



Title: Portable and Mobile Mammography Screening Services

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Context and policy issues:

Breast cancer is the most common cancer diagnosed in Canadian women; one in nine will develop the disease and one in 25 will die from it.¹ About 21,600 new cases are diagnosed each year, the majority occurring in women aged 50 to 69.² Rising breast cancer incidence rates have been attributed to increased vigilance through mammography screening, and declining mortality rates to early detection and improvements in management.²

Since 1998, the Canadian Task Force on Preventive Health Care (CTFPHC) has recommended screening women aged 50 to 69 years by clinical examination and mammography every one to two years, this recommendation being based on the CTFPHC's assessment of what they deem to be the highest quality of evidence (randomized controlled trials [RCTs]).³ The Canadian Cancer Society recommends screening for women aged 50 to 69 every two years and advises those younger (ages 40 to 49) and older (age 70+) to discuss the issue with their doctors.⁴ The United States Preventive Services Task Force recommends screening mammography with or without clinical breast examination every one to two years for women ages 40 and older.⁵ Although opinions vary as to the degree of mortality benefit conferred by screening mammography, and the ideal age groups to screen, a recent Canadian review published breast cancer mortality reduction rates attributable to screening mammography of 9% to 15% overall and 24% to 29% for women over age 50.⁶

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Organized breast cancer screening programs began in British Columbia (BC) in 1988, expanding to currently include all jurisdictions except Nunavut. The latest pan-Canadian report on screening programs was published in 2005. The report is based on data from calendar years 2001 and 2002 as submitted to the Canadian Breast Cancer Screening Database by the 10 provinces; the territories did not participate.² The report states that a target of at least 70% participation in mammography screening among women aged 50 to 69 is unmet as only about 34% of eligible women accessed organized screening nationally in 2001 and 2002.²

In the pan-Canadian report, capacity issues were seen as a major factor (i.e., long waiting lists due to facilities operating at or near their limits). There are also challenges related to recruitment into screening programs including enrollment of women who are traditionally difficult to reach due to age, geography, ethnicity, culture, language, literacy, education, and/or access to primary care.^{2,7} In particular, failure of physicians to recommend mammography has been identified as a barrier, as has rural location.^{8,9} Elderly women, in particular, face barriers related to functional limitations, transportation, and other logistical issues. These access challenges may be addressed in part by mammography services that are portable or mobile, particularly those that visit familiar and comfortable facilities such as community centres, churches, and seniors' residences.^{7,10,11}

Definitions: Portable versus Mobile

In the literature, the term “mobile mammography” generally refers to vans or buses inside which mammography imaging equipment is fixed, often along with reception areas, dressing rooms, and film developing facilities. However, there has been a push to development of lighter “portable” machines that are less difficult to manoeuvre, allowing them to be transported readily, including by air, and then moved into a facility for use according to a travelling rotation. In some cases in the reference material obtained for this report, the term “mobile” refers to situations where a device is transported by a dedicated van but then off-loaded to be used inside a suitable facility. This is essentially a “portable” device but is in fact often called “mobile”, i.e., the term “mobile” seems to be used for both van-based and truly portable devices and situations.

Provincial screening programs:

Provincial mammography screening programs vary but all have dedicated screening centres established in hospitals and/or community centres. Some also have mobile services with specially equipped vans travelling among communities that may be far from urban centres or otherwise underserved, e.g., inner city neighbourhoods. A few also have portable services. Although not exhaustive, information is presented here for the provinces of Alberta, British Columbia (BC), Manitoba, Nova Scotia (NS), and Québec:

- Alberta has been providing screening mammography services for a number of years although a province-wide screening program was only recently established. In addition to a number of fixed sites, the program operates three mobile vans that serve over 100 communities, including six in inner-city Calgary and Edmonton. There is no air service but hard-to-reach communities may be accessed using ice roads in mid-winter.¹²

