

# Defective ultrasound transducers in Swedish hospitals

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# Two 2D images taken from the same patient, scanned at the same time with

- Two transducers of the same type
- The same scanner with identical adjustments



# Why do we have differences ?

- Transducer problems ?
- Transducer testing is often missed in clinical routines
- Transducer testing is often missed in manufactures maintenance programs

# Our transducer study

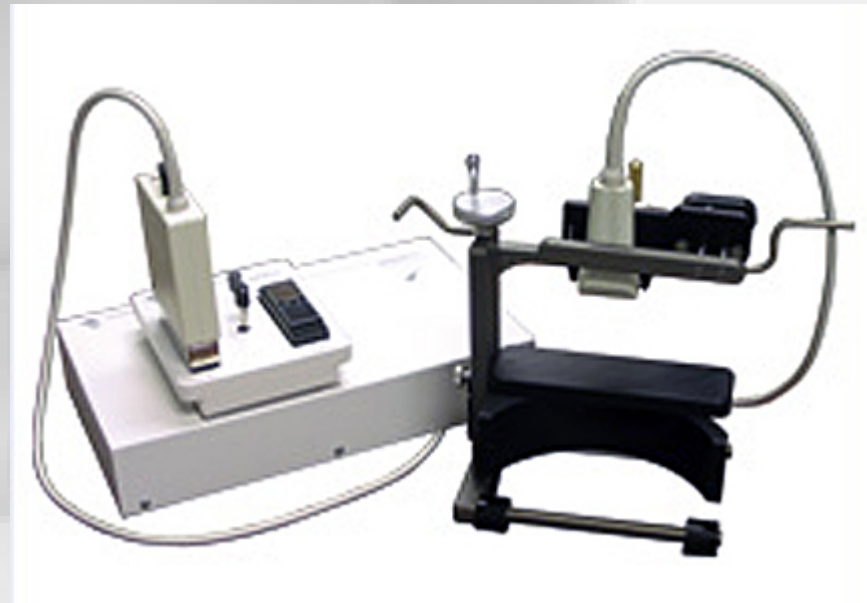
Aim: To investigate the number of defective transducers in clinical use in Swedish hospitals

- 704 transducers were tested between year 2004 and 2006 at thirty hospitals in the southern and middle part of Sweden
- The age of the transducers were from 3 month up to 10 years and came from 7 manufacturers which were given the letters A to G in the table
- All types of transducers, except vaginal, rectal and pen transducers, were tested
- The FirstCall Transducer Test System from Sonora Medical Systems was used for the tests

