



PHILIPS

SkyFlow

Diagnostic X-ray

SkyFlow brings significant dose reduction to ICU chest radiographs at Hospital Sant Pau

Who

Hospital de Santa
Creu i Sant Pau

Where

Barcelona,
Spain

Bedside chest radiographs are the most frequent radiological tests performed in the intensive care unit (ICU).^{1,2} In particular, patients with acute cardiopulmonary problems or those on mechanical ventilation may receive daily chest X-ray exams while in the ICU.

To investigate the dose reduction potential of Philips SkyFlow for portable chest radiographs in the ICU, the Hospital San Pau conducted a visual grading study. ANOVA tests show that even with a dose reduction of up to 40 % SkyFlow images receive significantly higher grading scores than images without SkyFlow acquired at normal dose. The convincing results have had immediate impact on the settings used in the daily practice on the ICU.



Scientific study compared images at two dose levels

To determine this impact, the hospital conducted a study with 50 patients who received clinically indicated chest X-rays on two consecutive days. The first day's images were acquired using a reference protocol of 80 kV, without a grid.

On the second day, dose was reduced up to 40 %, depending on the exposure index of the first image. The images were processed both with and without SkyFlow, and were then blind-rated by two expert radiologists, who graded the images on a scale of 1 to 10.

“Readers rated each image with both a general score and on the visibility of six anatomical features,” Dr. Capdevila explains. “We then averaged the scores of the readers per feature and used an analysis of variance (ANOVA) to assess the influence of dose and SkyFlow on image quality.”

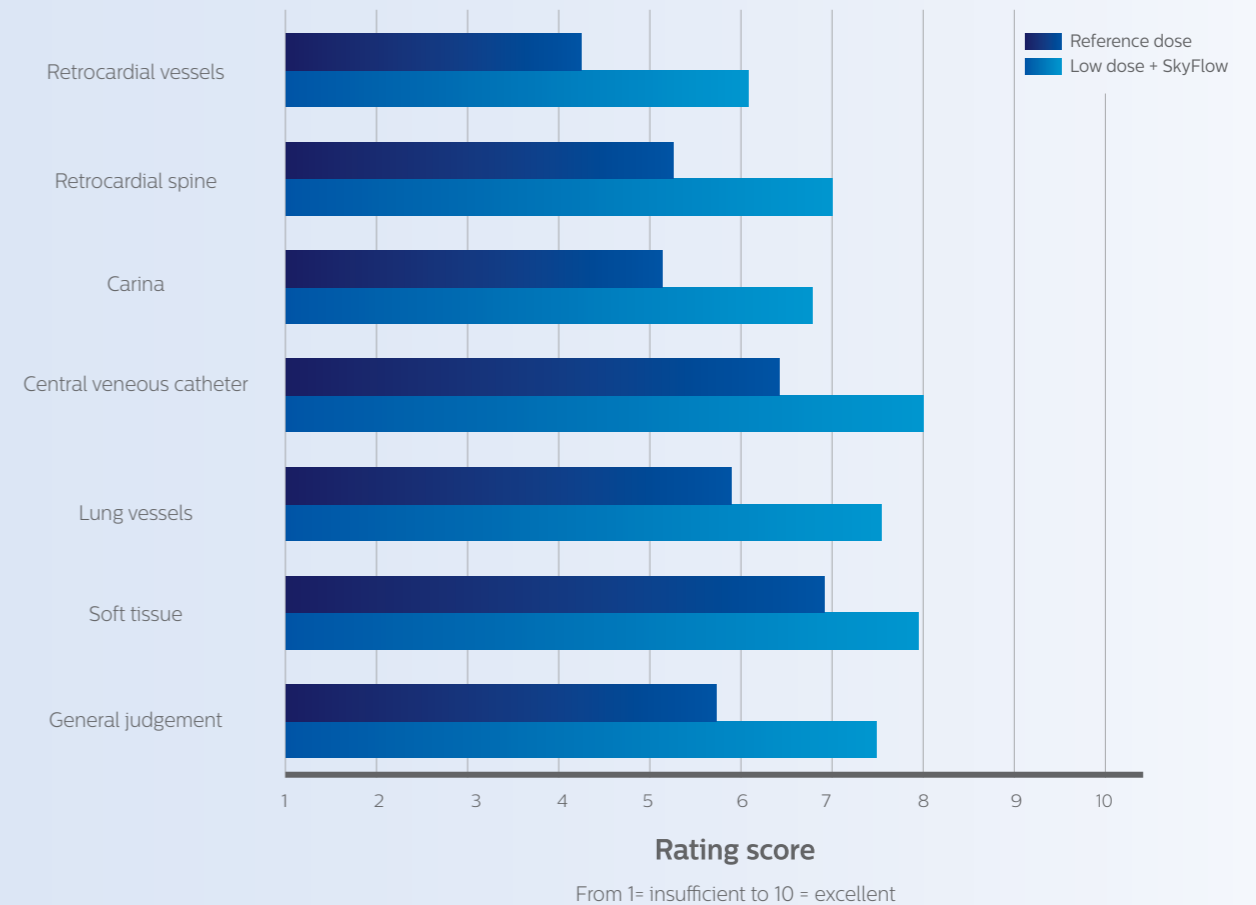
Result: Higher image quality with SkyFlow, even at lower dose

The ANOVA tests showed that the scores of images processed with SkyFlow were higher than those processed without it for each feature, as well as for the general score. Even the images obtained at reduced dose using SkyFlow were scored higher than standard protocol images without SkyFlow (see Figure 1).

