24 September 2020
Published by Hong Kong Breast Cancer Foundation

***Hong Kong Breast Cancer Registry Report No. 12* Press Conference**

How to Choose the Right Breast Cancer Detection Tool for Yourself

The Hong Kong Breast Cancer Registry (HKBCR) published its 12th annual research report at a press conference today (24 Sep 2020), along with a study that utilised data collected from 17,139 breast cancer patients. The study shed light on the characteristics of the commonest breast cancer detection tools, providing evidence-based reference for local women to choose the right detection tool for themselves. This in the long run would enhance their chance of early detection of breast cancer.

Mammography performed alongside breast ultrasound boosts screening accuracy

The Government revised its breast cancer screening policy in July this year that it now suggests women with average risk of having breast cancer to undertake mammography once every two years if they harbor certain breast cancer risk factors. The advantage of mammography is that it can detect tumours which are not fully developed or are at an early stage. A breast ultrasound, on the other hand, are often effective until the tumour takes shape.

Despite the advantages, some studies showed that breast tissues with higher density may render it difficult for 2D mammography x-rays to see through, making the image produced not clear enough to determine whether an abnormal finding is malignant. Women of Asian descent (especially younger ones) often have high breast density. This sparks controversies within the local medical sector, as well as women, as to whether mammography is preferable.

This study comprised the data of 17,139 local breast cancer patients the HKBCR collected since 2006. It was found that when performed alone, mammography had an accuracy of 85.2%; when performed with breast ultrasound, detection accuracy rose to nearly 95%. The surge is even more significant among young women who have high breast density.

Dr. Hung Wai-ka, Chairman of the HKBCF Breast Health Centre Advisory Committee and member of the HKBCF Management Committee explained: “Instead of comparing performance of mammography or breast ultrasound, I would rather say that they complement each other and when performed together, they can boost breast cancer detection rate considerably. To detect breast cancer at the earliest possible time, young women with high breast density should consider taking mammography and then breast ultrasound.”

Ah Yu was diagnosed with breast cancer in her 40s. Before her diagnosis, she had felt something wrong in her breast. Three months later, she went to HKBCF’s Breast Health Centre for mammography screening on her husband’s recommendation. At the time, mammography was not able to confirm her abnormality as breast cancer, so she was arranged for a breast ultrasound session during which she was eventually diagnosed. Under the COVID-19 pandemic, Ah Yu had to make travels to the hospital for chemotherapy, which gave her immense pressure. She hoped that women can take the initiative to have their breasts checked regularly and urged them to seek immediate medical advice should any abnormalities occur.

Ms. Wong, in her 50s, has had the habit of undertaking regular breast screening. She was diagnosed on her second visit to regular screening. On the day of diagnosis, she undertook mammography twice, both of which showed abnormality, though her breast ultrasound result found nothing. She was diagnosed with stage 0 breast cancer (DCIS) and now recovered after breast conserving surgery and radiotherapy.

The four breast cancer detection tools

To some women, they may be hesitant to have many breast cancer detection tools to choose from. Some even think regular body check can replace breast health screening. **Prof. Winnie Chu**, Professor of Department of Imaging and Interventional Radiology, CUHK and Prince of Wales Hospital, introduced the tools at the conference: "The more common breast cancer detection tools are 2D and 3D mammography, breast ultrasound, and Magnetic resonance imaging (MRI). MRI are mostly performed on women at high risk of having breast cancer; while mammography suits women at average risk since it can discover early micro-calcification and help breast cancer diagnosis at large."

"From 40 years old on, women should undertake breast health screening every two years," **Prof. Chu** added. "3D mammography can take multiple images of breast tissues from different angles and thus produce a more accurate screening result."

Government revised its screening policy but has yet to roll out any measures

The HKBCF made a policy address submission respectively in 2018 and 2019, advocating the phased implementation of population-wide breast screening programme. Although the Government revised its breast screening policy in July 2020 that it now suggests women with average risk of breast cancer to undertake mammography once every two years, there is so far no screening measures in place. **Mrs. Eliza Fok**, Chairman of the HKBCF, reiterated the three phases of implementing population-wide breast screening: first, put in place a regular screening programme for high risk women; secondly, a pilot screening programme for women residing in districts with lower household income, higher rate of advanced stage breast cancer and lower screening rate; and thirdly, a population-wide breast screening programme.

Mrs. Fok said: "Since the Government has not yet rolled out any concrete measures regarding breast screening, the HKBCF hopes that with this study, women can understand the benefits of the existing breast cancer detection tools and make the best choice for themselves."

In Hong Kong, the number of breast cancer cases is constantly on the rise and exceeds 4,300 in 2017. The Hospital Authority (HA) has set up the Hong Kong Cancer Registry (HKCaR) to collect data of different local cancer cases. Their focus is nonetheless on the number of new cases, death toll and average age of diagnosis, etc.

The HKBCR was founded in 2007. Throughout these 13 years, the HKBCR has captured data relevant to the patients' background, breast cancer screening habits, clinical characteristics, etc. The studies would help develop treatment options and healthcare policies best suited to the local situation. On average, the HKBCR are able to capture 40% of local breast cancer cases every year.

Dr. Polly Cheung, founder of the HKBCF and Chairman of HKBCR Steering Committee said: "Due to the pandemic, external personnel are restricted into and out of local public and private hospitals and clinics. This poses immense challenge to our staff who are responsible of collecting first-hand breast cancer patient data." Now that the pandemic is gradually subsiding, the HKBCF hopes that it can expedite its data collection process and that we can work closely with HA and private hospitals in achieving this.

Please go to this link for the event press release, slides, bulletins and photos:
https://drive.google.com/drive/folders/1JIpKMXd06SuKwdcpnr-fR0QK3TkFPCWL?usp=sharing

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Hong Kong Breast Cancer Registry No. 12
Press Conference

How to choose the right breast cancer detection tool for yourself

24 September 2020

HKBCF

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Overview

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Hong Kong Breast Cancer Registry
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1. Updates on HK Breast Cancer Registry
   - Dr. Polly CHEUNG, Founder of Hong Kong Breast Cancer Foundation, Chairman of Hong Kong Breast Cancer Registry Steering Committee

2. Breast Cancer Imaging
   - Professor Winnie Chu, Department of Radiology, Faculty of Medicine, The Chinese University of Hong Kong, Prince of Wales Hospital

3. Diagnostic performance of Breast Imaging in breast cancer –data from HKBCR
   - Dr. Wai-ka HUNG, Member of Hong Kong Breast Cancer Foundation Management Committee, Chairman of Breast Health Centre Advisory Committee

4. Conclusion and Recommendation
   - Mrs. Eliza FOK, Chairman of Hong Kong Breast Cancer Foundation

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Updates in HK Breast Cancer Registry

Dr. Polly CHEUNG

Founder of Hong Kong Breast Cancer Foundation
Chairman of Hong Kong Breast Cancer Registry Steering Committee

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Female breast cancer in Hong Kong 2017

	Incidence	Mortality
Number of cases registered	4,373	721
Rank	1	3
Proportion of all cancers	27%	12.3%
Median age (years)	57	60
Age-standardized rate [ASR][1]	62.9	9.4
Average annual percent change of ASR over the past 10 years[2]	+2.5%	+0.5%
Lifetime risk before age 75	1 in 15	1 in 97

1 Rates are standardized to the age distribution of the World Standard Population of Segi (1960). Comparisons with these rates from other sources are valid only under the same standard population for calculations.
2 Average Annual Percent Change of ASR over the past ten years is estimated based on the recent 25 years of available data.

Source: Hong Kong Cancer Registry

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Breast cancer – biggest cancer threat to Hong Kong women

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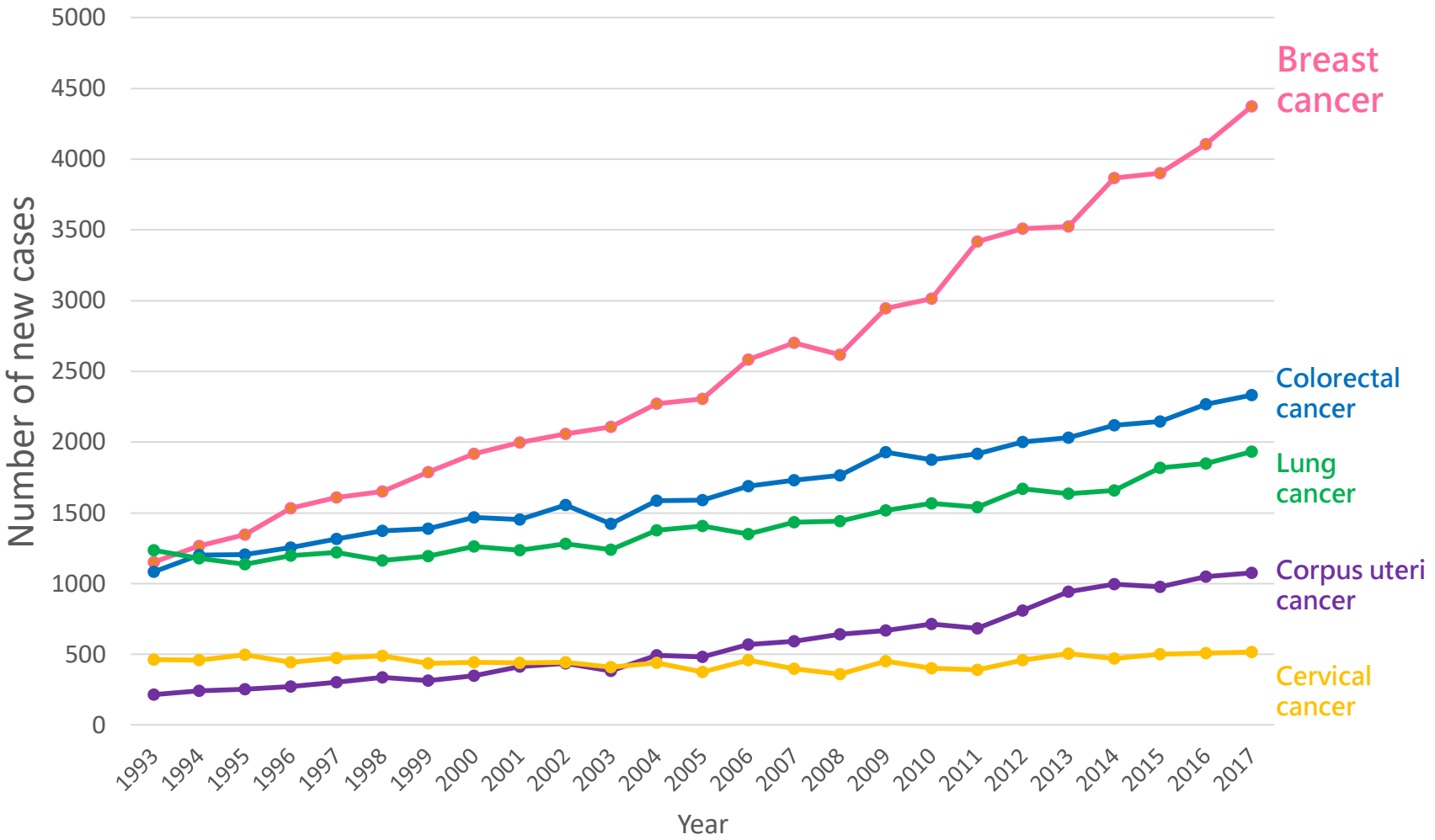