- The BC program, established in 1988, was Canada's first. Thirty-five centres and three mobile vans in the Interior/Kootenay, coastal, and northern regions of the province perform about 260,000 mammograms annually.¹³ The mammography equipment travels by van but is moved from the van into community centres, halls, churches, or other suitable facilities once the destination is reached. In early 2006, a mobile service was piloted in Vancouver and its suburbs with an aim of recruiting women who had access to fixed sites but were not using them.¹⁴
- Manitoba's program started in 1995 and mobile services for rural and northern areas were added three years later. The equipment currently travels by van and is unloaded and set up at its destination. Of the 29,000 screening mammograms carried out by the program in 2002, 8,500 (29%) occurred at mobile sites which at that time included 80 rural communities and nine inner city neighbourhoods in Winnipeg. A second mobile unit has been added. Currently some remote communities are served by van on winter ice roads.¹⁵
- The NS program relies extensively on mobile services as it has three vans serving the western, eastern, and northern areas of the province in addition to eight fixed sites. The vans are computerized with real-time computer linkages to interpretation centres and the administrative office. Operating close to capacity, the vans have moved to extended hours including weekends.¹⁶
- The Québec program commenced in 1998 and now operates with 85 screening centres. There is a fully equipped mammography bus that visits remote areas as well as a portable unit that "can be sent by air, sea, land, or rail to provide screening services for remote communities with no road access."¹⁷

Research questions:

1. What is the clinical effectiveness of portable mammography units for breast cancer screening?
2. What are the portability, ease of use, and patient through-put of these devices?
3. What is the cost-effectiveness of portable mammography units for breast cancer screening?

Methods:

A limited literature search was conducted on key health technology assessment resources, including PubMed, CINAHL, EMBASE, The Cochrane Library (Issue 2, 2007), University of York Centre for Reviews and Dissemination (CRD) databases, ECRI's HTAIS, EuroScan, international HTA agencies, and a focused Internet search. Results included English language articles published between 2002 and May 2007. Experts in the field, device manufacturers and suppliers were also contacted.

Summary of findings:

The search of the published literature identified 120 articles of potential relevance; of these, 19 were obtained in full text for detailed analysis. With respect to secondary research, only one meta-analysis was located, this synthesizing information on the effectiveness of interventions to promote mammography among women with low rates of screening, including mobile mammography services.¹⁸ Several useful grey literature resources were identified and additional references were located through review of bibliographies. Most articles reported on experience or issues implementing mammography in hard-to-reach populations of eligible women and this often involved mobile mammography services. Use of mobile mammography services was often discussed but “portable mammography” was seldom specifically mentioned.

Clinical effectiveness of portable mammography units for breast cancer screening

Clinical effectiveness is the ultimate test of the wisdom of implementing a screening manoeuvre. In the case of portable/mobile mammography, the benefits of screening mammography are well established (as mentioned above, reductions in breast cancer mortality of 9% to 15% overall and 24% to 29% for women over age 50).⁶ For portable/mobile mammography, the most significant clinical question is whether additional benefits occur by moving the technology to women and thereby increasing access, particularly for populations where access is a significant barrier, i.e., Is mammography recruitment enhanced and in particular are hard-to-reach women screened? The 15 studies described below address this issue.

Studies reporting specifically on portable mammography services

Only one study specifically referred to portable mammography services and this reported on the implementation of breast and cervical cancer screening services among five tribes of American Indian women (in Oklahoma, South Dakota, Washington State), and Alaska Native women (in Barrow and Anchorage). Information was obtained through use of focus groups, interviews with key informants and program-eligible women, and program documents. The main focus was on the challenges and barriers encountered and the strategies implemented in response (Table 1).

In designing a service delivery model it was found that providing access to mammography screening was especially challenging as fixed sites were limited, waiting times were long, and travel was a major limitation. Mobile or portable mammography were seen as possible solutions with the services being arranged at places where the targeted women felt comfortable such as community centres and tribal health clinics.