# Sonora FirstCall Ultrasound Test System

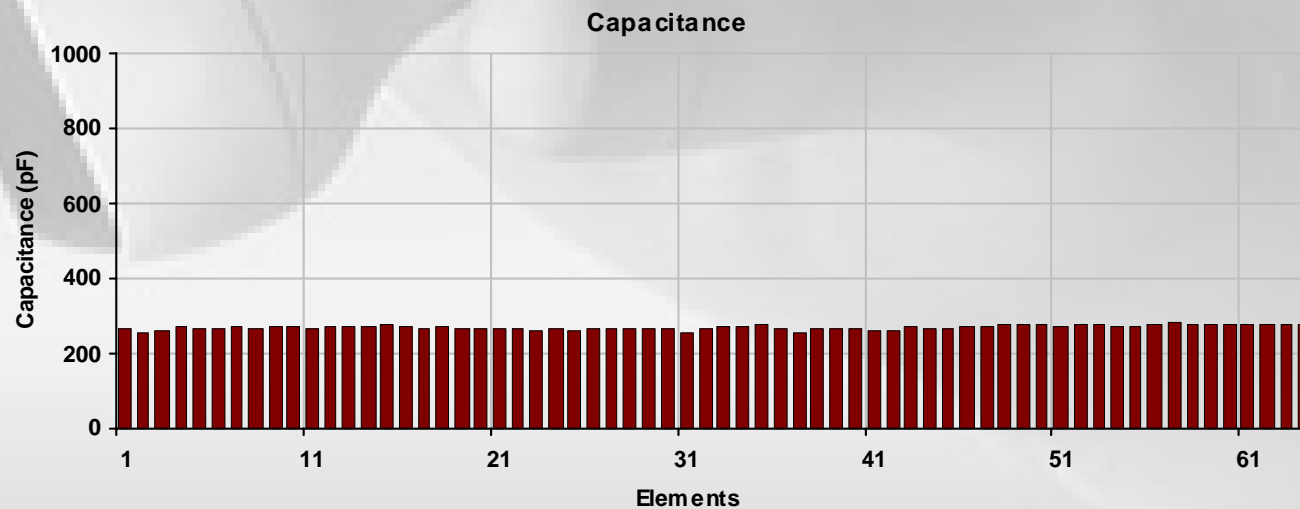
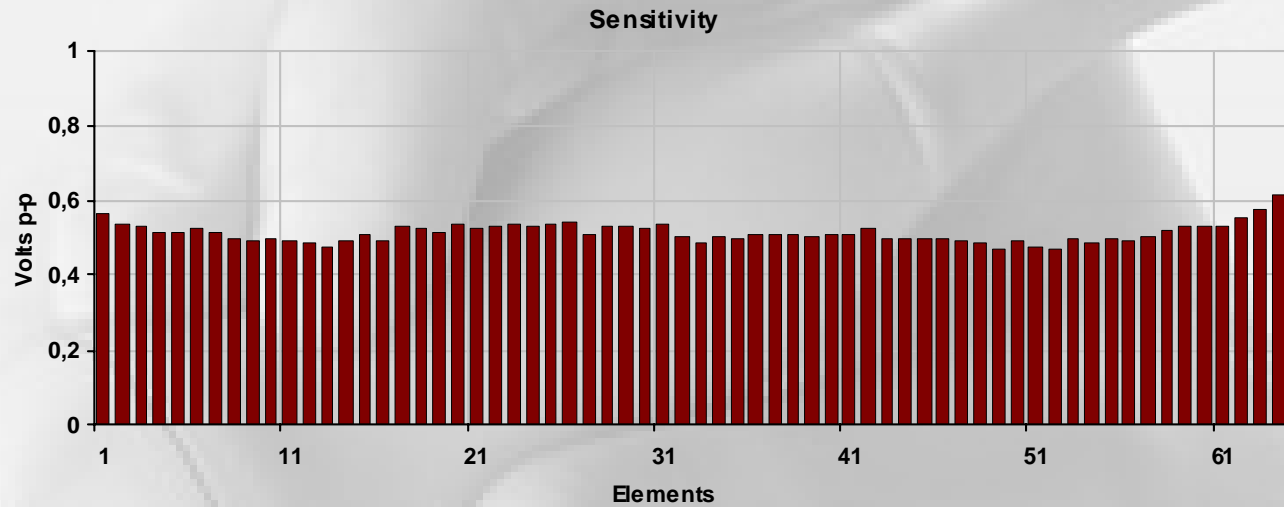
Each transducer element is individually tested with respect to:

- Element sensitivity
- Capacitance
- Pulse width
- Center frequency
- Fractional bandwidth
- Pulse shape



# Sonora FirstCall Test System

Sensitivity and capacitance element-by-element tests from a fully functioning transducer with 64 elements



# Sonora FirstCall Test System

Each element in the transducer was classified according to its sensitivity value

- Functionally acceptable  
Operates at >75% of the mean sensitivity value
- Weak element  
Operates between 10% and 75% of the mean sensitivity value
- Dead element  
Operates <10% of the highest sensitivity value

# Sonora FirstCall Test System

The Transducer is classified as defective if it has:

- More than 4 consecutive weak elements or more than 20% weak elements
- More than 2 dead elements or more than 2 consecutive dead elements

# Results

Frequency of error in percent  
Mean value of total frequency of error: 39.8 %

manufacturer/error (%)	Delamination	Cable breaks	Shorts	Weak elements	Dead elements	Total
<b>A</b>	<b>7,7</b>	<b>9,6</b>	<b>3,8</b>	<b>3,8</b>	<b>0</b>	<b>24,9</b>
<b>B</b>	<b>25,0</b>	<b><u>33,3</u></b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>58,3</b>
<b>C</b>	<b>41,9</b>	<b>3,2</b>	<b>3,2</b>	<b>6,5</b>	<b><u>12,9</u></b>	<b>67,7</b>
<b>D</b>	<b>45,9</b>	<b>1,9</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>47,8</b>
<b>E</b>	<b>31,0</b>	<b>6,9</b>	<b>3,4</b>	<b>0</b>	<b>0</b>	<b>41,3</b>
<b>F</b>	<b>11,1</b>	<b>11,1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>22,2</b>
<b>G</b>	<b>25,1</b>	<b>8,9</b>	<b>3,9</b>	<b>0</b>	<b>0</b>	<b>37,9</b>