“In the study, the dose-reduced images were acquired at 40 % less dose in 39 of the 50 patients. Nevertheless, image scores with SkyFlow were clearly superior compared to reference dose images without SkyFlow. This result gives us confidence that we can use SkyFlow to achieve good image quality, while also achieving significant dose reduction,” Dr. Ribas concludes. “These convincing results have had immediate impact on our routine dose settings,” she adds. We’ve now reduced the dose settings by 20 % in our standard chest protocol. As we are continuously monitoring image quality and dose, we may even go lower in the future.”

Figure 1.

Graph of image ratings with grading scale



“We want to use the lowest dose possible, and yet we need high image quality.”

Antoni Capdevila, leading the Diagnostic Imaging Department

Low dose required for ICU patients without compromising on image quality

At Hospital de Santa Creu I Sant Pau (Barcelona, Spain), the most frequent indication for chest X-ray exams is to verify correct positioning of tubes and lines. Antoni Capdevila, leading the Diagnostic Imaging Department, explains that frequency of chest X-rays in the ICU necessitates extra vigilance about patient dose. “While the dose of a single chest X-ray is low, patients who are in the ICU for an extended time, or who are admitted several times, accumulate more dose,” he says. “We want to use the lowest dose possible, and yet we need high image quality.”

He notes that the Sant Pau ICU does not use anti-scatter grids to improve image quality, because there is a trade-off with dose and that the use of them is not handy. “An additional problem with grids is that exact positioning is very challenging with ICU patients, and severe grid cut-off may result in loss of useful radiation and even retakes,” he says. “In the past, we had to accept that the contrast of the grid-less images is poor due to scattered radiation. However, when we introduced Philips SkyPlate detectors and SkyFlow, we saw such an improvement in image quality that we wanted to investigate if we could reduce our dose settings.”

Modern flat-panel detectors provide opportunity to reduce dose

“We immediately realized that our CR settings were too high for our new DR systems,” says Dr. Monserrat Ribas, leading the Medical Physics department. “We wanted to take full advantage of the dose savings potential without compromising image quality, so we reduced dose stepwise. On average, we realized a reduction in the dose area product (DAP) by approximately 50 % compared to CR.” Radiologists at Sant Pau also noticed that SkyFlow scatter correction technology had a positive impact on image quality. “Even after the large initial dose reductions, we saw that image quality with SkyFlow was still a lot better than before,” Dr. Capdevila says. “We were confident that dose could be reduced further. So we decided to investigate how SkyFlow combined with an even lower dose impacted image quality.”



Photograph by Lluís Casals

Without SkyFlow



With Skyflow



How SkyFlow works

For use in both bedside and trolley chest exams, SkyFlow technology identifies scatter signal and automatically subtracts it from the image, resulting in grid-like image contrast³.

To deliver the correct contrast automatically for each individual patient type - from pediatric to bariatric, SkyFlow first estimates the scatter based on pre-calculated scatter patterns that originate from physical simulations and are available in a database. Using a database results in a short computation time.

Next, SkyFlow calculates from this image the scatter signal that a grid would remove at optimal alignment. That signal is subtracted from the original detector image, resulting in a scatter-corrected image with grid-like image contrast.

Hospital information

Hospital de la Santa Creu i Sant Pau in Barcelona is a university hospital established six centuries ago, making it the oldest hospital in Spain. The hospital is among the most relevant for education and research in the country.

An historical complex and a new building block compose the hospital. The old structure is an example of modernist architecture, built at the beginnings of 20th century and declared World Heritage Site by UNESCO in 1997. The construction of the new hospital began in 2000 and was completed after ten years.

Patients admitted to the ICU at the Hospital de Santa Creu I Sant Pau: 30 % of patients are postsurgical heart, 16 % post general surgery, 21 % respiratory complications, 26 % rating vias and catheters and 7 % other.

1. Eisenhuber E, Schaefer-Prokop CM, Prosch H, Schima W. Bedside chest radiography. *Respir Care*. 2012 Mar; 57(3):427-43
2. Rubinowitz AN, Siegel MD, Tocino I. Thoracic imaging in the ICU. *Crit Care Clin*. 2007;16:539-573
3. Mentrup D, Jockel S, Menser B, Neitzel U. Iterative scatter correction for grid-less bedside chest radiography: Performance for a chest phantom *Radiat Prot Dosimetry* 2016; 169 (1-4): 308-312

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