

© Health Research and Educational Trust

DOI: 10.1111/1475-6773.12748

PUBLIC HEALTH SERVICES AND ECONOMICS

Cost Analysis and Performance Assessment of Partner Services for Human Immunodeficiency Virus and Sexually Transmitted Diseases, New York State, 2014

Britney L. Johnson , *James Tesoriero*, *Wenhui Feng*, *Feng Qian*, and *Erika G. Martin*

Objective. To estimate the programmatic costs of partner services for HIV, syphilis, gonorrhea, and chlamydial infection.

Study Setting. New York State and local health departments conducting partner services activities in 2014.

Study Design. A cost analysis estimated, from the state perspective, total program costs and cost per case assignment, patient interview, partner notification, and disease-specific key performance indicator.

Data Collection. Data came from contracts, a time study of staff effort, and statewide surveillance systems.

Principal Findings. Disease-specific costs per case assignment (mean: \$580; range: \$502–\$1,111), patient interview (\$703; \$608–\$1,609), partner notification (\$1,169; \$950–\$1,936), and key performance indicator (\$2,697; \$1,666–\$20,255) varied across diseases. Most costs (79 percent) were devoted to gonorrhea and chlamydial infection investigations.

Conclusions. Cost analysis complements cost-effectiveness analysis in evaluating program performance and guiding improvements.

Key Words. Partner services, economic evaluation, HIV, sexually transmitted diseases

Partner notification and contact tracing, which originated in the United States in the 1940s to follow syphilis outbreaks, are a long-standing public health strategy used to reduce disease transmission and promote infection control. Now known as “partner services,” its activities include interviewing and counseling infected individuals, delivering risk reduction messages, distributing condoms, eliciting partner information, and notifying, testing, and treating exposed partners. Partner services programs play a substantial role in the

HIV/STD prevention portfolio of state and local health departments, and they have been shown to be an effective way of identifying undiagnosed HIV and STDs in high-risk populations. The Centers for Disease Control and Prevention (CDC) recommends partner services for persons infected with HIV, syphilis, gonorrhea, and chlamydial infection and their partners (CDC 2008).

As state and local health departments adapt to changing funding allocations and policy recommendations, it is increasingly important for programs to systematically demonstrate their value and effectiveness (Chesson et al. 2005; Mays et al. 2009; Aral and Blanchard 2012; Lasry et al. 2012). In addition to evaluating return on investment, there is growing recognition that cost analyses, commonly used in other public sectors, can guide programmatic decision making and quality improvement (Honore et al. 2007; Honore and Costich 2009). Existing research supports the effectiveness of partner services delivered by health departments over patient or provider partner notification, but the cost of these programs in real-world settings is unclear (Du et al. 2007; Hoots et al. 2012; Hogben et al. 2016). When calculating costs, previous studies have taken direct measurement micro-costing approaches, focusing on the time, in minutes, spent delivering an intervention (Shrestha et al. 2009; Rahman, Khan, and Gruber 2015). This can underestimate true programmatic costs, as many programs support full-time employees who have other responsibilities (reporting, payroll, administrative paperwork, etc.) that are not directly related to the delivery of an intervention, but are essential to program maintenance.

New York State (NYS) provides a useful case scenario; its HIV/STD partner services program includes over 75 disease investigation specialists (DISs) who conduct investigations in 57 geographically varied counties outside New York City (NYC). Twelve of these counties, accounting for approximately 70 percent of disease morbidity, are funded directly by NYS to deliver partner services through their local health department. The remaining 45 counties are served by state-funded staff based in six regional offices. NYS has one of the highest burdens of individuals living with HIV nationally (CDC 2015a) and a high volume of reportable STD diagnoses (CDC 2015b). Given the complex

Address correspondence to Britney L. Johnson, M.P.H., Oak Ridge Institute for Science and Education (ORISE), Centers for Disease Control and Prevention, 1600 Clifton Road, MS E-80, Brookhaven, GA 30329; e-mail: mwq4@cdc.gov. James Tesoriero, Ph.D., is with the New York State Department of Health, AIDS Institute, Albany, NY. Wenhui Feng, M.P.P., and Erika G. Martin, Ph.D., M.P.H., are with the Rockefeller Institute of Government, Albany, NY, and the Rockefeller College of Public Affairs & Policy, University at Albany, State University of New York, Albany, NY. Feng Qian, M.D., Ph.D., is with the University at Albany School of Public Health, State University of New York, Rensselaer, NY.

funding streams for HIV/STD partner services (including state-funded and federally funded DISs, contracts to local health departments, and supplemental funding for other HIV/STD prevention activities), cost analysis methods can help better delineate program delivery costs from the state perspective.

