Introduction

- Important to keep mean glandular dose (MGD) as low as reasonably achievable [1,2]
- MGD breast density-dependent [3-9]
- Without per-patient density measurement, crude assumptions often made for MGD estimation [7]
- Patient-specific MGD previously proposed, but only compared to manufacturer-reported dose [10]
- Vendors may use one of a variety of accepted dose models [3-6]
- Use of density for MGD estimation often unclear

Objective:

Compare patient-specific mean glandular dose (MGD) using volumetric breast density (VBD) measurements to MGD calculated according to population-average glandularity.

Method

Dose Model

- MGD for digital mammography (DM) and tomosynthesis (DBT) estimated by Dance et al. model [6-9]:

\[ \text{MGD (mGy)} = K \cdot g \cdot c \cdot s \cdot T \]

- Widely accepted model [11], which incorporates corrections for breast glandularity, according to the ‘c-factor’

- NHSBSP software v2.4 estimates DM and DBT by Dance et al. model [12]
- Typically used for patient dose surveys [13]
- Output compared to patient-specific MGD for over 1400 anonymized DM, and 500 DBT exams
- Dosimetry data (tube output, HVL, per anode/filter/kVp) used to calibrate MGD for both patient-specific and NHSBSP-estimated values

Breast Glandularity

- VBD measured using Volpara algorithm v1.5.2.0 [14]
- Glandularity estimated in NHSBSP software by Dance model, according to age and breast compressed thickness [7, 11]
- VBD transformed to % glandularity by weight to match Dance breast model conditions [6, 10]

Results

Table 1. Patient dose calculated using Volpara v1.5.2.0 vs NHSBSP v2.4. All differences were significantly different than zero, p<0.05.

- Excellent correlation found between MGD using our method and NHSBSP software
- MGD values vary based on c-factor

<table>
<thead>
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<th>Vendor</th>
<th>Imaging System</th>
<th>DM / DBT</th>
<th>Imaging System</th>
<th>DM / DBT</th>
<th>Volpara-to-NHSBSP Pearson Correlation</th>
<th>Mean MGD Difference (min, max) [%]</th>
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<td>DM</td>
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<td>Tomo</td>
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</table>

Conclusions:

- Compared to using population averages, personalized MGD estimates that incorporate breast density measurement can result in substantially different dose estimates.
  - MGD calculated using patient-specific breast density ranged from about ±20% of that via population averages
  - MGD tended to be underestimated for low thickness breasts by population-based model
  - Practical to estimate patient-specific MGD with automated VBD measurement
  - Patient-specific MGD could be important for accurate radiation risk estimation, stratification to different screening modalities

Disclosures:

- Melissa Hill provides scientific consulting services for Volpara Health Technologies Ltd.

References

11. van Engen, R et al., EUREF, 2013.