**Table 1:
Cancer Screening Programs for Native American Women:
Challenges and Strategies**

CHALLENGE	STRATEGY IMPLEMENTED IN RESPONSE
Designing and implementing a screening service model where none existed.	Consider different models including integration into existing clinics or setting up specialty clinics; implement the model that best fits the population being served and existing health care resources.
Increasing access to mammography screening.	Contract with a mobile mammography provider.
Securing the support and cooperation of providers and staff in busy clinics.	Educate staff; enlist support of appointment clerks and medical records staff; identify a champion or main supporter in each clinical setting.
Providing cultural sensitive care.	Use female providers and Native American staff where possible; allow ample time for appointments; create a comfortable environment; use “gentle” communication style; communicate in Native language or have translators available; use culturally appropriate education materials.
Providing diagnostic services.	Facilitate equipment purchase and staff training; provide case management for women with abnormal results; provide transportation support.
Providing treatment services.	Provide case management for women in need of treatment; provide transportation support; provide access to resources where necessary.

One of the Alaska programs struggled with the issue of remote villages inaccessible by road and experimented both with flying women out for screening and flying a technician and portable mammography equipment into the outlying villages (specific details on the portable service were not provided). Program implementers identified several significant challenges related to portable/mobile services, including technical quality, scheduling, and results receipt and follow-up.¹⁹

Many of these issues and solutions were echoed in a more recent research paper funded by the US Agency for Healthcare Research and Quality, and once again the specific need for mobile mammography services for American Indian women was emphasized.²⁰

Studies reporting on mobile mammography services

A meta-analysis was conducted at the National Cancer Institute in Bethesda, Maryland. Of interest were mammography-enhancing intervention studies that included a control group of patients and focussed on women with historically low rates of screening. These women tended to be older, poorer, rural, from racial-ethnic minorities (particularly Native

American and Hispanic), with lower educational levels. The outcome of interest was mammography rates post-intervention. Inclusion criteria were met by 38 studies conducted between 1984 and 1997; all but two were from the United States (US). Results showed that access-enhancing interventions, including mobile mammography, were the most effective and were superior to community education, media campaigns, and social network interventions. Combinations of initiatives were the best. The most benefit was achieved by combining access-enhancing and individually-directed interventions which resulted in an estimated 27% increase in mammography use. An increase in mammography use of 20% was found with a combination of access-enhancing and system-directed interventions.¹⁸

Individual studies examining use of mobile mammography to recruit hard-to-reach women include (presented here from older to most recent):

- Upstate New York was the setting for a study of community education programs developed to enhance delivery of mobile mammography. Six communities were offered education programs in addition to a mobile van, while seven matched communities received only van services. In follow-up, a telephone survey of potentially eligible women revealed that in the intervention communities more women had had mammography within the previous two years than in the control communities (82% versus 72%; $p < 0.01$).²¹
- In Kentucky, three years of experience (1990 to 1993) with a mobile breast program were summarized. Women aged 35+ from a variety of backgrounds could self-refer: the medically indigent via the state health department, corporate settings, and public availability through venues such as county fairs. Results showed that almost 5,000 women made use of the service of which 21 ultimately had cancer diagnosed (0.004%) with the ratio of cancers/mammograms being 1/232. Two thirds of cancers were in women over age 50 although these women made up only one third of the study population.²²
- A small pilot study (n=62) in Georgia recruited women age 50+ who had not had a mammogram with 12 months and who had problems with transportation to fixed mammography facilities. Appointments with a mobile service were made at medical clinics convenient for the women. Although study numbers were small, two women were found to have early breast cancer – a higher than expected return – and for the study authors this provided justification for use of the intervention.²³
- Receptivity to a mobile mammography service based at specifically chosen Los Angeles churches was explored with an aim of increasing mammography rates for disadvantaged women, particularly those of Latino and African American heritage. A church-based service was seen as a useful venue to target women who were lower income, older, and from minority groups. A total of 1,117 eligible women were interviewed to see whether they were likely to take advantage of such a service. Those who indicated they were most likely to use a church-based mobile service were Spanish-speaking Latinas, including those without recent mammograms. In general, women who had not been compliant with regular mammography screening indicated the most interest in the service.^{7,11}