This research builds off a recent time study of DISs in NYS (excluding NYC). That study measured how much time DISs spent on a sample of disease-specific partner services investigations and evaluated how staff labor and effort varied across partner services assignments (Martin et al. 2015). The current analysis applies the time study's estimated staff efforts per disease to real-world cost and outcomes data, providing a meta-perspective of resource allocation in the state's partner services program. In addition to expanding the evidence base for the costs of partner services for HIV and syphilis, this study provides broader practice-based estimates of the costs of health department-delivered partner services for gonorrhea and chlamydia (Macke et al. 1998; Macke 2000; Golden et al. 2003). The objective of the analysis is twofold: to estimate the total annual program cost of HIV/STD partner services in NYS, and to estimate costs for specific disease intervention activities conducted *within* programs to guide decision making and quality improvement. The analysis may also provide information that is helpful to other jurisdictions seeking to maximize the effectiveness of their partner services programs in resource-constrained environments.

METHODS

Study Setting and Analytic Overview

This study applied principles of public health cost analysis to HIV/STD partner services, from the perspective of the NYS Department of Health's Division of HIV/STD/Hepatitis C Prevention (Haddix, Teutsch, and Corso 2003; Smith and Barnett 2003). A programmatic cost analysis approach ensured maximum utility for programmatic decision makers (Sullivan et al. 2014). Given the labor-intensive nature of disease investigation work, a micro-costing staff allocation method was applied, which allocates total program costs based on the percentage of staff time spent on each intervention (in this case, the type of infection being investigated) (Frick 2009; Shrestha, Sansom, and Farnham 2012). All costs are from the NYS perspective and therefore do not include client costs, indirect medical costs, or cost savings from averted infections.

Calculation of Costs

The average time to investigate each disease, based on the past time study's direct measures, was used to estimate the staff effort allocation (Martin et al. 2015). For example, if HIV assignments were 5 percent of all cases assigned, but took twice as long as a gonorrhea investigation to complete, they would represent 10 percent of actual staff time (and program cost) under the effort allocation method. Disease-specific costs presented in this analysis are based on all cases investigated in 2014 and were calculated as the percentage of staff effort per disease multiplied by the annual total program cost.

As a portion of the state's partner services costs are contracted out, administrative costs for the state and local health departments were collected separately and then combined to create the total program cost. The component costs for this analysis were based on contract budget categories of salary, fringe, equipment and supplies, travel, and indirect administrative expenses. All cost data are presented in 2014 dollars.

Staff Salary Costs. Among state-funded employees, annual salary and fringe costs were collected for all funded DISs and first-line program supervisors, who spend 100 percent of time on partner services work. Indirect costs for state staff were applied to salary and fringe based on federally negotiated indirect cost rates (22 percent or 14.9 percent, depending on the funding source). Salary, fringe, and indirect costs for individuals funded through contracts were based on the total contract amount requested by the local health department.

Travel and Other Costs. The indirect cost rates include building, utility, and overhead costs, so these costs are not reported separately. Travel costs incurred by state DISs were collected from statewide financial management systems, and supply and miscellaneous expenditures (such as vehicle maintenance, interpreter services, and waste pickup) were collected from program managers. Among local health departments, travel and other costs were derived from reviewing contracts.

Performance Assessment

Program outcomes were provided by the NYS AIDS Institute's Bureau of STD Prevention and Epidemiology, and they reflect all diagnoses and partner services investigations conducted for cases of HIV, syphilis, gonorrhea, and chlamydia from January through December 2014. To estimate costs across

stages of the partner services cascade, three program process measures and one program outcome measure were applied as follows: (1) cost per index case assignment, (2) cost per index patient interviewed by partner services staff, (3) cost per partner notified of exposure, and (4) cost per key performance indicator. Case assignments were defined as any newly diagnosed case assigned via statewide surveillance systems to a DIS for treatment verification and interview, based on disease prioritization grids. For each assigned case, the DIS attempts to interview the diagnosed patient, elicit partner information, and notify any subsequent partners of exposure. The key performance indicators are based on the CDC's evaluation recommendations and measures commonly used in partner services research (Shrestha et al. 2009; CDC 2010; Rorie et al. 2014). The key performance indicators reflect the direct short-term public health impact of the partner services intervention. For syphilis, gonorrhea, and chlamydia partner services, the key performance indicator was the number of notified partners who were infected and brought to treatment, or preventively treated for exposure. For HIV partner services, this was the number of notified partners who were tested and newly diagnosed with HIV.

