HHS Public Access

Author manuscript

Cancer Causes Control. Author manuscript; available in PMC 2020 February 01.

Published in final edited form as:

Cancer Causes Control. 2019 August ; 30(8): 813–818. doi:10.1007/s10552-019-01190-2.

The effect of delivery structure on costs, screening and health promotional services in state level National Breast and Cervical Cancer Early Detection Programs

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Abstract

Purpose—We estimated the costs and effectiveness of state programs in the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) based on the type of delivery structure.

Methods—Programs were classified into three delivery structures: (1) centralized, (2) decentralized, and (3) mixed. Centralized programs offer clinical services in satellite offices, but all other program activities are performed centrally. Decentralized programs contract with other entities to fully manage and provide screening and diagnostic services and other program activities. Programs with mixed service delivery structures have both centralized and decentralized features. Programmatic costs were averaged over a 3 year period (2006–2007, 2008–2009, and 2009–2010). Effectiveness was defined in terms of the average number of women served over the 3 years. We report costs per woman served by program activity and delivery structure and incremental cost effectiveness by program structure and by breast/cervical services.

Results—Average costs per woman served were lowest for mixed program structures (breast= $225, cervical = $216) compared to decentralized (breast = cervical = $276) and centralized program structures (breast = $259, cervical = $251). Compared with decentralized programs, for each additional woman served, centralized programs saved costs of $281 (breast) and $284 (cervical). Compared with decentralized programs, for each additional woman served, mixed programs added an additional $109 cost for breast but saved $1,777 for cervical cancer.

Conclusions—Mixed program structures were associated with the lowest screening and diagnostic costs per woman served and had generally favorable incremental costs relative to the other program structures.

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Conflict of interest All authors declare that they have no conflict of interest.

Keywords

Cost effectiveness; Cancer screening; Breast; Cervical

Introduction

As the largest cancer-screening program in the United States, the National Breast and Cervical Cancer Early Detection Program (NBCCEDP) serves as a learning laboratory for other national cancer and non-cancer prevention and control programs. The NBCCEDP's organizational structure is complex; CDC funds states, tribes/tribal organizations, and US territories across the US and each grantee's program has established a unique screening delivery system to serve their population of eligible women. Each of these programs uses one of the following three different service delivery mechanisms in their respective jurisdictions: (1) centralized, (2) decentralized, and (3) mixed [1]. Centralized programs offer clinical services in satellite offices, which may include local health departments that are not independent entities from the state health departments, but all other program activities are performed centrally (e.g., tracking and case management service). Decentralized programs, on the other hand, contract with local and regional health departments, primary care clinics (e.g., community health centers), private hospitals, or other healthcare facilities to fully manage and provide screening and diagnostic services and other program activities.

Programs with mixed service delivery structures have both centralized and decentralized features [2.] There is a great deal of variation among states with a mixed delivery structures and this variation depends upon the needs and capacity at the health department. Various activities of the program may be managed at the state health department while other activities are managed at district level or even in the providers' offices. For example, some state health departments do their program enrollment through the provider offices, but have patient navigation and the billing controlled centrally at the state health department. Other programs contract with providers directly for clinical services such as Federally Qualified Health Centers.

NBCCEDP grantees selected their program structures for specific reasons and the delivery structure was not arbitrary or randomly assigned. The delivery structure for each grantee is based on the infrastructure of their health department system. States that function through health districts were more likely to have a decentralized program whereas states with internal infrastructure may centralize the entire program in the state health department.

In recent years, attention has been given to the estimated costs and effects of these delivery structures for cancer screening, diagnostic follow-up, and other program services. Because program resources reach only a fraction of eligible women, all other things equal, service delivery mechanisms that provide efficient allocation of resources are clearly desirable. Such service delivery mechanisms should enable programs to screen and serve optimal numbers of eligible populations. Currently, there is no information describing how the three service delivery structures used by NBCCEDP grantees impact costs and effectiveness. In this study, we assessed the costs and effectiveness of various delivery structures used to deliver

screening, diagnostic, and other program services in the NBCCEDP and examined how different types of service delivery structures affect the number of women served.