- An RCT recruited 499 women in Los Angeles aged 60 to 84 years who had not had a mammogram within the past year from 60 community centres. All women were provided with on-site education about health issues for older women including breast cancer and screening mammography. A follow-up letter two weeks later prompted them to have a mammogram, half being offered mobile service at their community centre. Follow-up three months later revealed that more women with access to the mobile service reported that they had taken advantage of it than did women who received only education and a reminder (55% versus 40%; $p=0.001$), with uptake occurring particularly amongst those whose mammogram was more than two years earlier.²⁴ The data from this RCT were re-examined several years later focussing on psychosocial variables (health beliefs, knowledge, and barriers) and their influence on mammography receipt. The major barrier was found to be difficulty accessing a mammogram and when this barrier was removed through the mobile service, other potential barriers such as pain and fear of finding cancer seemed to be diminished as well.²⁵
- Initiatives aimed at increasing mammography screening rates in a group of disadvantaged women in Connecticut targeted those aged 50 to 67 and eligible for both Medicare and Medicaid benefits ($n=5760$). These women had lower rates of mammography than did their peers (53% versus 62%) despite having coverage. They were characterized by low income, living alone, minority race, low educational status, chronic illness, cognitive impairment, and a history of institutionalization. Barriers to access were lack of transportation, lack of appreciation of the risk of breast cancer, daily burdens such as raising grandchildren, and fear of the mammogram itself. Initiatives involved a mobile mammography van for low-income housing sites as well as a direct mail campaign, education sessions, and community outreach. Only preliminary results were presented but these showed a high rate of appointment-keeping for the van (88% to 90%). Identified challenges included: (a) identifying and targeting the target population; (b) van issues including lack of wheelchair accessibility and low numbers of bookings at some sites; and (c) problems building sustainability into the program.²⁶
- Women's focus groups in England explored views of the breast screening experience. Participants ($n=27$) were women over 50 recently screened with normal results. Mobile facilities were highly rated as being convenient, easily recognized, offering more personal service and free parking, although space and privacy were identified as issues.²⁷
- Clinical nurse specialists were funded to develop initiatives to increase mammography screening in four underserved communities in rural southeastern Indiana where the nearest community hospitals were at least 50 km away. County-based nursing teams delivered educational sessions at churches or community centres coincident with a mobile van being available to deliver free mammograms. Notice was provided through local newspapers. The response from local women was overwhelming as double the expected number made appointments (141 versus 80 anticipated). Cost and travel distance were given as the most common reasons for failing to be screened and fewer than 25% had had mammograms within the past two

years. Rates of abnormal mammograms were high, at 21% versus $\leq 10\%$ generally seen.²⁸

- Health care is organized regionally and provided free of charge in Denmark. Biennial screening mammography commenced in 1991 in Copenhagen with eligible women aged 50 to 69 being invited by mail to participate. The region of Flyn followed in 1993. An analysis of the first six years of experience in Flyn reported very high participation rates at 84% where about 136,000 women were recruited for the first round of screening; 94% of these women responded to invitations to return two and four years later. Services were offered at one fixed site in the main city of Odense (55%) and via a mobile unit which covered the rest of the region (45%). Of the women screened in the first round, 1% were diagnosed with invasive breast cancer or ductal carcinoma in situ; this dropped to 0.5% in successive screening cycles.²⁹ No further detail about the mobile service was provided but clearly the program was structured successfully.
- A Canadian study in northwest Ontario interviewed 105 women of ethnic origin (e.g., Ojibwa, Oji-Cree, Ukrainian, Italian, Finnish) to determine their knowledge, attitudes, beliefs, and practices regarding breast and cervical cancer screening. With respect to mammography, a mobile service visits rural and urban areas in the area and the participants were very positive about it although no further specific information was provided. Overall, the researchers found that interviewees confirmed the need for appropriate marketing strategies to take account of local beliefs and attitudes, and early education in order to influence young women who could in turn influence older members of their families.³⁰
- In England a large study (n=34,868) of screening mammography uptake for women aged 50 to 64 and its link with low socio-economic status, travel distance, and location of service was conducted from 1998 to 2001. Of the mammography locations, one was a fixed hospital site and 12 were mobile. Women in the poorest socioeconomic category had the lowest rates of mammography attendance at 73% over three years (versus 82% for the least deprived women). However, beyond this variable, no influence was found related to distance from a screening facility, urban/rural status, and fixed versus mobile site. Uptake was slightly higher when mobile screening was offered at a non-health facility (e.g., swimming pool, leisure centre) versus a health facility.³¹
- The US Indian Health Service, in collaboration with the Sioux tribes and the University of Michigan launched an initiative to deliver mobile mammography to remote reservations where mammography access was previously limited and screening levels were low. Digital technology and satellite transmission of images allowed mean reporting time from transmission of an image to the University of Michigan Breast Imaging Division to the reporting of a result within 30 to 50 minutes. This allowed immediate follow-up for 72% of the 58 women whose abnormal screening results required additional imaging. The level of satisfaction among women patients was high.³²