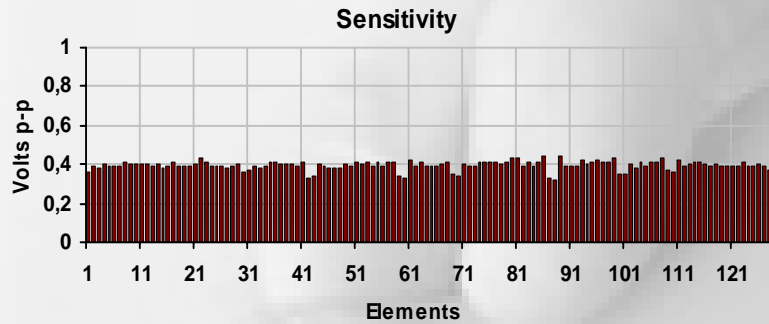
# Results

Distribution in percent of errors, all manufacturers

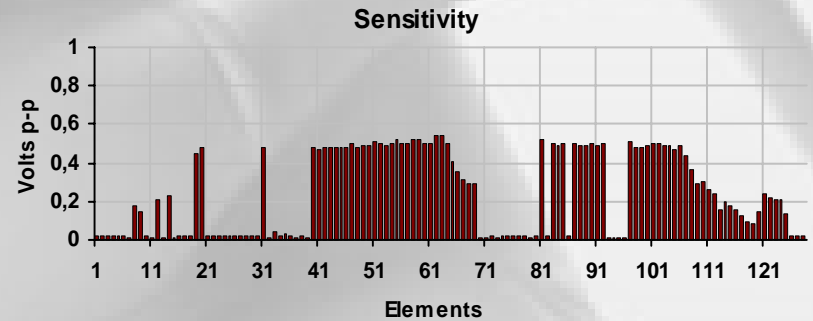
<b>Error</b>	<b>Percent</b>	<b>Amount</b>
<b>Delamination</b>	<b>66.5</b>	<b>179</b>
<b>Cable breaks</b>	<b>21.2</b>	<b>57</b>
<b>Shorts</b>	<b>8.6</b>	<b>23</b>
<b>Weak elements</b>	<b>2.2</b>	<b>6</b>
<b>Dead elements</b>	<b>1.5</b>	<b>4</b>
<b>Total</b>	<b>100</b>	<b>269</b>