Methods

Cost assessment tool

To collect economic costs related to the NBCCEDP, we used a customized cost assessment tool (CAT). The development and testing of the CAT has been described previously [1, 3]. In brief, the CAT collected activity-based economic cost data from the programmatic perspective, regardless of the funding source used to pay those costs. A detailed protocol was used to guide the data collection at each of the 68 grantees funded at the time of data collection.

In the CAT, grantees reported costs for items such as staff time, materials purchased, and screening costs. For each line item, grantees were provided space to list up to three activities for which the resource was used. Each activity was selected from the following options: management, screening, case management, tracking and follow-up assessment, public education and outreach, professional education, coalition and partnership building, quality assurance and improvement, and surveillance and evaluation. For example, hours reported for a registered nurse may have been allocated to case management, professional education and quality assurance and improvement. Further, in the CAT, grantees were also required to report the relative focus of each activity on breast or cervical cancer in their programs.

We used the CAT to collect cost data for the 2006–2007, 2008–2009, and 2009–2010 program fiscal years. Grantee activities and costs supported by all funding sources, including CDC, the state, and other organizations, were collected in the CAT and reported in this study. Five grantees (California, Hawaii, Maine, Michigan, and Minnesota) provided cost data for 2007–2008 rather than for 2009–2010. Because we analyzed average annual costs (see Statistical Analysis below), we retained these grantee’s programs in the analysis.

To ensure the accuracy of data collected with the CAT, we performed a series of data quality checks. We verified that all CAT modules were fully and accurately completed. We reviewed the submitted data to determine whether grantees reported their actual total expenditures for clinical (screening and diagnostic) procedures rather than their rates per procedure. We checked to ensure that grantees did not double-report cost data across modules. We also compared data across fiscal years to identify large, potentially erroneous, changes in reported costs. For grantees with incomplete or potentially inaccurate data, we resolved inconsistencies via e-mail and telephone calls and, in some cases, through revisions in the CAT.

Our final analysis sample included 147 program-years. We excluded tribes and territories because our preliminary analysis indicated that their cost structures were very different from those of the state programs. We also excluded six program-years in which total costs differed by more than 10% from adjusted annual funding due to data quality concerns. These six program-years represented 1 year of data from each of six different states: five of those

program-years were the first year of data collection (2006–2007) and one program-year was 2008–2009.

Women served

Data on the numbers of women served were obtained from CDC's Minimum Data Elements (MDE) and the CAT. The MDE collects patient-level clinical data that are associated with federal NBCCEDP funds, whereas the CAT collected clinical data on women screened with non-federal funds and in-kind contributions. The total number of women served included all women who were screened or who received diagnostic follow-up using either federal or non-federal funds.

Statistical analysis

Program costs and the number of women served were averaged over time at the grantee level before analysis to obtain statistics for a representative year. Program costs for each activity were calculated by pooling all expenditures allocated to that activity. Activity costs per woman served were calculated by dividing activity costs by the number of women served. All costs in this analysis are presented in 2010 dollars. We report median activity costs per woman served by program delivery structure. We test the null hypothesis that delivery structure is independent of costs using a nonpara-metric k sample test on the equality of medians in unpaired data (Stata command "medians"; Stata Version 14.0, College Station, TX).

We examined the pseudo-incremental cost effectiveness of program delivery structure, defined as the difference in cost between two delivery structures divided by the difference in the number of women served. In cases in which a program structure is more expensive (higher cost) but also more effective (greater number of women served), incremental cost effectiveness can be calculated; this provides the cost effectiveness of one program structure relative to another. Activity costs were allocated to breast and cervical cancer-specific costs using the allocation for each activity reported in the CAT. We then aggregated the within-program averages for overall program costs and women served by delivery structure. Average and incremental cost effectiveness ratios were calculated using these delivery structure totals.