Hong Kong Cancer Registry 2017

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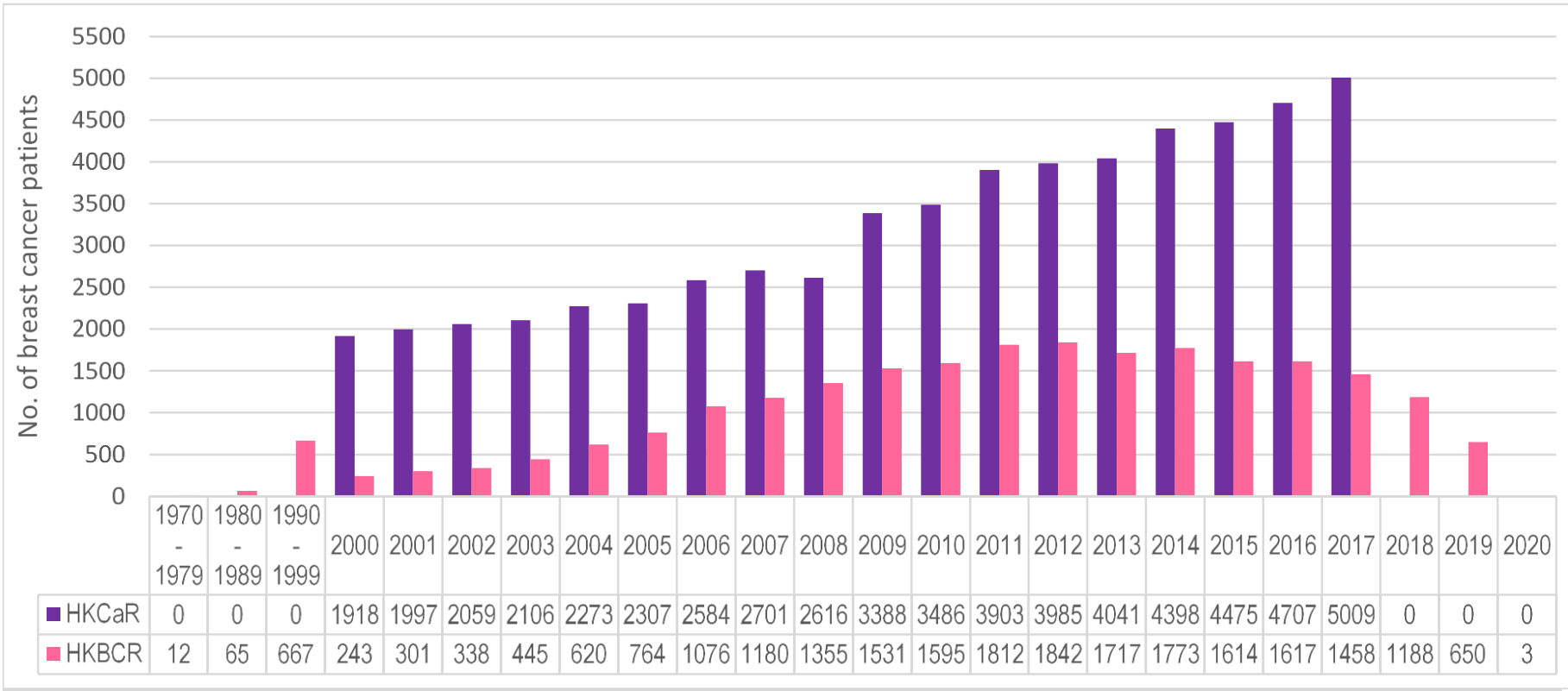
Distribution of Year of Diagnosis of HKBCR Participants



	1970 - 1979	1980 - 1989	1990 - 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
HKCaR	0	0	0	1918	1997	2059	2106	2273	2307	2584	2701	2616	3388	3486	3903	3985	4041	4398	4475	4707	5009	0	0	0
HKBCR	12	65	667	243	301	338	445	620	764	1076	1180	1355	1531	1595	1812	1842	1717	1773	1614	1617	1458	1188	650	3
HKBCR/HKCaR, %	N/A	N/A	N/A	12.7	15.1	16.4	21.1	27.3	33.1	41.6	43.7	51.8	45.2	45.8	46.4	46.2	42.5	40.3	36.1	34.4	29.1	N/A	N/A	N/A

Total no. of participants as of Feb 2020 = 23,886

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HKBCR – Wide coverage of participating centres

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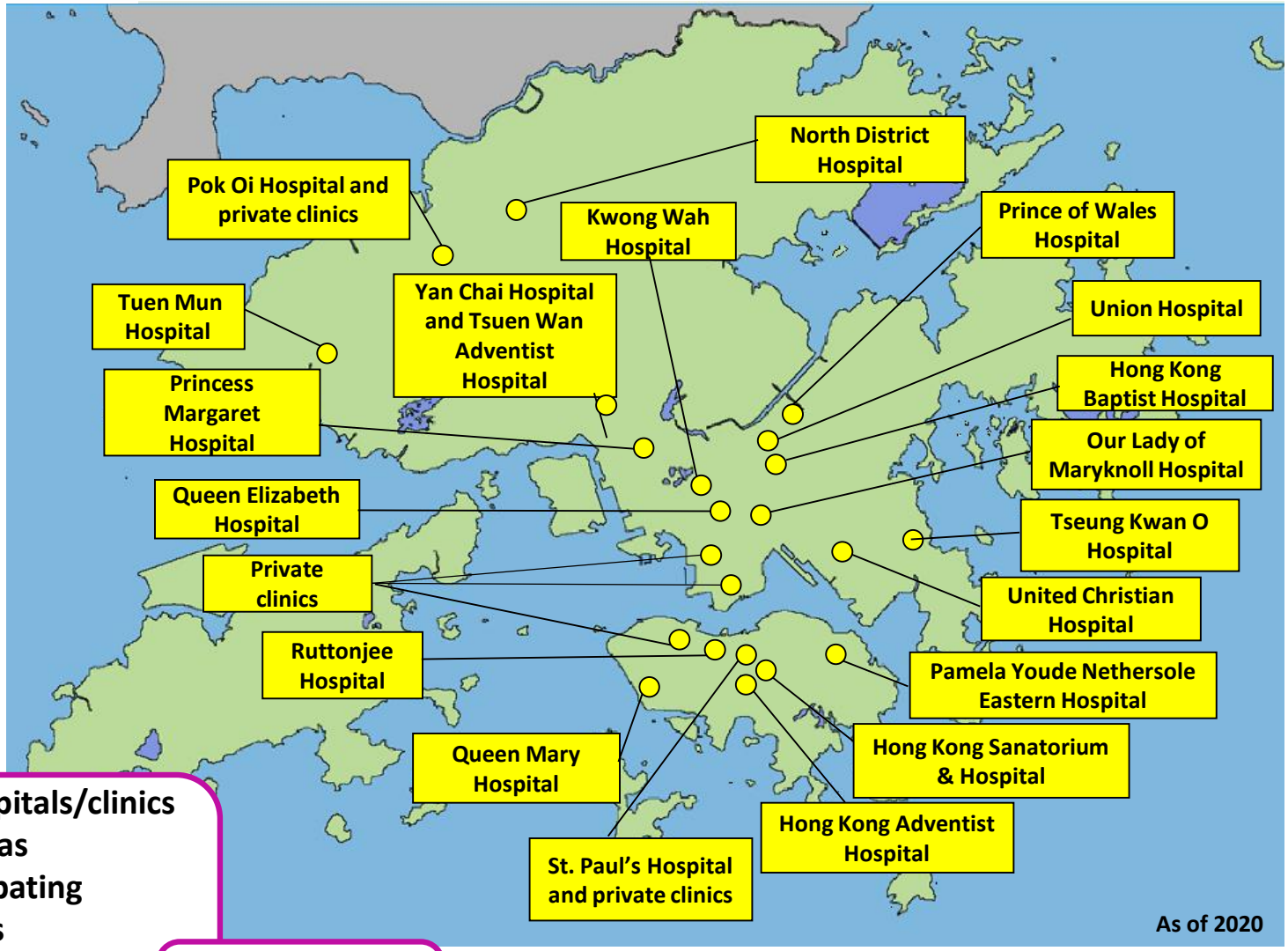

62 hospitals/clinics joined as participating centres

23,886 patients have registered

Public: **74%**
Private: **27%**

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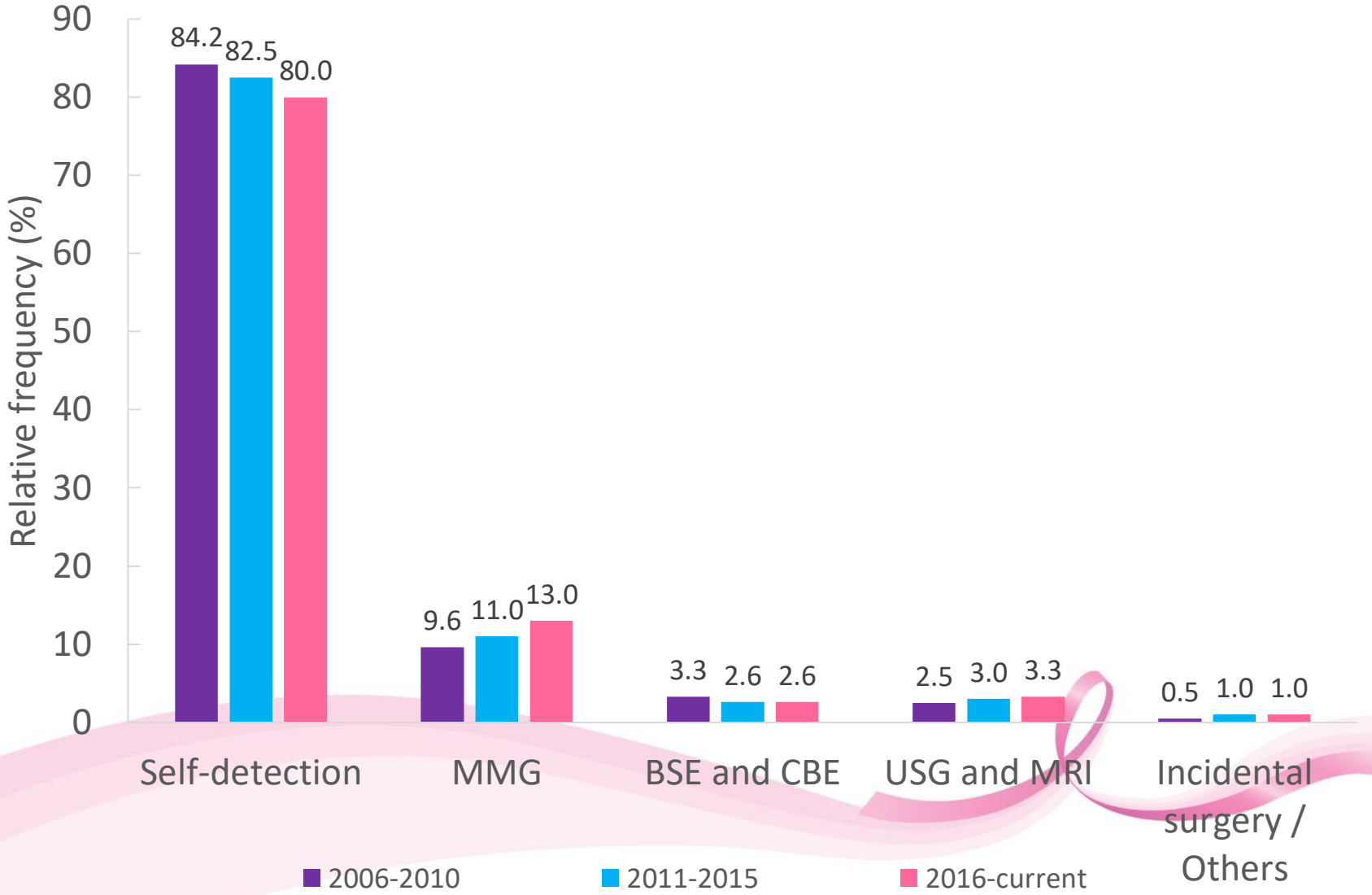
Method of First Breast Cancer Detection