- The most recent study of mobile mammography for underserved women occurred in Illinois. The authors provided a description of an existing free county-sponsored mobile program over three years from 1999 through 2001. The number of women examined was not reported although data for number of site visits (321) and abnormal results (636) were presented. Community-based organizations and community health centres made up the majority of visit sites, these being resources that typically serve low income populations with sub-optimal rates of mammography screening.³³

Portability, ease of use, and patient through-put of the devices

Information related specifically to portable mammography services

According to the information available, the lightest and most compact device, and the only one considered to be “portable”, is manufactured by Planmed (Helsinki, Finland). Planmed markets the Sophie, a film-based device suitable for transportation outside of a dedicated mammography bus/van. The wheeled device is capable of folding up for transport, weighs 180 kg (396 pounds), and is 120 cm (4 feet) tall. It has a braking system and is powered by regular wall outlet connections.³⁴ This device is distributed worldwide including in Canada and the United States (US).

According to a 2004 US publication, the cost of Planmed’s Sophie device was \$US 80,000 but additional considerations are a film processor (\$US 15,000) and film cassettes (\$US 5000).³⁵ A second manufacturer, Hologic, discontinued a competitor device (Lorad) at least five years ago although a number of programs in Canada still use this older technology. Several manufacturers produce film-based mammography units that are larger including Hologic, General Electric Medical Systems, and Siemens. These are suitable for mobile but not portable services. There are no digital devices small enough to be portable.

Information related to portable and/or mobile mammography services

With respect to the practicalities of use of portable and/or mobile mammography, all published material either referred to mobile services or did not make a distinction between portable and mobile.

With respect to through-put, a US mobile mammography pilot study published in 2000 reported booking 18 appointments daily (8:30 am to 2:40 pm), which suggests appointments 15 or 20 minutes in length.²³ An English study reported appointments of 20 minutes from beginning to end.²⁷ and this finding was echoed by a US study reporting that 90% of women spent 30 minutes or less when attending a mobile facility.³⁶ Another report estimated 30 minutes of a woman’s time, of which 10 to 20 were spent having the mammogram.³⁷

Annual through-put was reported at 4000 patients in rural North Carolina; this program also reported that the mammography van logged 400,000 miles before requiring replacement.³⁵ A South Florida program served about 3,500 women yearly with the van

operating three to six hours, five day per week. However, the authors of the report on this program projected that up to 55 examinations per day were possible if staffing and other resources were adjusted accordingly. The cost-effectiveness analysis emphasized the significant benefits possible due to economies of scale.³⁷

Cost-effectiveness of portable / mobile mammography units for breast cancer screening

Once again, all published material reporting on the economic considerations of portable and/or mobile mammography either referred specifically to mobile services or did not make a distinction between portable and mobile services. It is therefore not possible to comment specifically on the cost considerations related to portable mammography.