Sensitivity analyses

We performed two sensitivity analyses related to our inclusion and exclusion criteria. First, we conducted the analysis excluding the program-years representing 2007–2008 instead of 2008–2009 (CA, HI, ME, MI, and MN). Second, we conducted the analysis including the program-years in which total costs differed by more than 10% from adjusted annual funding.

Results

Across the 51 state programs (including Washington DC), ten were centralized, 17 were decentralized, and 24 were mixed (Fig. 1). Figure 2 reports median costs per woman served for each activity by program structure. Screening and diagnostic services had the highest median costs per woman served (from $131.84 for mixed programs to $152.57 for

centralized programs). The next highest median costs per woman served was for program management (from $14.98 for mixed programs to $32.99 for decentralized programs) and patient support/case management (from $10.88 for centralized programs to $30.71 decentralized programs). Differences in median costs per woman served were largest for these activities and were significantly different from screening and diagnostic services ($p = 0.012$) and program management ($p = 0.012$). Decentralized programs spent the most on program management. Mixed programs' median screening and diagnostic service costs per woman served were approximately $20 lower than centralized and decentralized programs.

Table 1 presents the results of the pseudo-incremental cost-effectiveness analysis. Centralized programs are reported first because they served the smallest number of women, followed by the decentralized programs, and then the mixed programs. Compared with a base of centralized programs, decentralized programs incurred costs of $281 for each additional woman served for breast cancer and $284 for each additional woman served for cervical cancer. Compared with decentralized programs, mixed programs added an additional $109 for each additional woman served for breast cancer but saved $1,777 for each additional woman served for cervical cancer. In both sensitivity analyses (excluding the 2007–2008 program-years and including the program-years in which total costs differed by more than 10% from adjusted annual funding) the results for average and incremental cost effectiveness were nearly identical to those reported Table 1, with estimates within a few dollars of the original analytic sample (available upon request).

Discussion

Our results indicate that program delivery structure was associated with the cost and effectiveness of services provided by NBCCEDP grantee programs. Mixed program structures were the most common among NBCCEDP grantees and they had the lowest screening and diagnostic costs per woman served. This is important, as programs were required to spend at least 60% of their funds on these activities during the time of this study. Screening and diagnostic costs were approximately five times higher than costs per woman served for the next highest cost activity (program management).

Programs with mixed structures served the most number of women annually. For breast cancer screening services, these program s also had the highest total costs. However, for cervical cancer screening services, programs with mixed structures actually served more women than decentralized programs at a lower cost.

These results could reflect the fact that a mixed program structure allows programs to specialize on specific activities for which they are the most efficient. M any mixed programs do not have local health departments that can deliver screening services. Thus, the most common activities to be outsourced are direct screening and follow-up services and billing support. There is heterogeneity across programs in the decision on which activities to keep within the program and which to decentralize.

We excluded tribes and territories from our analysis. Previous cost analyses of the NBCCEDP have also excluded cost data from tribes and territories for several reasons [1, 2,

4]. First, there are significant demographic and cultural differences between states, tribes, and territories [5]. Second, organizational factors that impact delivery of screening services are different among tribe and territory grantees of the NBCCEDP as compared to the states [6]. Lastly, including data from smaller tribe and territory grantees created instability in national estimates.

Our results give some understanding of the relative costs of these program structures. However, we have a small number of programs for some structures (e.g., only ten centralized program s). Furthermore, costs and the number of women served depend on many factors not included in this analysis. These include the population of eligible women in the catchment area, availability and costs of clinical and program staff, and other characteristics specific to the program ‘s target population [2, 7–9].