Diagnostic tests for breast cancer

Proportion of patients using the test	2006-2010 (N=6884)	2011-2015 (N=8761)	2016-current (N=3998)
Breast Imaging			
Mammography	83.6%	86.4%	87.7%
ULtrasound	77.1%	81.5%	85.4%
MRI	6.0%	11.8%	12.3%
Breast Tissue Biopsy			
Fine needle aspiration	47.1%	37.6%	28.8%
Core needle biopsy	52.7%	70.5%	80.0%
Excisional biopsy	13.7%	9.0%	4.8%

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Summary

- Most patients first detected breast cancer by feeling breast lumps
- Detection of asymptomatic breast cancer through screening mammogram is a minority
- Majority of patients undergo breast imaging and tissue biopsies to make a diagnosis of breast cancer

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Imaging tests for breast cancer

Professor Winnie Chu
Professor of Radiology
Chinese University of Hong Kong
Prince of Wales Hospital

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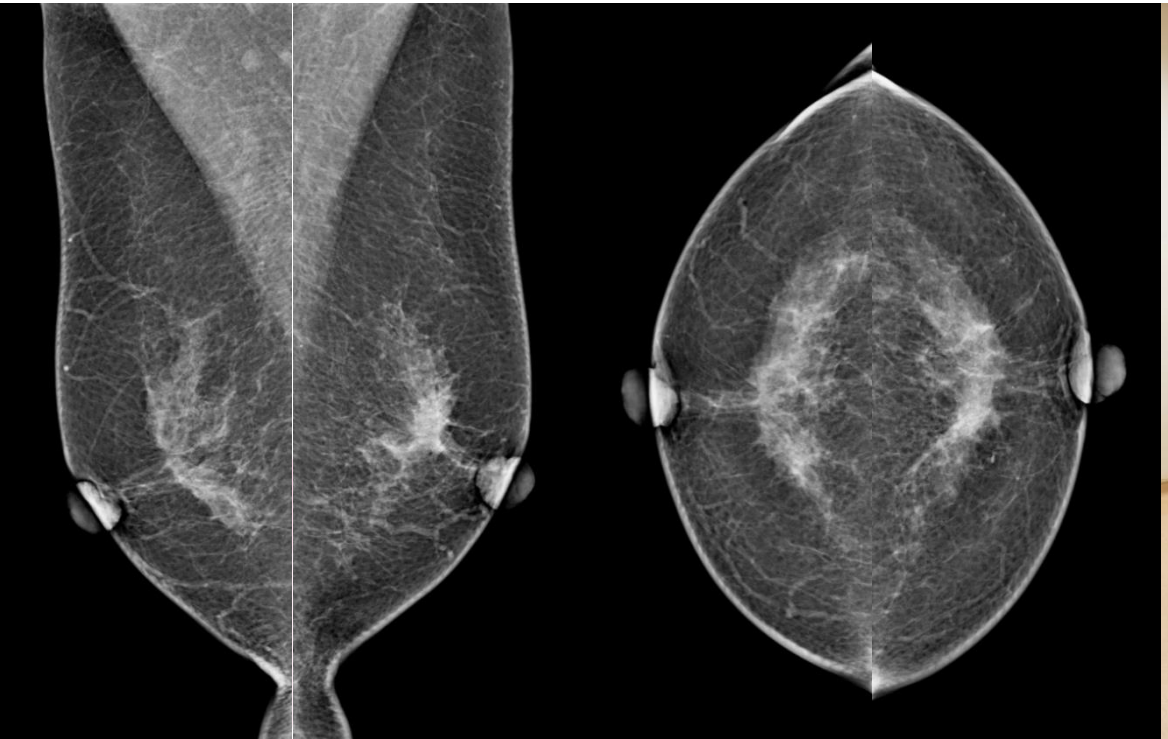
Digital Mammography

General recommendation for screening:

- 1-2 yearly for women aged 45 – 75
- Can be as early as age 40
- No upper age limit, as long as a woman is in good health



American Cancer Society®

ACOG
The American College of Obstetricians and Gynecologists

ACR®
American College of Radiology

ACP
American College of Physicians
Leading Internal Medicine, Improving Lives

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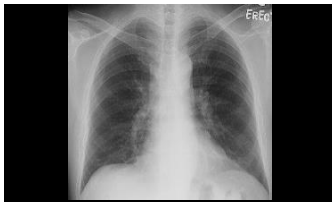
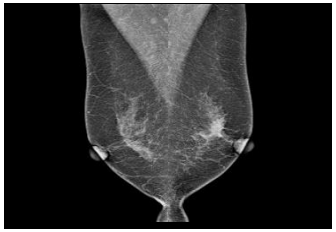
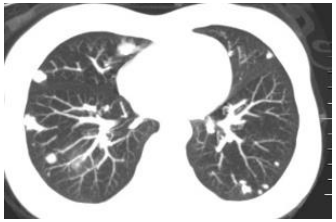
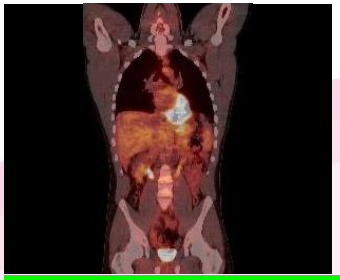
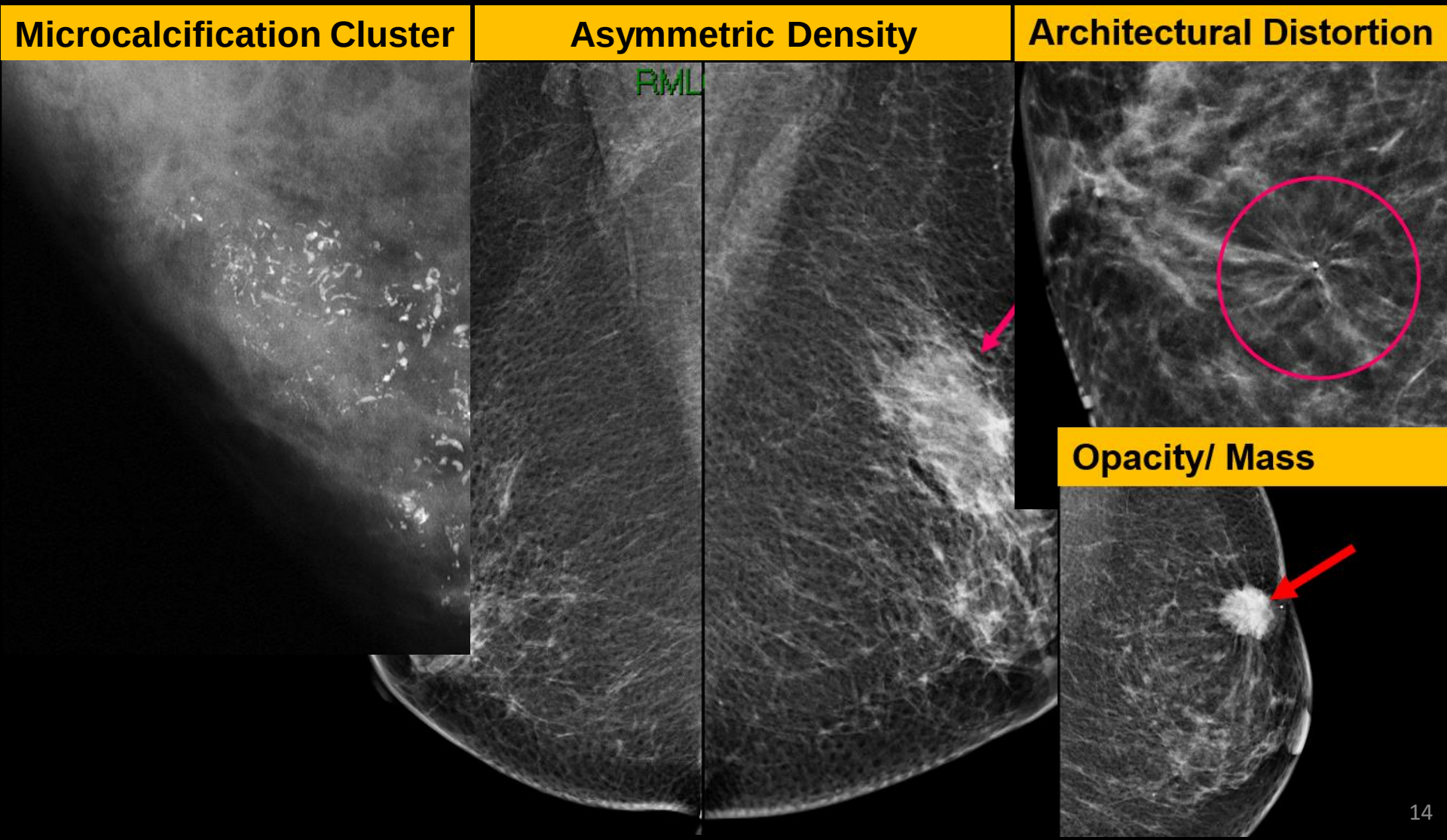
Typical Medical Radiation Doses

	Effective Dose (mSv)	CXR Equivalents	Natural Background Radiation
 Chest X-ray	0.1	1	10 days
 Mammography	0.4	4	7 weeks
 Chest CT- Diagnostic	7	70	2 years
Chest CT- Low dose for screening	*1.5*	*15*	*6 months*
 Whole body PET CT	25	250	10 years

Natural Background Radiation in Hong Kong ~ 3 mSv
** Annual radiation exposure dose limit = 50 mSv*

RadiologyInfo.org For patients RSNA ACR
For the most current information, visit radiologyinfo.org.

Mammographic Features of Breast Cancer



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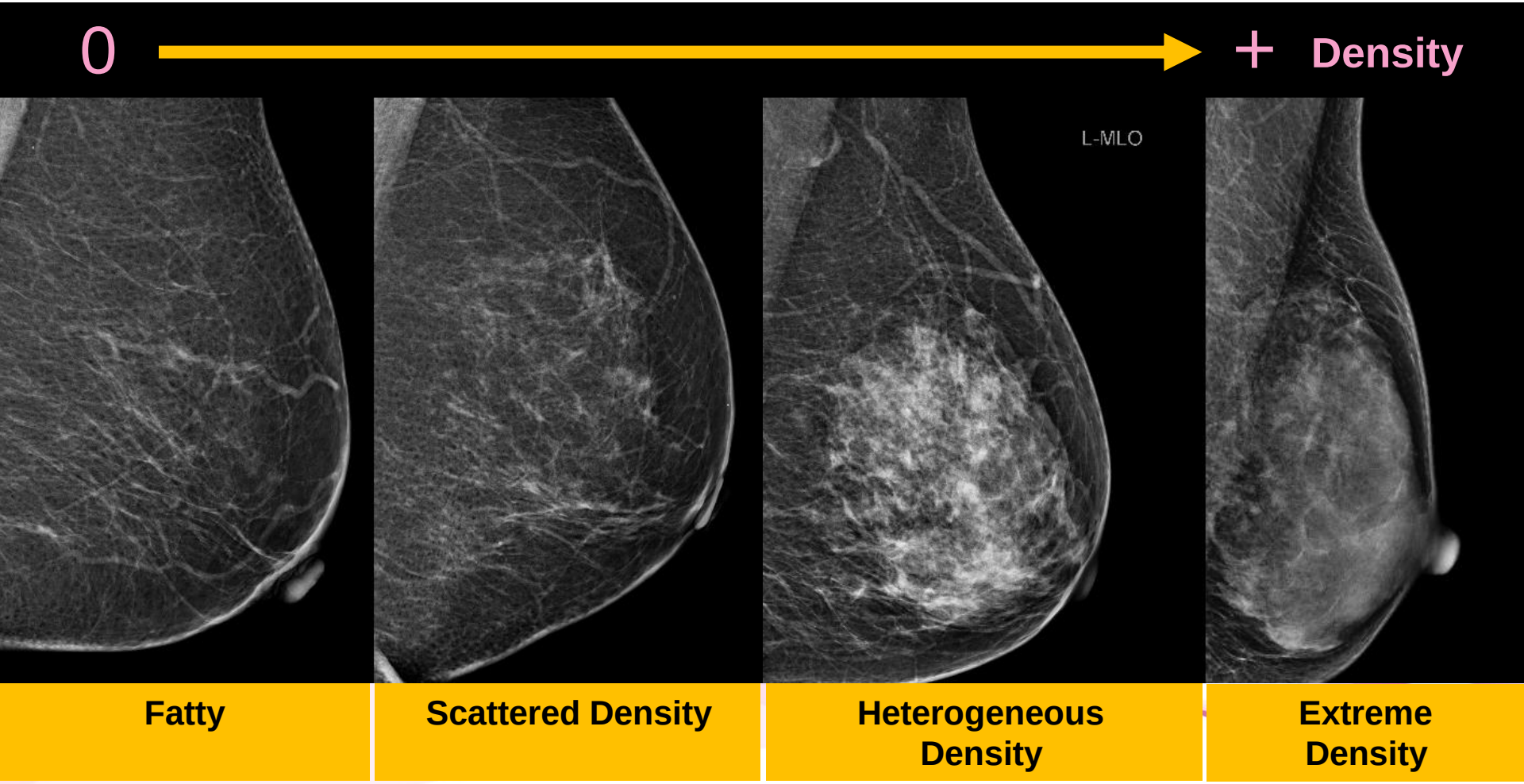
Breast Density