# Ultrasound scanning, Radiology (compare with image 2)

New transducer

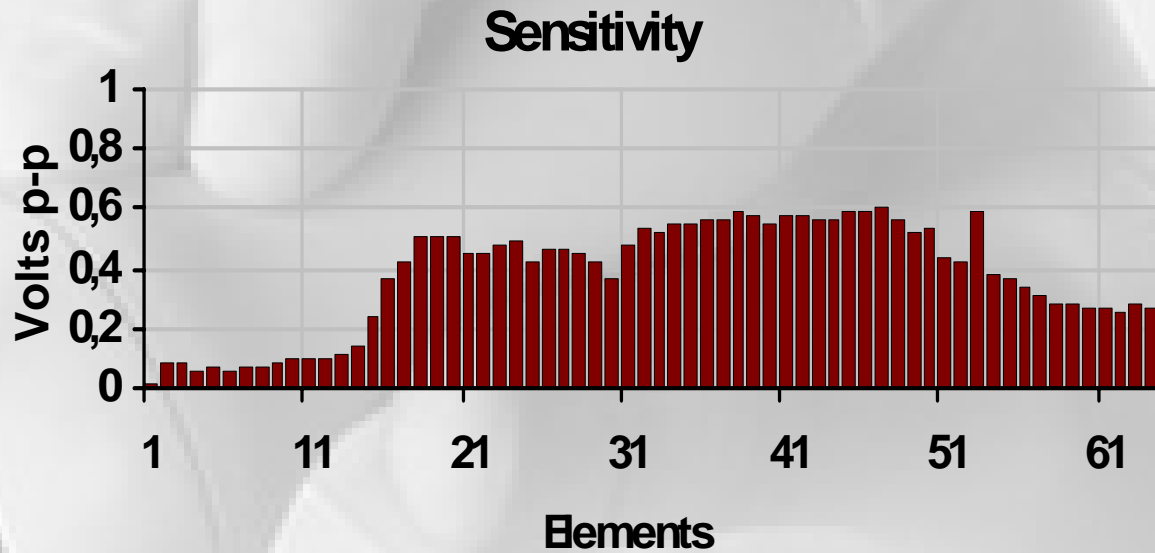


An older transducer with the main part of elements defect



# Observation 1:

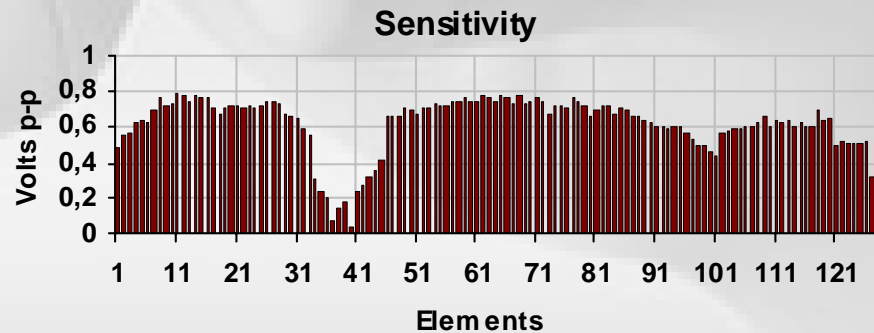
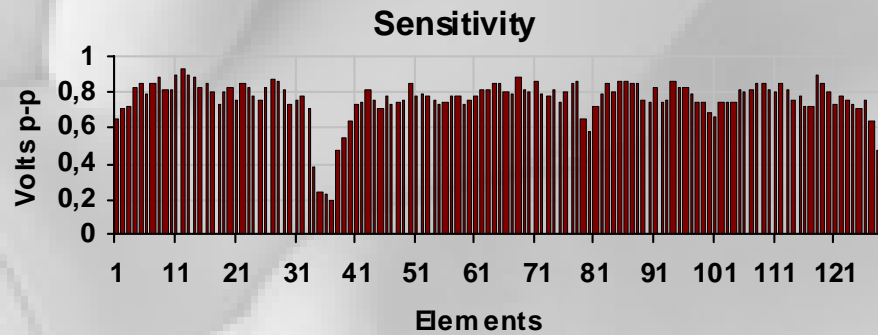
A cardiac transducer with delamination



# Observation 2:

Transducer function can become worse in a short period of time

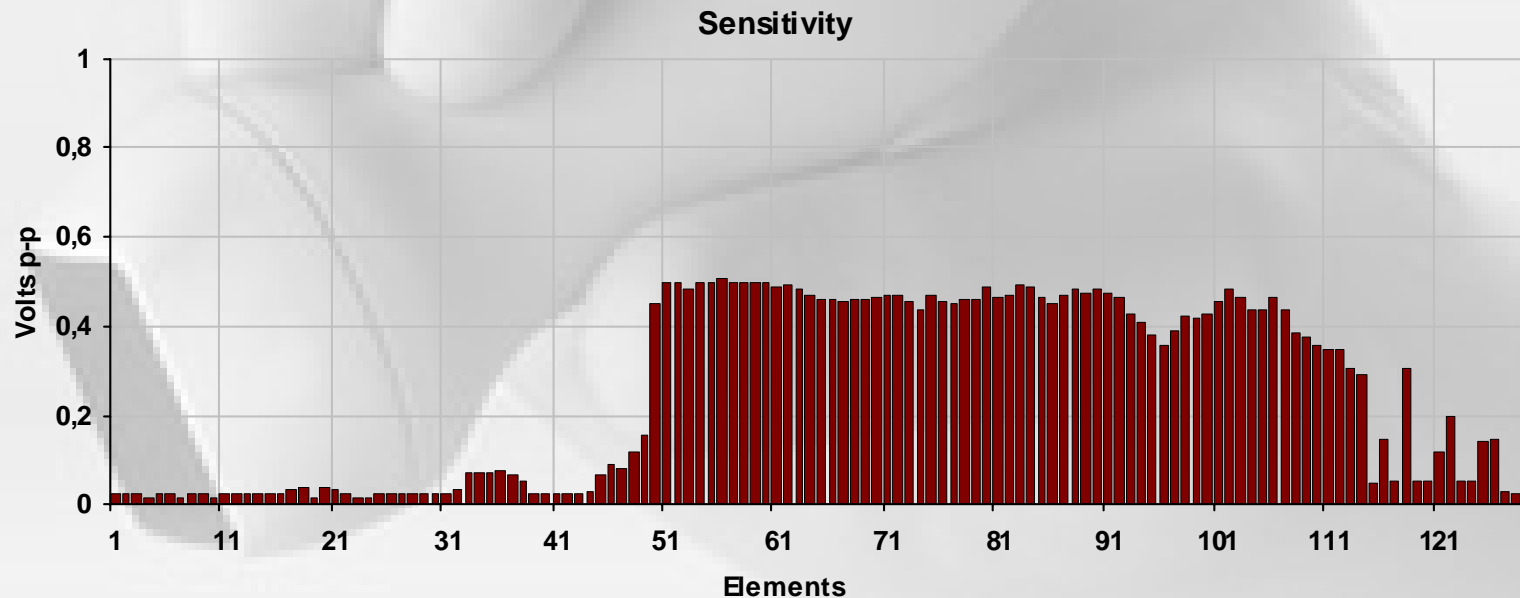
A transducer tested twice with an interval of three month