The costs and cost-effectiveness of screening mammography delivered via a mobile service in 1999 were estimated in a US-based analysis. The actual cost per mammogram was calculated to be \$US 139 including materials, personnel, van, film interpretation, and follow-up of abnormal results. Clinical breast exam added another \$US 70. Based on detecting seven cancers per 1000 women screened, the cost per cancer detected was calculated to be \$US 20,100. The authors determined that a mobile service would be most feasible if it: targeted hard-to-reach underserved women, maintained high volumes, coordinated with primary care providers, and built on an existing infrastructure.⁷

With respect to practicalities, a partnership among two foundations and a hospital in Denver, Colorado, led to establishment of a mobile mammography service in late 2005 to screen uninsured and underserved women in the area through visits to community clinics, businesses, churches, homeless shelters, and battered women's shelters. A 12-metre van, purchased for \$US 450,000, is staffed by a receptionist and a technologist (who double as the drivers). Inside are a reception area, a mammography suite, two dressing units, and two examination rooms. Each year an estimated 3,000 screening mammograms will be carried out.³⁸

All other material specifically examining costs and mobile mammography was pre-2000 (presented here from older to most recent):

- A Massachusetts radiologist estimated the expenses associated with providing a privately-operated mobile screening mammography program using an 11 metre van staffed by two registered technologists which also included on-board film processing and educational videotapes. In 1998, 3,522 women were examined at an average cost of \$US 83 per exam; in 1999, 4,232 women cost an average of \$US 78; and in 2000, 5,005 women cost an average of \$US 69. These costs exclude radiologist interpretation fees. US Medicare was providing a global screening fee of \$US 50 to \$US 60. Projections estimated that an average payment of \$US 55 would require examination of more than 7,500 patients a year or 28 patients a day to break even and subsidization was seen as a necessity to make operation of a mobile mammography viable for a private operator.³⁹

- Survey data from 1992 were analyzed by the US National Cancer Institute to determine the prevalence and performance of mobile mammography facilities, focussing on cost, price, quality assurance, and access. Only 2.4% of over 1,000 US mammography facilities were identified as mobile, accounting for 3% of mammography examinations at that time. Most were affiliated with community hospitals or private radiology practice. Mobile services were more likely than their stationary counterparts to be associated with higher through-put (33% higher), batch film processing, batch interpretation, patient reminder systems, and computerized reporting. Costs for screening mammograms were lower at \$US 76 versus \$US 91 for fixed sites. In particular, batch interpretation fees were significantly lower at \$5 versus \$20 per film. Mobile services were also more likely to offer convenient hours and to screen women who were self-referred.⁴⁰
- Australia implemented screening mammography nationally in 1991, targeting women aged 50 to 69 every two years and offering the service to patients free of charge. The “travel cost” method was used to examine the use of accredited mobile mammography screening units in New South Wales using telephone survey data obtained from households in 10 rural towns (population 5,000 to 15,000 adults) in 1994. The actual cost of \$93.40 per mobile mammogram for new patients was drawn from earlier literature as was the \$20.34 incremental cost for a screen performed using a mobile versus a fixed facility. The analysis was performed using a societal perspective which determined that the economic benefits for women of mobile screening outweighed the economic costs if a rural town was situated 29 km or more from a fixed screening unit.⁴¹
- A detailed cost-effectiveness evaluation of mobile mammography was performed based on a South Florida program serving indigent women. Costs were adjusted to 1995 US dollars. The van operated from three to six hours daily and served about 3,500 women per year. This article stated that the average price of a mammogram in the US at that time was \$US 180 to \$225, with an efficient high-volume service able to reduce this to \$US 96, and that the literature reported mobile mammogram costs at \$46 to \$90. Costs were very sensitive to the efficiency/volume of the service and the age group of women screened (i.e., women aged 40+ versus women aged 50+):
 - A low volume program would screen 15 women daily or 3,750 women annually at an estimated cost of \$US 98 per woman. Program costs were estimated to be \$US 366,780 annually and the cost per cancer detected to be \$US 13,041 if women over age 40 were screened or \$US 11,453 if screening was limited to women aged 50+.
 - A very high volume program could screen 55 women daily or 13,750 women annually at an estimated cost of \$US 70 per woman. Program costs were estimated to be \$955,844 annually and the cost per cancer detected to be \$US 9,269 if women over age 40 were screened or \$US 8,140 if screening was limited to women aged 50+.³⁷