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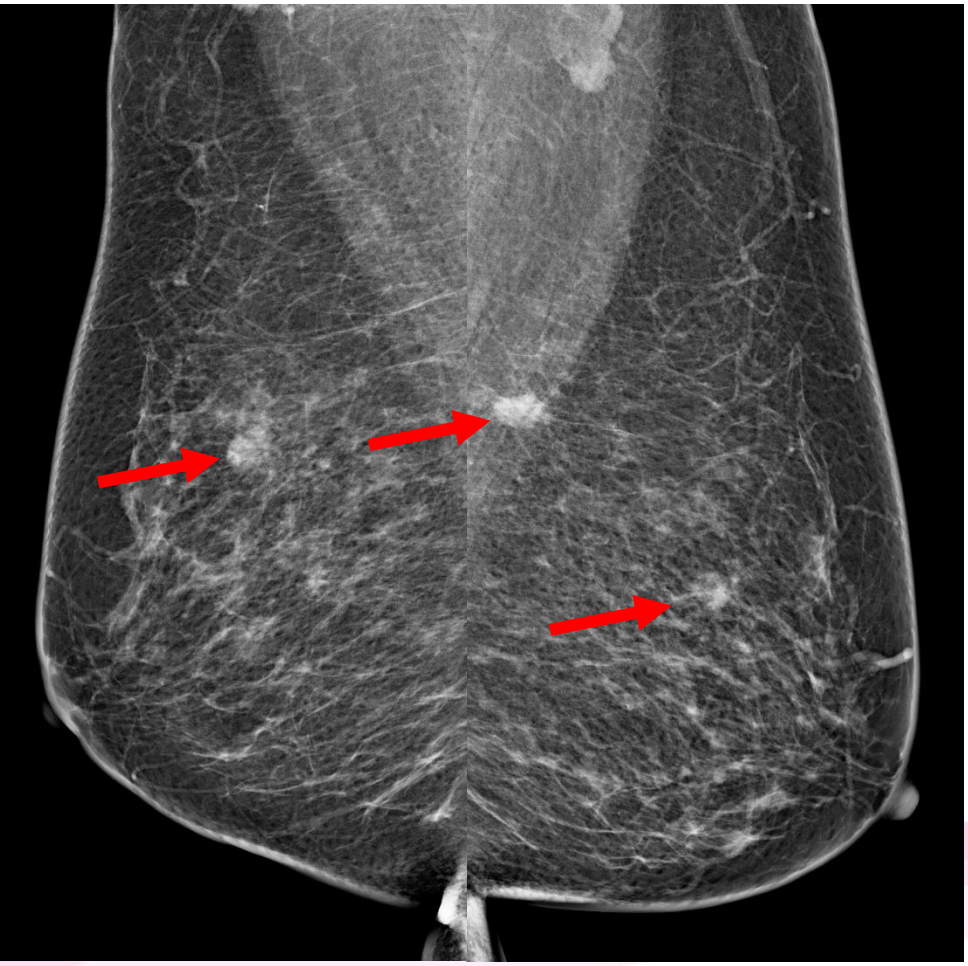
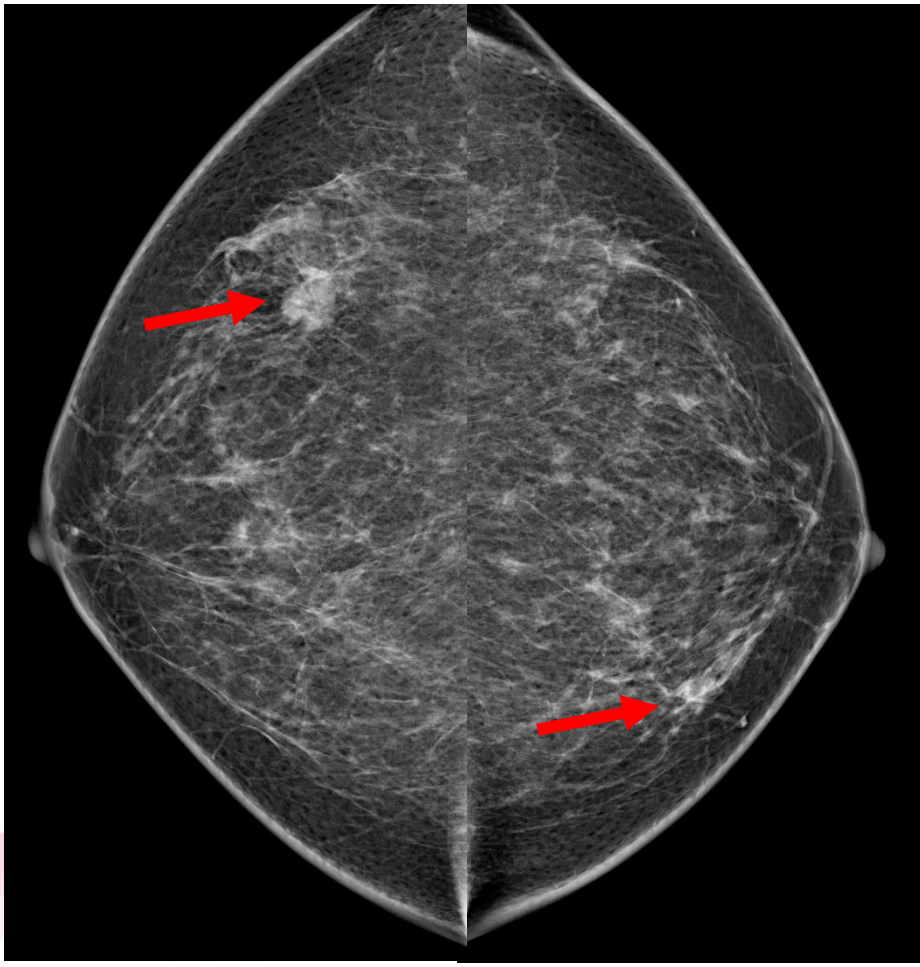
Detection is easy if ….





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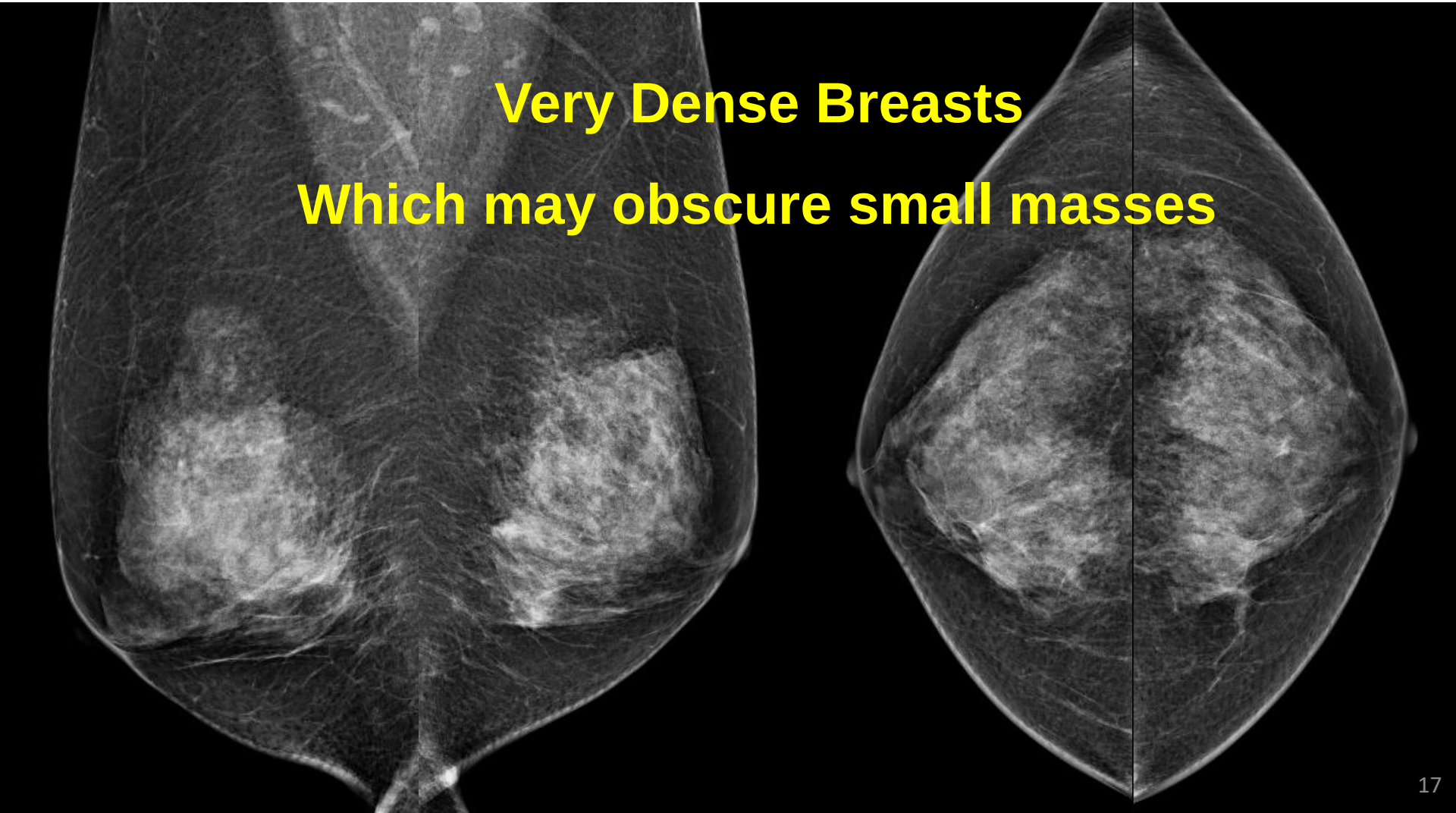
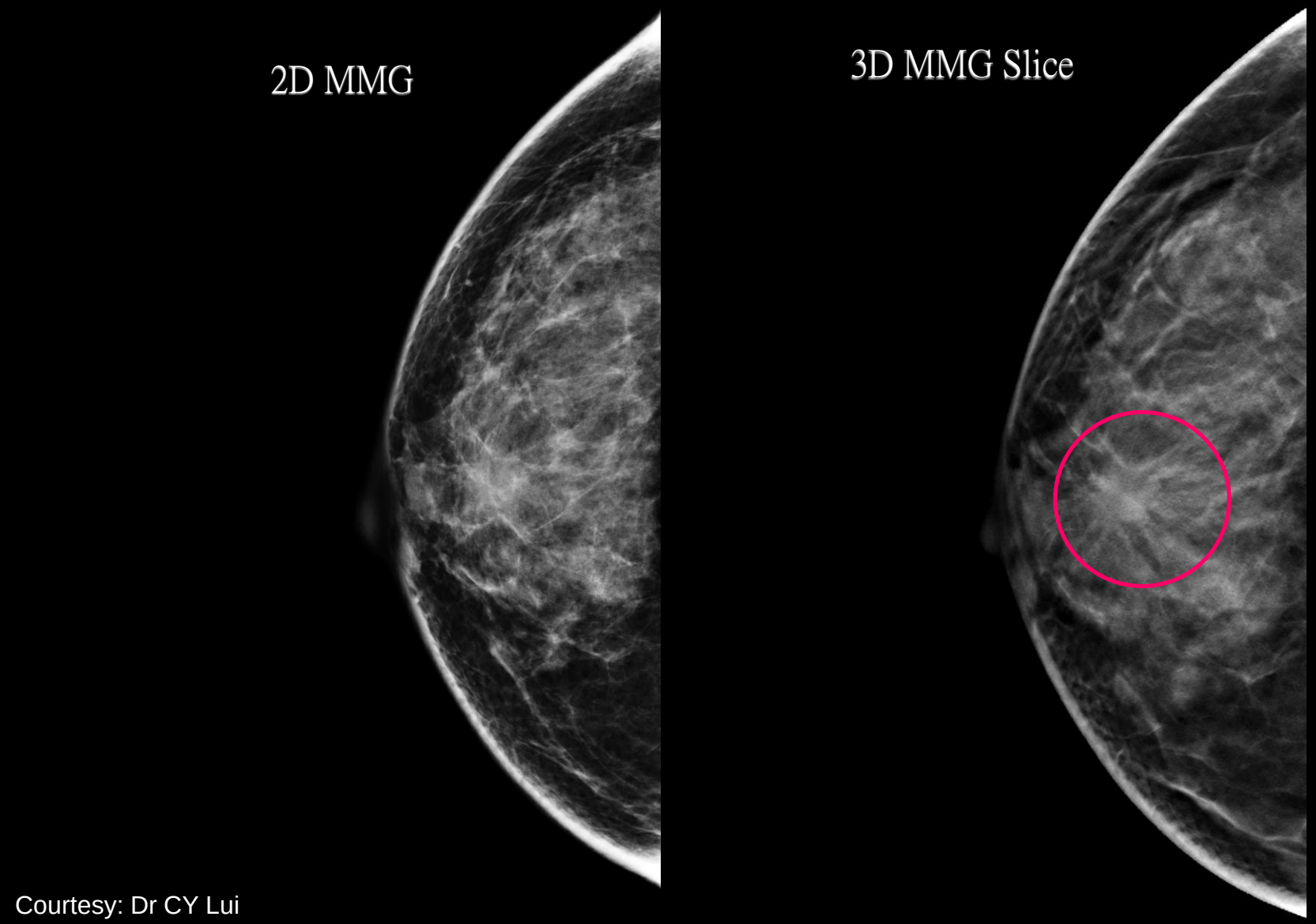
Life is Not so Simple….