# Observation 3:

The user had difficulty in deciding if the transducer was defective

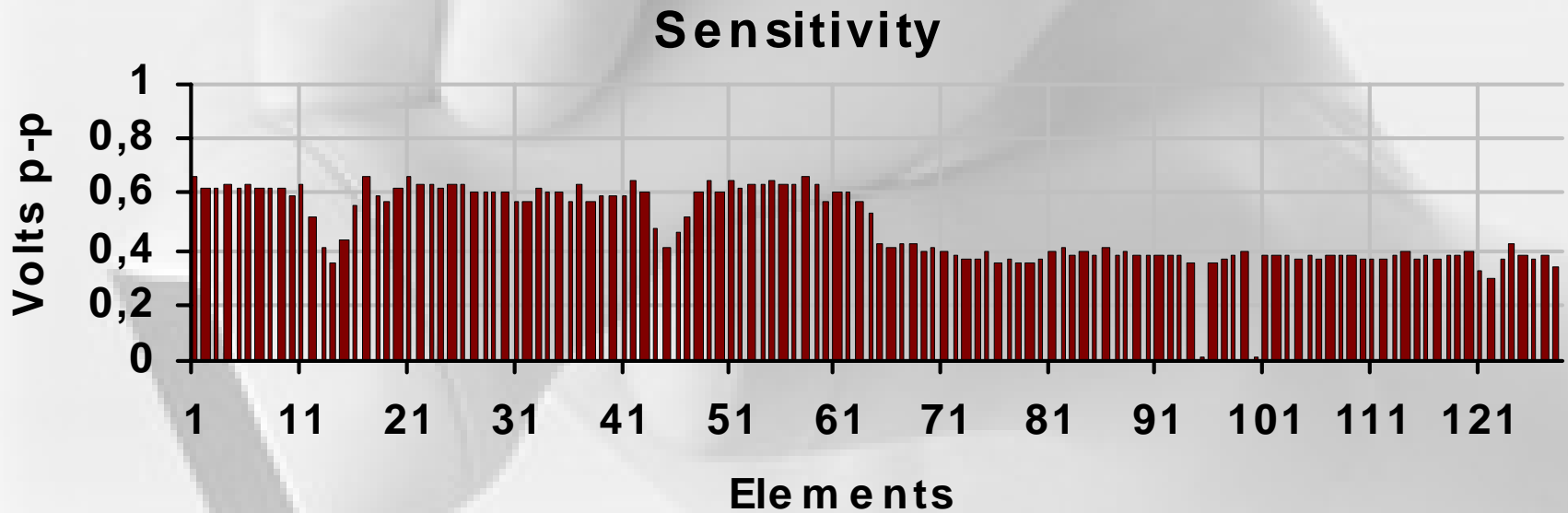
This transducer was in daily use in a X-ray department in the Stockholm area (2005)



# Observation 4:

Completely new transducers can also suffer from defects

This transducer was tested after delivery to  
Karolinska University Hospital



# Follow-up study, summer 2008

- A follow-up study with tests of 185 transducers in the Stockholm area was accomplished during summer 2008
- The aim was to investigate if the error frequency had decreased as a result of earlier change of transducers and if the error types were the same as in the first study
- The error frequency for the Stockholm area had decreased with an average value of 4,6 % compared with earlier results and the error types were dominated by delamination problems

# Conclusion

- Our basic study, 2004-2006, showed that 39.8 % of the transducers had functional failures, some of them were severe
- The follow-up study, 2008, showed an error frequency of 24,3 % in average for the Stockholm area, still a relative high percentage
- Tests of transducers on a regular basis is in our opinion a necessity in order to minimize the risk that defective transducers are in use in our hospitals, this shows also in the follow-up study. We recommend a test interval of 6 month in clinics with many scanning procedures.
- "Small" errors which do not affect the image quality in 2D very much, can result in large measuring errors in spectral and color Doppler
- Len's delamination problems can accelerate very fast
- It can be very difficult for a user to, from the 2D image alone, decide if the transducer is defective or not
- New and used transducers can have defects and must, because of that, also be tested before they are introduced in clinical use