In addition, NBCCEDP grantees selected their program structures for specific reasons, and the delivery structure was not arbitrary or randomly assigned. The choice of delivery structure may be associated with other factors that affect cost effectiveness, creating confounding of the measured association. For example, the NBCCEDP has been shown to exhibit economies of scale, in which the average cost per woman served decreases as the number of women served increases [10]. If larger programs tend to choose a mixed delivery structure, this could lead to lower costs per woman served. Therefore, caution should be used in interpreting the results of this study.

Conclusion

A key decision for disease prevention and control programs is how to structure the delivery of health services. In the NBCCEDP, delivery structure was associated with average and incremental cost effectiveness of the state programs. In particular, a mixed delivery structure was associated with lower costs per woman served. The results are suggestive that a mixed structure, in which programs perform activities in which they have a comparative advantage and outsource all other activities, may be a promising approach to improve the efficiency of the programs. Programs would need to ensure that such a structure is feasible and appropriate given their own context.

Acknowledgments

The authors thank Wesley Crouse for his assistance in data collection.

Funding This study was funded by Contract No. 200-2002-00575 TO 06 and 200-2008-27958 TO 9 from the Centers for Disease Control and Prevention (CDC). The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC.

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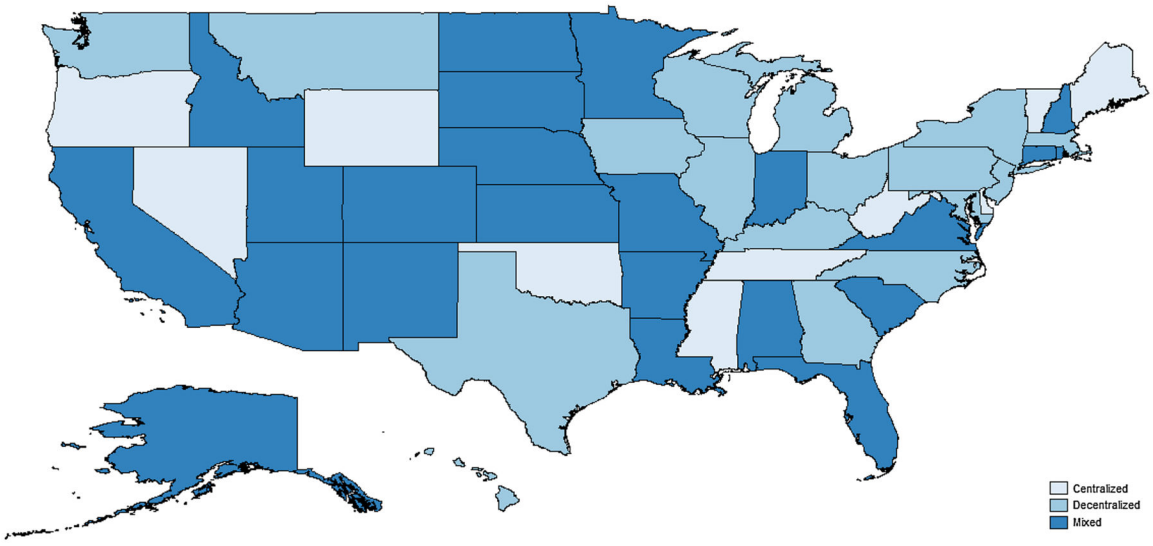