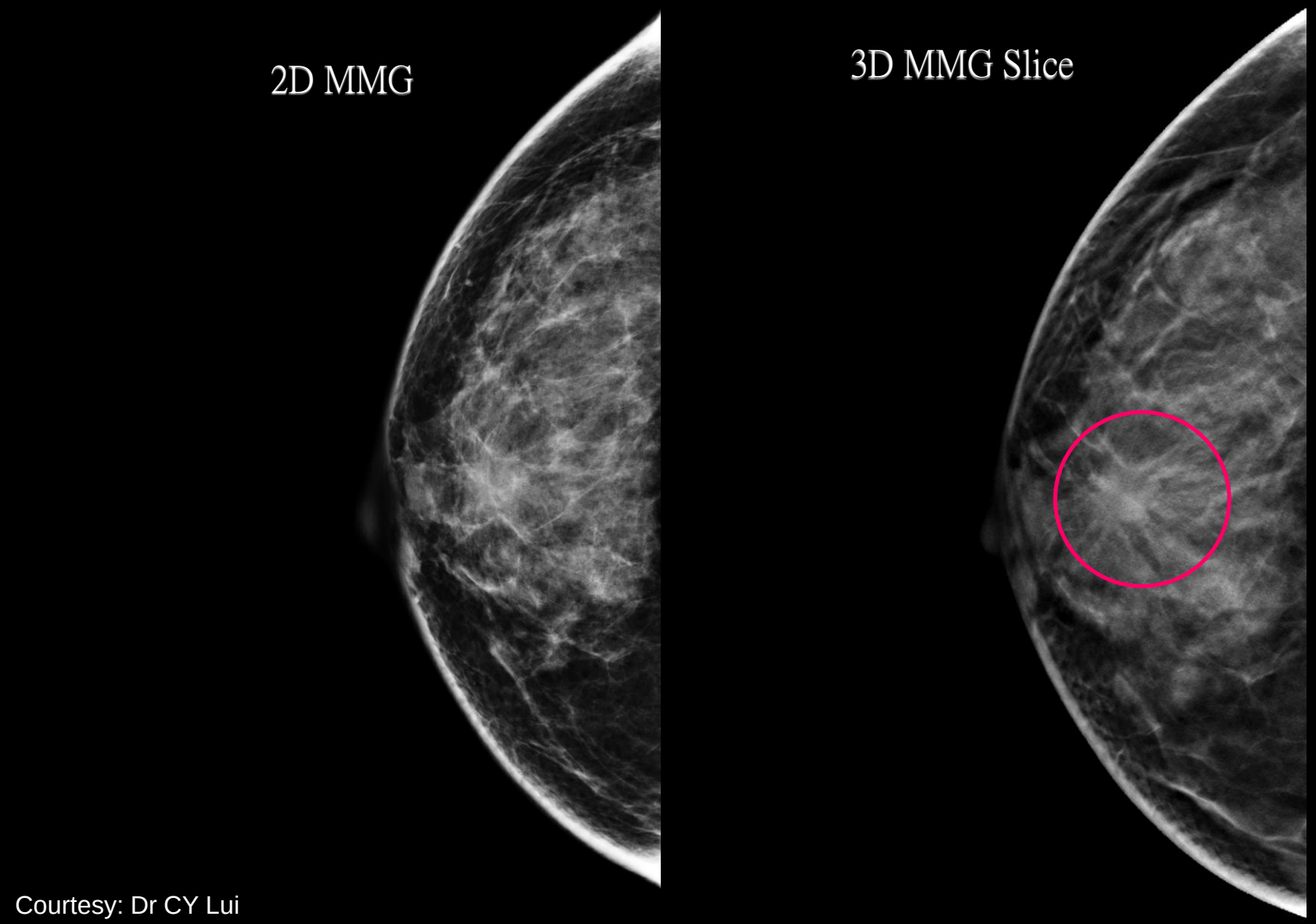


3D MMG can detect cancers that could be obscured in 2D MMG



Courtesy: Dr CY Lui

3D MMG can detect cancers that could be obscured in 2D MMG



Courtesy: Dr CY Lui

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3D Mammography/ Tomosynthesis

Advantages:

- Better sensitivity **(84%-90%)**
- Improve cancer detection rate
  (incremental 2.7 cancers per 1000 screens)
- Fewer recall **(reduced by 17·2%)**
- Less breast compression **(less discomfort)**

Phi et al. BMC Cancer (2018)
Ciatto et al, Lancet Oncol (2013)

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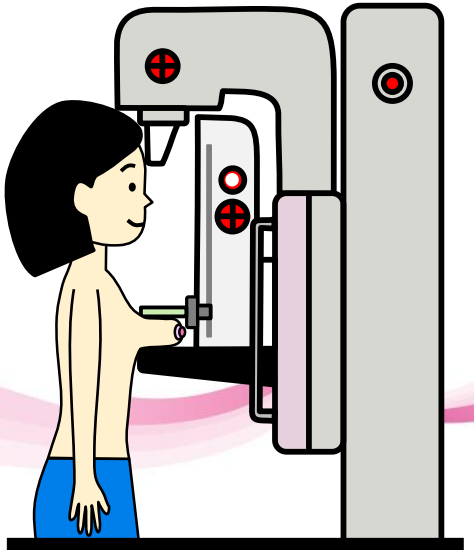
Hong Kong College of Radiologists Statement

- Full field mammography is the standard of care
- Advanced Technology such as 3D Mammogram/ Digital Breast Tomosynthesis (DBT) has better detection rate, reduction in recall rate and false positive rate

https://www.hkcr.org/



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Hong Kong College of Radiologists Statement

- Mammography service should be of good quality in order to maximize its benefit and to reduce the risk of ineffective radiation exposure
- Mammography should be performed with a dedicated mammography machine, operated by a trained radiographer and reported by a trained radiologist

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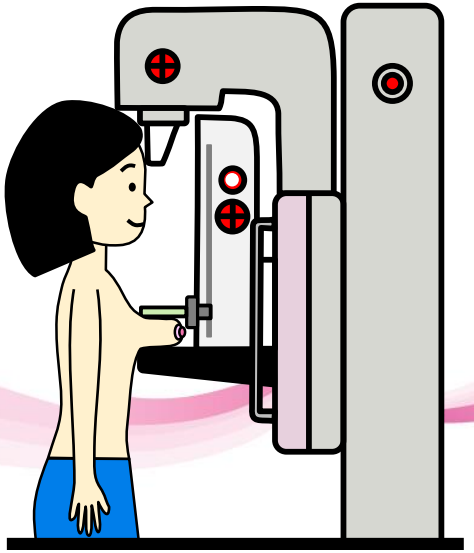

Hong Kong College of Radiologists Statement

- Other imaging modalities are complementary to mammography
- **Ultrasound:**
  - Indicated for mammographic and palpable abnormalities
  - Not effective of routine screening
    - not whole breast imaging at once, cannot detect microcalcifcations
  - Adjuvant to mammograms for women with dense breasts

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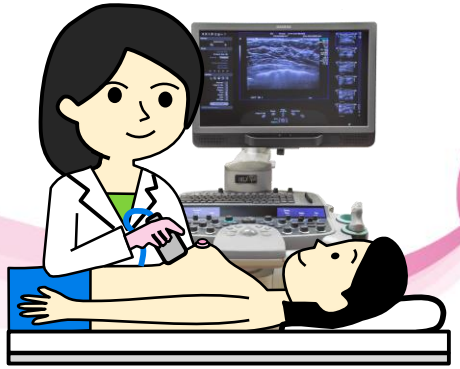

