols in children and infants

Philips is the only CT vendor in the world to use a dedicated pediatric CTDI phantom to determine protocols and calculate the dose equivalent for pediatric care. Other CT manufacturers use a standard adult phantom for pediatric dosage, resulting in significantly higher dose.

With the pediatric phantom, Philips is able to accurately reduce head protocols in children by more than 20 percent, and body protocols by more than 60 percent - without sacrificing image quality.

Using the pediatric CTDI phantom, the dedicated pediatric protocols - based on age and weight of the child - were designed specifically to produce consistent, high image quality at significantly reduced dose.

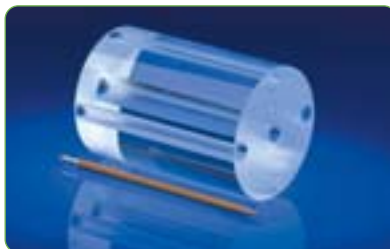
Developed and verified at leading pediatric hospitals (British Columbia Children's Hospital, Vancouver, and Children's Hospital of Philadelphia, Pennsylvania), these pediatric protocols have been proven to maintain diagnostic image quality standards at the minimum possible patient dose.

Child lung CT
at 79mAs



Infant and Child Reference Doses

Using the unique pediatric CTDI Dose Phantom, simulation of infant head attenuation factors (AAPM 2001 Annual Meeting, WIP Abstract #7262) can be achieved. This phantom was used to measure infant (newborn to one year) head and body reference doses for the Philips multislice CT scanner. Using this exclusive phantom, the above infant and child reference dose ratios have been determined as ideal protocols for pediatric scanning.



Philips 10cm Diameter Infant CTDI Dosimetry Phantom

Infant and Child Reference Doses	
Infant CTDIw Head Ratio	$(1.2) \times (\text{Adult CTDIw Head display}) =$ correct estimate of pediatric dose administered
Infant CTDIw Body Ratio	$(2.5) \times (\text{Adult CTDIw Body display}) =$ correct estimate of pediatric dose administered
Child CTDIw Head Ratio	$(1.1) \times (\text{Adult CTDIw Head display}) =$ correct estimate of pediatric dose administered
Child CTDIw Body Ratio	$(1.7) \times (\text{Adult CTDIw Body display}) =$ correct estimate of pediatric dose administered

These factors adjust the CTDIw dose displayed on Brilliance, more accurately determining true pediatric doses.

More awareness: controlling dose level

Dose Display — CTDI, Dose Length Product (DLP), and Effective Dose Display* information prior to, during and after scanning.

Philips multislice CT scanners provide the user with weighted CTDI information (average dose over the volume scanned) and Dose Length Product prior to scanning, for the scan parameters defined within the protocol (see CTDI Dose Display figure).

Sites can take advantage of these features to monitor and reduce exposure (mGy), especially in pediatric patients.

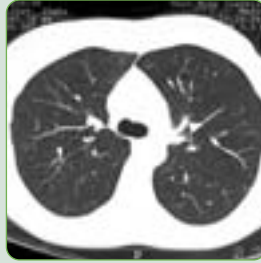
Weighted CTDI display complies with the European Community legislation that comprehensive patient irradiation information is displayed before a study is performed. The calculated dose for the patient is dependent upon the kV, mAs, slice thickness, slice increment and scan length.



CTDI Dose Display



Adult abdomen using
50mAs



Adult lung CT at 20mAs



Paranasal sinus Sagittal
MPR at 49mAs

Dose Length Product

To better represent the overall dose delivered by a given scan protocol, Dose Length Product (DLP) values are displayed on console. DLP reflects the total energy and potential biological effect delivered through a given exam.

Effective Dose Display

The potential biological effects from radiation depend not only on the dose, but also on the radiosensitivity of the

tissue being examined. Philips' effective dose display takes this radiosensitivity into account. It reflects the risk of a non-uniform partial body exposure in terms of a uniform, whole-body exposure (in mSv) - allowing comparison of biological effect between different types of exams.

*Work-In-Progress. Not commercially available.

*Calculated dose protocols
monitor and reduce exposure.*



Child IAC at 180 mAs



**Continuous CT (CCT) —
shielding design feature for the
radiologist's safety.**

CCT limits X-ray generation to the 240 degrees beneath the patient, shielding the radiologist from scatter radiation.

Interventional procedures can be performed under CT fluoroscopic guidance with reduced risk to the radiologist and staff.

Partnership for **clinical**

Dose Management Guidelines for the End-user

Is CT appropriate, or are other non-ionizing techniques sufficient?

First, weigh your options. Generally, CT is a fast and widely available method for diagnosis that can precisely target almost every part of the body. But would other non-ionizing techniques be adequate alternatives to the CT procedure that is prescribed?

Is the lowest technique to make a diagnosis selected?

The second step is to ensure that the correct technique for the lowest possible dose has been selected to make a diagnosis. Philips has created

a low dose scanner that will aid you in dose management. But because image quality is highly subjective, it may be possible to further reduce technique and still achieve adequate diagnostic image quality.

Have steps been taken to eliminate repeat exams?

The last step is to eliminate any necessity for repeat examinations by instructing the patient to keep still and breathe when appropriate throughout the exam.

Patient positioning prior to scanning is also important to ensure the exam is performed as efficiently as possible.

excellence

without compromise

*Together, we are managing dose,
reducing exposure, enriching lives.*



Optimal dose management reaches beyond the capabilities of the CT scanner. Philips has created a highly dose-efficient system, but users must take the appropriate steps to use it as effectively as possible.

Together, we must ensure that equipment and techniques meet standards that minimize dose.

Within these standards, patients and healthcare providers must decide when and how to use dose on a case-by-case basis.

Through the teamwork and dedication of Philips, clinicians and patients - dose management, and dose reduction, becomes a reality.

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Interested?

Would you like to know more about our imaginative products? Please do not hesitate to contact us. We would be glad to hear from you.

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