Fig. 1.
NBCCEDP delivery structure

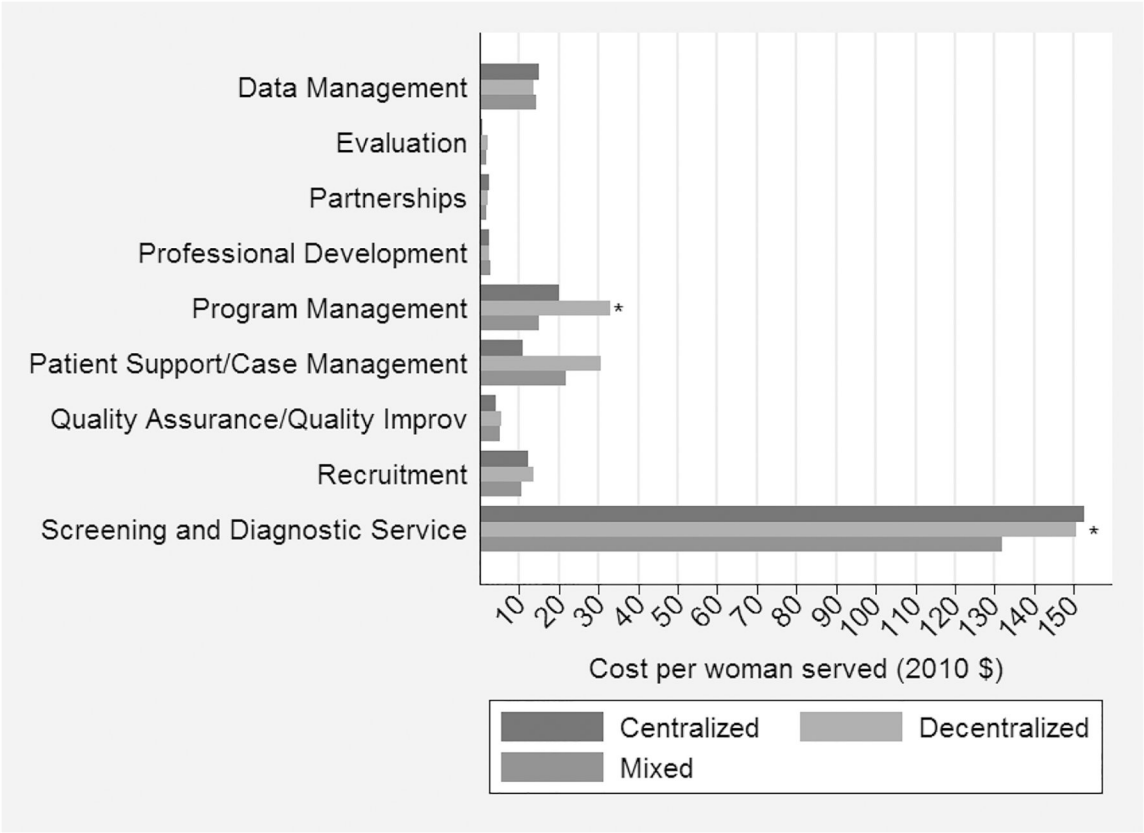

Fig. 2.

Median cost per woman served by program component and delivery structure (2010$) (The distribution of cost per program component excludes in-kind contributions. * indicate cost categories that are statistically significantly different across delivery structures at the 95% CI based on a nonparametric *k* sample test on the equality of medians in unpaired data)

Table 1

Average annual program costs and women served in the NBCCEDP by program structure (2010 $)

Program structure	Breast cancer screening				Cervical cancer screening			
	Program costs[a]	Women Served	Average cost effectiveness	Incremental cost effectiveness	Program costs[a]	Women Served	Average cost effectiveness	Incremental cost effectiveness
Centralized[b] (n = 10)	13,849,647	53,405	259		11,304,013	44,968	251	
Decentralized (n = 17)	68,142,747	246,671	276	281	52,015,555	188,408	276	284
Mixed (n = 24)	79,933,843	355,285	225	109	41,864,842	194,120	216	−1,777
Total	161,926,236	655,361	247		105,184,410	427,496	246	

[a] In-kind contributions are not included due to the inability to validate the quality of those variables

[b] Centralized: DE, ME, MS, NV, OK, OR, TN, VT, WV, WY. Decentralized: GA, HI, IL, IA, KY, MD, MA, MI, MT, NJ, NY, NC, OH, PA, TX, WA, WI. Mixed: AL, AK, AZ, AR, CA, CO, DC, CT, FL, ID, IN, KS, LA, MN, MO, NE, NH, NM, ND, RI, SC, SD, UT, VA