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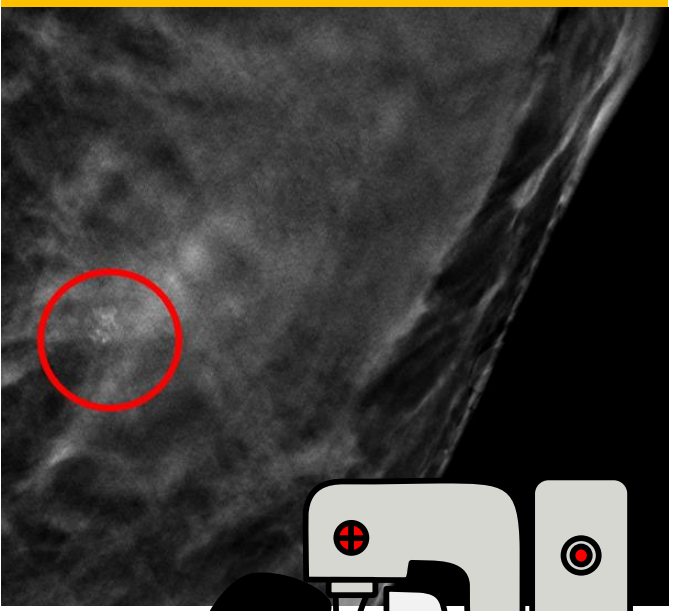
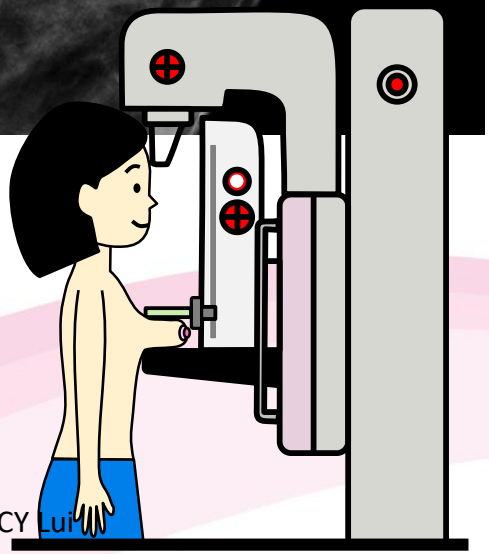
Ultrasound

Abnormality on MMG Or palpable mass	Ultrasound confirmation	Ultrasound-guided biopsy for tissue

3D Mammogram
- Vacuum Assisted Biopsy

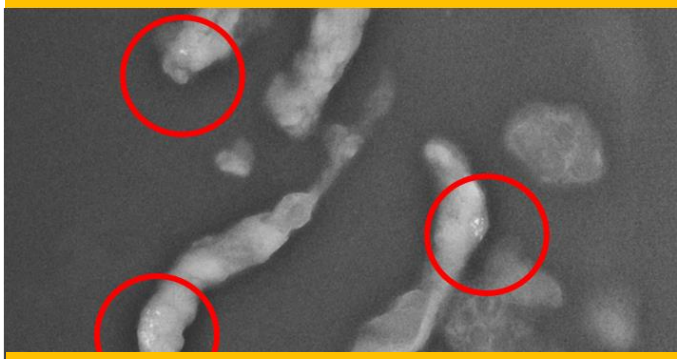
Microcalcifications Confirmed on Tomo



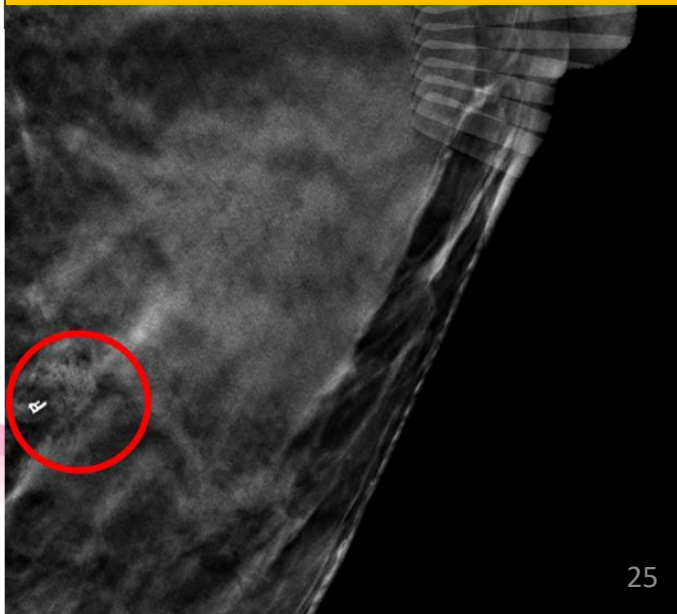


Target Confirmed at Biopsy

Specimen XR confirms removal of calcifications



Marker post biopsy confirms removal of calcifications



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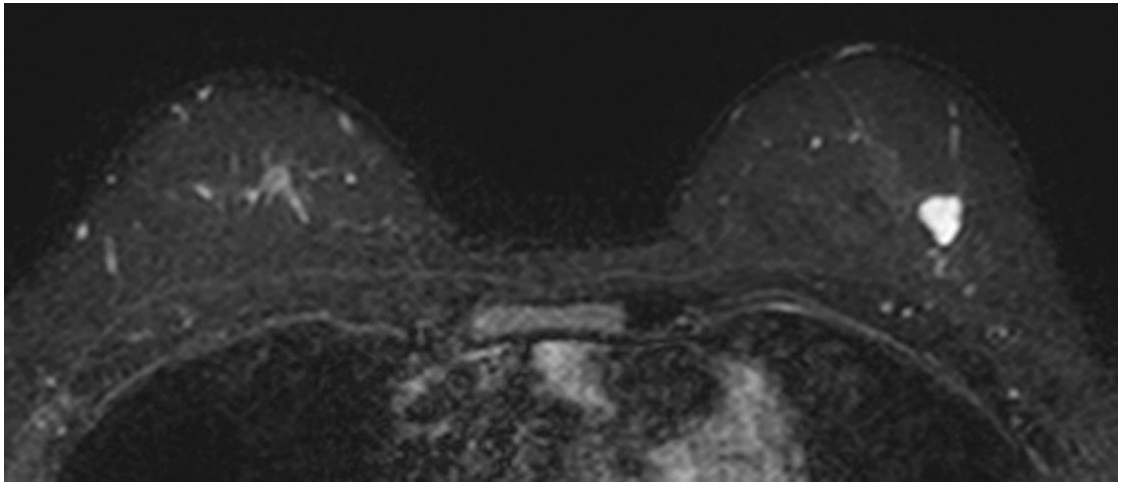
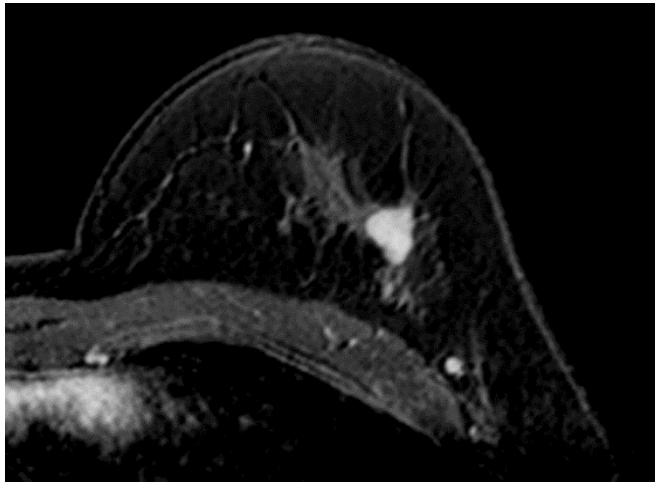
Magnetic Resonance Imaging

- This option is mainly reserved for problem solving, staging, treatment response
- For women at high risk of breast cancer





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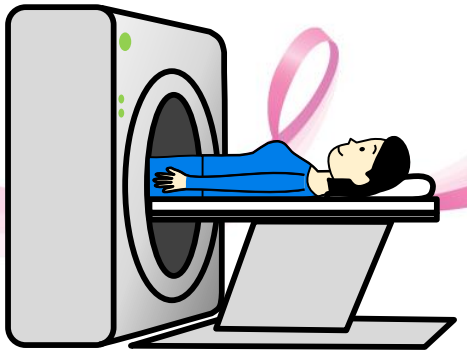

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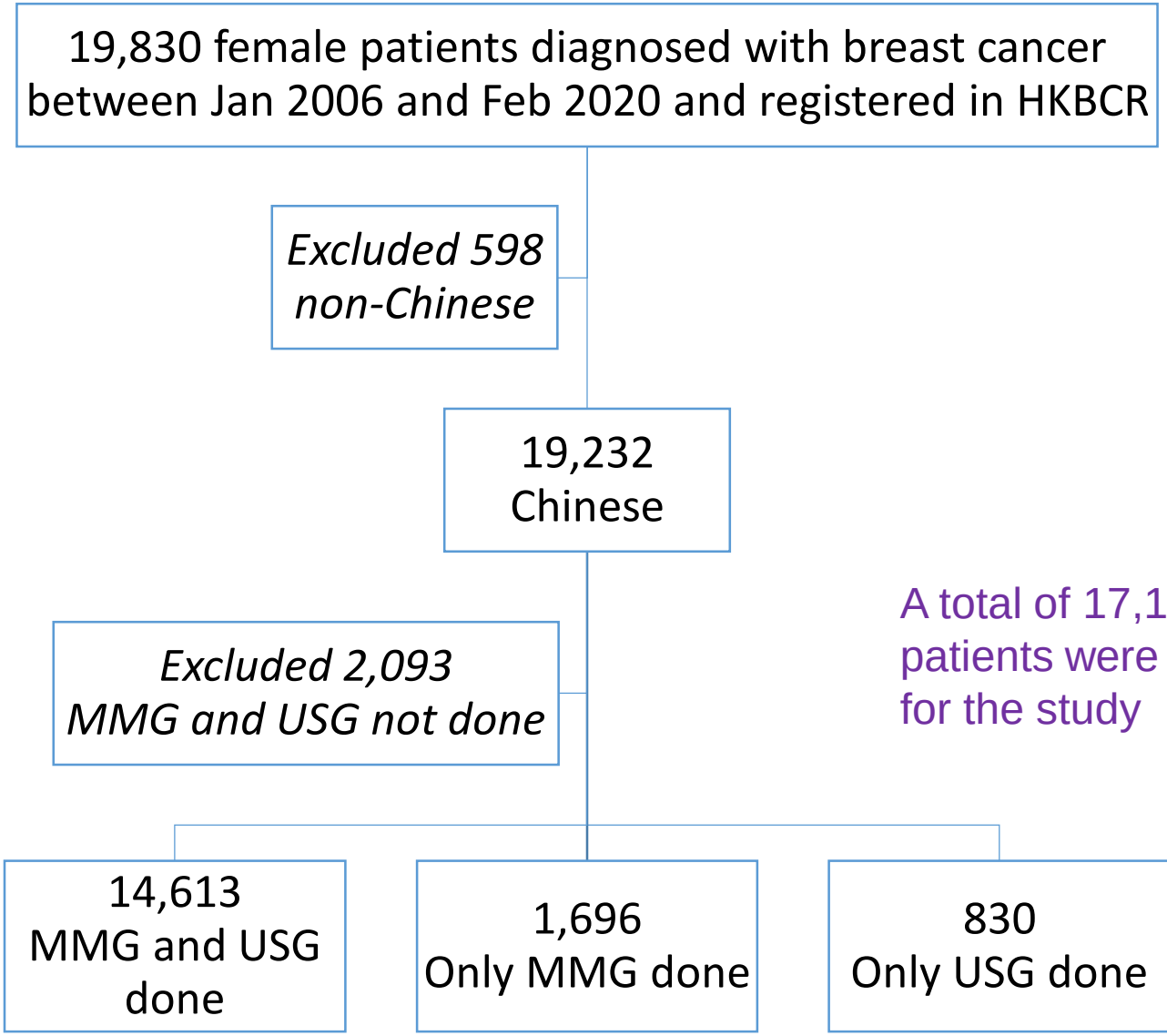
Imaging Diagnosis of Breast Cancer – data from HK Breast Cancer Registry

Dr. Wai-ka HUNG
Member of Hong Kong Breast Cancer Foundation Management Committee
Chairman of Breast Health Centre Advisory Committee

Aim of study

- Evaluate the diagnostic performance of mammogram (MMG) and breast ultrasound (USG) in breast cancer patients
- Examine the complementary role of MMG and USG in diagnosis of breast cancer

Method of study



A total of 17,139 patients were eligible for the study

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Method of study

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- Period of study: Jan 2006 - Feb 2020
- Number of cases included: 17,139
  - done MMG and/or USG