The professional fee involved for radiologist interpretation of films deserves special mention. One author noted a fee of \$US 20 per examination for interpretation of diagnostic mammograms. However, “batching” of films, i.e., reading many films in a sitting, is a technique possible when viewing screening mammograms and can reduce this fee to \$5 in some settings.⁴⁰ Mobile mammography lends itself to batch interpretation of films as a radiologist is not on site but receives large numbers of films at a time. A radiologist can interpret at least 20 examinations per hour or up to 80 with administrative help.⁴²

The personal cost issues involved in obtaining screening mammograms were explored in a Connecticut study that surveyed women attending both mobile (n=3) and fixed (n=6) sites. Quantitative data were not collected. Parking costs and time required were lower for those at the mobile sites although there was no difference when it came to personal costs such as missing work and need for family care. Personal costs were higher at urban sites and for younger women, mainly due to the need for time off work and childcare.³⁶

Although not a direct cost issue, one reference reported on the challenges faced by technologists operating mobile mammography services including the need to perform quality control tests on the equipment while in the field as well as management of processing chemistry. Due to the responsibility and autonomy innate in the job, technologists must be resourceful, highly competent, confident, independent, and physically able to deal with heavy and unwieldy equipment.³⁵

Conclusions and implications for decision or policy making:

Screening mammography is a widely accepted and important element of preventive health care. However, efforts to reach all eligible women have fallen short, particularly for those disadvantaged due to remote/rural location, as well as age, ethnic/cultural issues, education, and other factors.

In Canada’s North, access is a particular challenge as some communities are only accessible by air or water, or roads that are in poor condition and/or only seasonal. This means that innovative systems must be developed to reach the population of women requiring screening. Access is a significant stumbling block in many jurisdictions but the literature reports that portable and/or mobile mammography have brought screening mammography closer to women, especially for those rural or remote.

Studies have shown increased rates of screening when mammography services are taken to locations comfortable and convenient for women. Generally mobile services are operated with self-contained specially equipped vans; however, smaller and more portable devices are available and have seen limited dissemination, including transportation by air into remote locations.

In researching this topic, very little information was found that was specific to portable services suggesting that most programs have not implemented portable services but rather have relied on mobile services (or have not written about their experience). Although data specific to portable mammography are not available it seems reasonable

to suggest that such units would produce improvements in access similar to the more common mobile configurations.

Anecdotal information suggests that portable mammography has a number of limitations, such as: the availability of only one type of mammography device, difficulty fitting the device through the doors of small aircraft capable of landing in remote locations, the need for skilled personnel to load and unload sensitive equipment, technician injuries resulting from manipulating heavy and awkward devices, physicist expertise on-site to check device accuracy, significant transportation expenses to target small numbers of women in remote locations, and lack of follow-up services when diagnostic mammograms are required to investigate abnormal screens.

No specific information was available about the costs associated with portable units. With respect to mobile services, some studies report that operating costs run slightly higher than fixed site services, while some report lower costs. The costs of acquiring and maintaining a vehicle would be avoided with portable units; however, the cost of moving these units to remote communities via air or other means must be considered. Beyond this, the unit cost per exam would generally be influenced by the same considerations that impact mobile units. Cost per mammogram is directly related to volume of screens performed, whereas cost per cancer detected is influenced by the age of women screened, since positive results are more likely as women age and screening young women will result in fewer positive results. Efficiencies are possible if only the most appropriate women are screened and high volumes are achieved, with savings coming from the batch processing and interpretation of films possible through screening programs.

On a final note, digital imaging is gathering momentum as increasing numbers of hospital-based imaging departments convert from film to digital technology. Prior to implementation of a mobile film-based mammography service, research into the state of play of digital imaging technology would be a reasonable idea. At present, there are no portable digital mammography devices available and it is uncertain as to whether such technology will become available over the next several years.

Prepared by:

V. Foerster MD MSc CCFP

J. Murtagh MHA CHE

M. Severn MA MLIS

Health Technology Inquiry Service

Email: htis@cadth.ca

Tel: 1-866-898-8439

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