- Among patients undertaken MMG and/or USG

	N detected	% accuracy
MMG (N=16,309)	13,899	85.2
USG (N=15,443)	14,198	91.9
MMG & USG (N=14,613)	13,777	94.3

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Diagnostic performance of MMG in all patients

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	Total no.	MMG+	MMG-	% accuracy	
Age (N=16,127)					
<40	1,360	1,077	283	79.2	
40-49	5,122	4,102	1,020	80.1	83.3%
50-59	5,364	4,689	675	87.4	
60-69	3,085	2,791	294	90.5	
≥70	1,196	1,090	106	91.1	90.7%
Breast density (N=11,232)					
Fatty	1,516	1,367	149	90.2	
Scattered density	993	875	118	88.1	89.4%
Heterogeneous density	7,890	6,642	1,248	84.2	
Extreme density	833	673	160	80.8	83.9%

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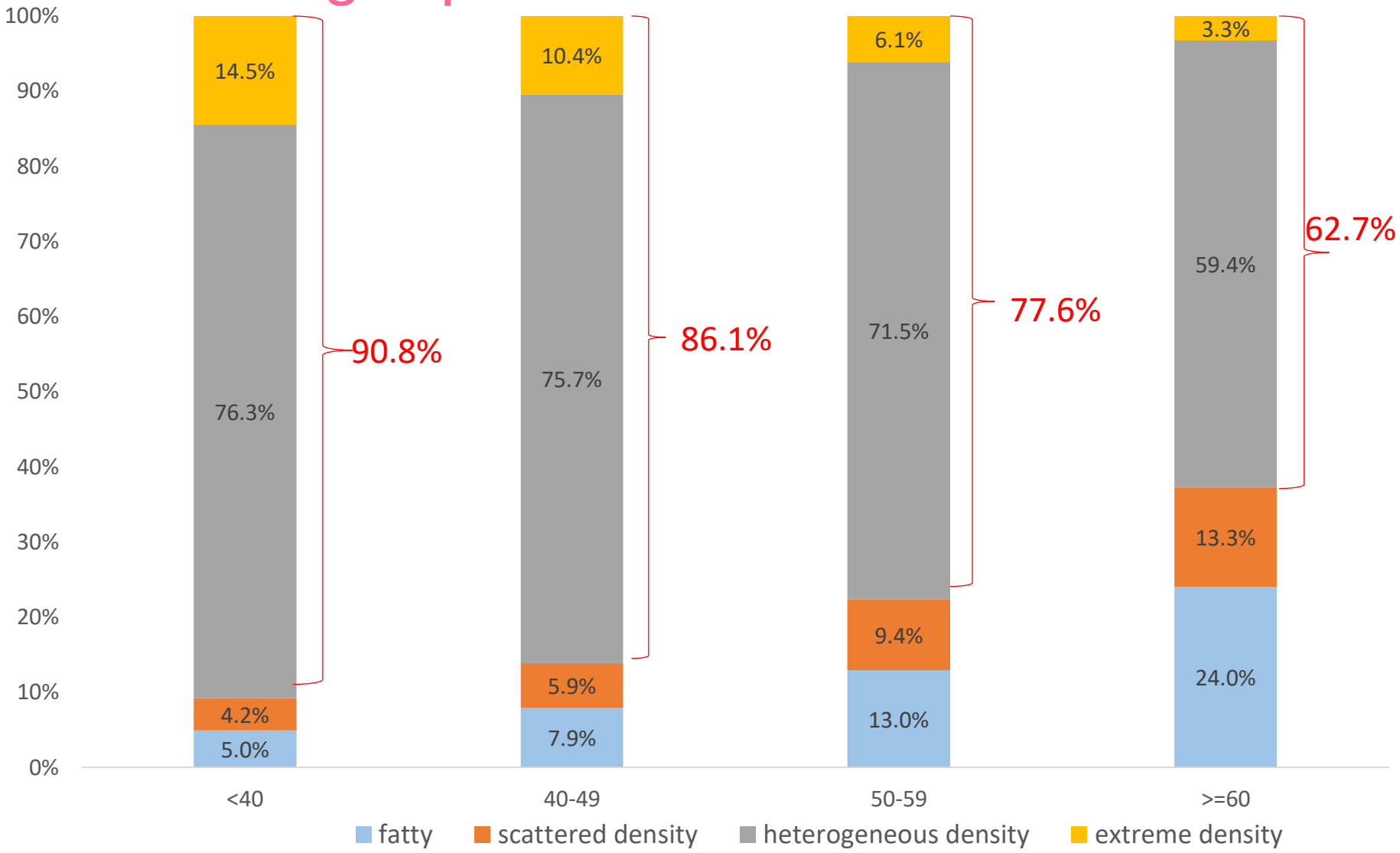
Younger patients had denser breasts



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Mammographic features observed (N=14,950)

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	Symptomatic (N=12,310)		Asymptomatic (N=2,640)		P value
	N	%	N	%	
Opacity only	4,474	36.3	556	21.1	<0.001
Microcalcifications only	1,931	15.7	1,080	40.9	<0.001
Opacity + microcalcifications	2,405	19.5	352	13.3	<0.001
Architectural distortion only	195	1.6	61	2.3	0.009
Asymmetric density only	441	3.6	69	2.6	0.013
Other findings	2,864	23.3	522	19.8	<0.001

Diagnostic performance of USG in all patients

	Total no.	USG+	USG-	% accuracy
Age (N=15,264)				
<40	1,393	1,229	164	88.2
40-49	4,846	4,350	496	89.8
50-59	4,998	4,636	362	82.8
60-69	2,881	2,729	152	94.7
≥70	1,146	1,094	52	95.5
Tumour size (N=11,486)				
≤1.00cm	1,723	1,450	273	84.2
1.01-2.00cm	4,245	3,988	257	93.9
2.01-5.00cm	5,101	4,932	169	96.7
>5.00cm	417	402	15	96.4

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Diagnostic accuracy of breast imaging for patients who have both MMG and USG done (N=14,613)

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	USG+	USG-	Overall
MMG+	12,131 (83.0%)	335 (2.3%)	12,466 (85.3%)
MMG-	1,311 (9.0%)	836 (5.7%)	2,147 (14.7%)
Overall	13,442 (92.0%)	1,171 (8.0%)	14,613 (100.0%)

85.3% cases are detected by MMG. With additional USG, 9.0% more cases are detected. In total, the combination of MMG and USG could detect **94.3%** cases.

Diagnosis of breast imaging for patients who have MMG and USG occult cancers (N=780)

	Overall (N=780)	Symptomatic (N=610)	Asymptomatic (N=152)
Magnetic Resonance Imaging+	105 (13.5%)	66 (10.8%)	36 (23.7%)
Fine needle aspiration+ Or Core biopsy+	506 (64.9%)	395 (64.8%)	99 (65.1%)
Excisional biopsy+	169 (21.7%)	149 (24.4%)	17 (11.2%)

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Summary

- MMG is accurate in detecting cancer in 85.2% , higher accuracy in older patients and fatty / scattered density breast
- USG is accurate in detecting 91.9% of cancer, higher accuracy in bigger tumour size
- In MMG negative cases, USG detected additional 9.0% improving the cancer detection rate to 94.3%
- 3D MMG may improve diagnostic accuracy of MMG

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Conclusion and Recommendation

Mrs. Eliza FOK
Chairman of Hong Kong Breast Cancer Foundation

Summary of study results

- We have a better understanding of breast imaging from Prof Chu
- Imaging test using MMG and USG is important in diagnosing breast cancer in HK
- All patients with symptoms should undergo imaging test for diagnosis
- 3D MMG may help improve cancer detection in dense breasts

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Revised government policy on breast screening July 2020

Women at	Risk Factors	Recommendation
High risk	BRCA 1/2mutation carrier or their family members Family history of first/second degree relative having breast/ovarian cancer, bilateral or male breast cancer Personal history of DCIS, LCIS, ADH, ALH	Mammography screening every year
Moderate risk	Family history of 1 first degree relative age <=50 or 2 first degree relative > 50	Mammography screening every two years
General population Aged 44-69	History of benign breast disease No childbirth/ FLB>=30 BMI (>23 kg/m2) Early menarche <=11 yr Lack of physical activity	Mammography screening every two years

At least 34 regions/countries implemented population-wide breast screening programmes

Region / Country	Year began	Age groups covered	Participation rate (2010)	% mortality reduction (age group)
Japan	1977	40-75+	19%	Data not available
United Kingdom	1988	50-69	73%	39% (47-73)
Canada	1988	50-69	47%	Data not available
Australia	1991	40-75+	--	41% (45-80)
United States	1995	40-75+	67%	Data not available
New Zealand	1998	45-69	68%	17% (45-74)
Taiwan	1999	40-69	38%	41% (40-69)
Korea	1999	40-75+	39%	Data not available
China	2009	40-59	Unknown	Data not available

3 steps towards population-wide breast screening

- Early detection saves lives
- Screening programs have been implemented for colorectal and cervical cancers in Hong Kong
- Breast cancer is the most common cancer threat for local women, the Government should roll out a screening program as soon as possible
- HKBCF advocates a three-phase implementation of population-wide breast screening:
  - firstly, to provide breast screening for high-risk women
  - secondly, to start a pilot screening programe in low-income districts
  - thirdly, to implement population-wide screening based on the experience gathered in the first two phases

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Thank you
Q&A

Hong Kong Breast Cancer Registry Report No. 12 & Bulletin

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Diagnostic accuracy of breast imaging for symptomatic patients who have both MMG and USG done (N=11,848)

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	USG+	USG-	Overall
MMG+	10,081 (85.1%)	127 (1.1%)	10,208 (86.2%)
MMG-	990 (8.4%)	650 (5.5%)	1,640 (13.8%)
Overall	11,071 (93.4%)	777 (6.6%)	11,848 (84.4%)

Among symptomatic cases,
86.2% cases are detected by MMG. With additional USG, 8.4% more cases are detected. In total, the combination of MMG and USG could detect **94.6%** cases.

Diagnostic accuracy of breast imaging for asymptomatic patients who have both MMG and USG done (N=2,191)

	USG+	USG-	Overall
MMG+	1,557 (71.1%)	199 (9.1%)	1,756 (80.1%)
MMG-	276 (12.6%)	159 (7.3%)	435 (19.9%)
Overall	1,833 (83.7%)	358 (16.3%)	2,191 (100.0%)

Among asymptomatic cases
80.1% cases are detected by MMG. With additional USG, 12.6% more cases are detected. In total, the combination of MMG and USG could detect **92.7%** cases.

Symptoms in patients who have MMG and USG occult cancers (N=809)

	N	%
Painless lump	511	63.2
Nipple discharge	125	15.5
Pain	32	4.0
Nipple retraction	9	1.1
Changes in nipple	9	1.1
Skin change	6	0.7
Axillary node	5	0.6
Asymmetry	3	0.4
Ulceration	2	0.2
Swelling	2	0.2
Asymptomatic	**159**	**19.7**

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香港乳癌資料庫簡報
HKBCR Bulletin
2020年9月 第11期 September 2020 Issue 11

Diagnostic efficiency of mammogram in breast cancer patients: Complementary breast ultrasound improves cancer detection in young women with dense breasts

Editor's message

This issue intends to complement the "Hong Kong Breast Cancer Registry Report No. 12" on the diagnostic aspects in breast cancer detection and characteristics among local breast cancer patients. Our findings supported that the combination of mammography and ultrasonography may benefit relatively younger women with dense breasts. Our study aims at encouraging women to undertake breast imaging as a regular checkup or as first diagnostic tool towards suspicious breast symptoms. The findings encourage more research and discussion on improving the diagnosis of breast cancer.

Introduction

Mammography (MMG) especially through regular screening is the gobal gold standard of diagnosing breast cancer early (1). Detection of breast cancer at an early stage and small sizes is associated with better prognosis and hence reduces mortality. It is well understood that breast cancer can be discovered in preclinical phase, when ductal carcinoma in situ (DCIS) detected through regular breast screening can reduce the occurrence of invasive cancer (2). Therefore, MMG guidelines are established worldwide and these screening programmes have been reviewed in the literature, in which mortality reduction ranges from 20% to 43%, indicating that regular screening saves lives (3-7).

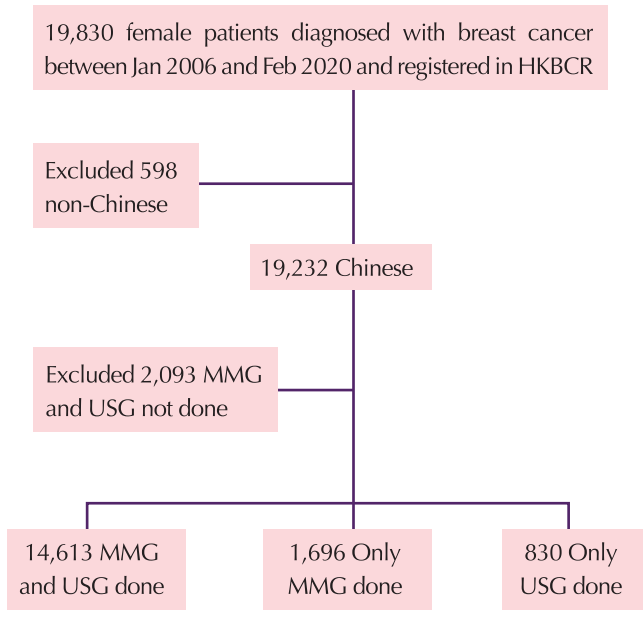
Despite scientific evidence showed that the advantages of MMG outweigh its disadvantages across all age groups (8-10), Hong Kong has not adopted any regular screening programmes. Without any guidelines of breast screening in the past decade, it is not surprising that the uptake of MMG is low among women in Hong Kong. Given that the incidence of breast cancer has been increasing in the past decade, the government has recently amended their recommendation for breast screening to include not only the high risk breast cancer individuals but also women in the general public bearing certain personal risk factors. The current study aims at providing information regarding the imaging diagnosis of breast cancer by examining the diagnostic accuracy associated with MMG and the additional benefit of ultrasound (USG) in different circumstances (11).

Method of study

Records on 17,139 female patients who had undergone MMG and/or USG and were diagnosed with breast cancer in or after 2006 were retrieved from the Hong Kong Breast Cancer Registry (HKBCR) (Figure 1). Results of MMG and USG are graded by Breast Imaging-Reporting and Data System (BI-RADS), with scores of 4-5 indicating positive for diagnosis of breast cancer. Based on the BI-RADS scheme, breast densities are divided into four categories–(a) almost entirely fat, (b) scattered fibro-glandular tissue, (c) heterogeneously dense, (d) extremely dense, with increasing proportion of fibro-glandular tissue from category a to category d. The overall diagnostic accuracy of each modality was assessed and evaluated by different age groups and breast density categories.

For those who have both MMG and USG performed, they were stratified into four groups based on the MMG/USG results. The cancer detection sensitivity of each group was calculated. A p-value of less than 0.05 was considered statistically significant by chi-square test.

Figure 1: **Flowchart of recruitment**



Results and Discussion

Table 1 presents the characteristics of the patients. The majority of patients had heterogeneously dense breasts. Near 80% of the women had radiological dense breasts (i.e., with heterogeneous and extreme density) in the current study. The majority (61.5%) of patients showed opacity on mammogram.

Table 1: **Age and breast screening findings of patients**

		N	%
Age group	<40	1,520	9.0
(N=16,948)	40-49	5,366	31.7
	50-59	5,606	33.1
	60-69	3,208	18.9
	≥70	1,248	7.4
Breast density	Fatty	1,516	13.5
(N=11,232)	Scattered density	993	8.8
	Heterogeneous density	7,890	70.2
	Extreme density	833	7.4
MMG features	Opacity only	5,201	33.4
(N=15,569)	Microcalcifications only	3,163	20.3
	Opacity and microcalcifications	2,889	18.6
	Architectural distortion only	266	1.7
	Asymmetric density only	532	3.4
	Other findings	3,518	22.6

To examine the cancer detection rates, the sensitivity among patients who had undergone MMG and/or USG is presented in Table 2. While MMG or USG alone could detect most (85.2% and 91.9%, respectively) of the cancer, the cancer detection rate was higher (up to 94.3%) when both imaging modalities were used. This finding suggested that USG was complementary to MMG by increasing the cancer detection rate.

Table 2: **Accuracy of MMG and USG**

	N	Accuracy (%)
MMG (N=16,309)	13,899	85.2
USG (N=15,443)	14,198	91.9
MMG & USG (N=14,613)	13,777	94.3

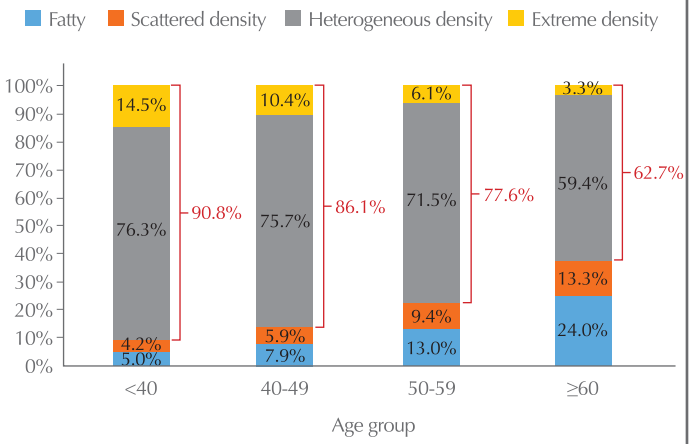
A. MMG findings with relation to age and breast density

The accuracy of MMG increased with age, and decreased with breast density (Table 3), as young patients had denser breasts (Figure 2). The majority (90.8%) of young patients aged below 40 had dense breasts, compared to 62.7% of old patients aged 60 and above. The accuracy of MMG was significantly different between patients at age below 40 (79.2%) and those aged 60 and above (90.7%; p<0.001). Such discrepancies between age groups were highly related to radiological breast densities, which are higher in young women, and in Asia countries (12). Although malignant opacities could be obscured in dense breast, suspicious microcalcifications (present in 35.2% of symptomatic patients undergoing MMG), could be visualized clearly, making it an important feature of breast cancer diagnosis in dense breasts on MMG (Table 4).

Table 3: **Age and breast density among patients undergone MMG**

		N	MMG+	MMG-	Accuracy (%)
Age group	<40	1,360	1,077	283	79.2
(N=16,127)	40-49	5,122	4,102	1,020	80.1
	50-59	5,364	4,689	675	87.4
	60-69	3,085	2,791	294	90.5 } 90.7%
	≥70	1,196	1,090	106	91.1
Breast density	Fatty	1,516	1,367	149	90.2
(N=11,232)	Scattered density	993	875	118	88.1
	Heterogeneous density	7,890	6,642	1,248	84.2
	Extreme density	833	673	160	80.8

Figure 2: **The relation between age and breast density**



According to how the patients firstly discovered their disease, 14,039 of them could be further divided into symptomatic and asymptomatic groups. While the symptomatic group refers to patients who consulted doctor on self-discovered breast symptoms relevant to cancer, the asymptomatic group refers to patients who were not aware of any breast changes, and their tumours were picked up by MMG, USG, clinical breast examination, other tests (such as CT scan and MRI), or incidental finding during breast surgery. Table 4 presents the MMG features observed in the two groups. Microcalcifications alone were significantly higher in the asymptomatic group (p<0.001) whereas significantly more patients with opacity and/or microcalcifications were seen in the symptomatic group (p<0.001). While microcalcifications are common in in situ cancer, it is hardly self-detectable without other symptoms of breast cancer (13, 14). Having microcalcifications detected implied earlier breast cancer diagnosis, particularly of stage 0. That could be one of the reasons that undergoing regular MMG screening has been proven as the only cost-beneficial modality to reduce breast cancer mortality (15).

B. USG findings

Table 5 shows the diagnostic performance of USG in all patients. Cancer detection rate with USG was high, ranging from 82.8% to 95.5%. Unlike MMG, the accuracy did not increase with age. It is, however, increased with tumour size from less than 1 cm to 5 cm. When a tumour is bigger, it is easier to be characterised by benign or malignant features on USG. In MMG occult cancer, USG detected additional cases, which were 9.0% of all cancer cases, improving cancer detection rate to 94.3% (Table 6). While the majority (78.2%) of patients with USG detected but MMG occult cancer presented with symptoms, only 21.8% of them were asymptomatic. In our subanalysis between the symptomatic and asymptomatic patients, USG picked up additional 12.6% of tumours in the asymptomatic group (Table 7).

Similar findings were shown in the Western societies. The combination of MMG and USG detected 27% more cancer than MMG alone in women presenting with breast symptoms (16). In a prospective cross-sectional study, USG detected an additional 3.7 malignant lesions per 1000 women per year in a three-year setting with 2,714 American women (17). The sensitivity increased from 55.6%, with MMG alone, to 94.4% with USG as a supplementary imaging modality (17). The results from these studies taken with those in the current study suggested USG as a useful adjunct screening tool as it is not hindered by breast density. When there is suspicion of multifocal or multi-centric disease in dense breasts, further assessment by magnetic resonance imaging (MRI) of breasts could reach a near 100% cancer detection rate (18).

Table 4: **MMG features observed in the symptomatic and asymptomatic groups**

	Symptomatic (N=12,310)		Asymptomatic (N=2,640)		P value
	N	%	N	%	
Opacity only	4,474	36.3	556	21.1	<0.001
Microcalcifications only	1,931	15.7 } 35.2%	1,080	40.9	<0.001
Opacity & microcalcifications	2,405	19.5	352	13.3	<0.001
Architectural distortion only	195	1.6	61	2.3	0.009
Asymmetric density only	441	3.6	69	2.6	0.013
Other findings	2,864	23.3	522	19.8	<0.001

Table 5: **Age and tumour size found in USG results**

		N	USG+	USG-	Accuracy (%)
Age group	<40	1,393	1,229	164	88.2
(N=15,264)	40-49	4,846	4,350	496	89.8
	50-59	4,998	4,636	362	82.8
	60-69	2,881	2,729	152	94.7
	≥70	1,146	1,094	52	95.5
Tumour size	≤1.00cm	1,723	1,450	273	84.2
(N=11,486)	1.01-2.00cm	4,245	3,988	257	93.9
	2.01-5.00cm	5,101	4,932	169	96.7
	>5.00cm	417	402	15	96.4

Table 6: **Diagnostic accuracy of breast imaging for patients who have done both MMG and USG**

	USG+	USG-	Overall
MMG+	12,131 (83.0%)	335 (2.3%)	12,466 (85.3%)
MMG-	1,311 (9.0%)	836 (5.7%)	2,147 (14.7%)

Table 7: **Diagnostic accuracy of breast imaging for patients who have done both MMG and USG in the symptomatic and asymptomatic groups**

	Symptomatic (N=11,848)	Asymptomatic (N=2,191)
MMG+ USG+	10,081 (85.1%)	1,557 (71.1%)
MMG+ USG-	127 (1.1%)	199 (9.1%)
MMG- USG+	990 (8.4%)	276 (12.6%)
MMG- USG-	650 (5.5%)	159 (7.3%)

Conclusion

The current study showed that MMG had a high diagnostic accuracy in Hong Kong Chinese population, despite a high proportion of patients with heterogeneous and extreme breast density. For those with dense breasts, additional USG could increase cancer detection rate by 9.0%. Therefore, MMG and USG has complementary role in achieving a high cancer detection especially for young women with dense breasts. The current study supported the combined use of mammogram and ultrasound in breast cancer diagnosis.

References

(Please refer to Chinese version)

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