RESULTS

Table 1 presents administrative cost data, broken down by budget category and disbursement mechanism. Program costs allocated to state health department-delivered partner services activities represent \$4.23 million (61.8 percent) of total program costs, with the remaining \$2.62 million (38.2 percent) provided to contracted local health departments. Among state and local budget items, personnel costs (salary and fringe) comprise the majority of budget outlays, at 85.3 and 96.1 percent, respectively. Indirect costs are higher for state-delivered programs (13.6 percent of state costs, vs. 1.3 percent of contracted costs), likely due to indirect costs being infrequently claimed on local health department contracts, and thus not incurred by the state health department as the budget holder. For the program overall, salary and fringe represent 89.5 percent of total budgetary costs, indirect costs 8.9 percent, with supplies, travel, and miscellaneous expenses <1 percent.

The disease-specific partner services costs and outcomes are listed in Table 2. Cost metrics are not separate and should not be added together; they represent different ways of allocating total costs to estimate investment at different steps of the partner services cascade. Overall, 25.2 percent of all newly diagnosed cases were assigned for partner services, although this varied across

Table 1: Distribution of HIV/STD Partner Services Costs, New York State, 2014

Budget item	State Health Department Direct Costs (\$)*	Percent of Total State Health Department Costs (%)	Contracts to Local Health Departments (\$)	Percent of Total Local Health Department Costs (%)	Total Program Costs (\$)	Percent of Total Program Costs (%)
	(a)		(b)		(a + b)	
Salary	\$2,324,797	54.9	\$1,730,969	66.1	\$4,055,767	59.2
Fringe	\$1,286,840	30.4	\$786,045	30.0	\$2,072,885	30.3
Indirect	\$576,371	13.6	\$34,315	1.3	\$610,686	8.9
Supplies/ equipment	\$8,177	0.2	\$17,263	0.7	\$25,440	0.4
Travel	\$30,007	0.7	\$25,599	1.0	\$55,606	0.8
Miscellaneous	\$4,578	0.1	\$25,102	1.0	\$29,680	0.4
Total	\$4,230,769	100	\$2,619,293	100	\$6,850,063	100

Data sources: Statewide financial management, contract management, and human resource administration systems.

*All costs are in \$2014, and from the perspective of the New York State Department of Health's Division of HIV/STD/HCV Prevention.

disease, with 95.6, 89.2, 58.6, and 16.9 percent of HIV, syphilis gonorrhea, and chlamydia cases assigned, respectively. Across the four diseases, average costs for HIV/STD partner services were \$580 per case assignment, \$703 per interview, \$1,169 per notification, and \$2,936 per key performance indicator. These outcomes differed by disease, based on relative time and effort spent on investigations. The program paid \$1,111 for every HIV partner services assignment, \$1,609 for every HIV partner services interview, \$1,936 for each partner of a newly diagnosed HIV-positive notified of their exposure, and \$20,255 for each new HIV-positive partner identified. For syphilis investigations, the program paid \$1,028 for each syphilis diagnosis assigned for investigation, \$1,072 for every interview conducted with an index patient, \$950 for each partner notified of syphilis exposure, and \$1,666 for each syphilis partner infected and brought to treatment, or preventively treated for syphilis exposure. Costs for gonorrhea and chlamydia investigations were comparable, with cost allocation indicating \$502 and \$524 per partner services assignment, respectively. Among gonorrhea assignments, each index patient interviewed cost \$608, each partner notified \$1,018, and each partner brought to treatment or preventively treated \$2,666. Among chlamydia assignments, each index patient interviewed cost \$635, each partner notified \$1,214, and each partner brought to treatment or preventively treated \$2,515.

Table 2: Disease-Specific Partner Services Costs and Outcomes, New York State, 2014

	<i>HIV</i>	<i>Syphilis</i>	<i>Gonorrhea</i>	<i>Chlamydia</i>	<i>Total</i>
Staff effort [†] , % of time spent per disease	11.5	9.8	28.4	50.3	100
Allocated program cost [‡] , \$	789,949	667,897	1,943,675	3,448,541	6,850,063
Program outcomes (N)					
Cases diagnosed	744	729	6,616	38,845	46,934
Index cases assigned	711	650	3,875	6,575	11,811
Index patients interviewed	491	623	3,199	5,432	9,745
Partners notified	408	703	1,909	2,841	5,861
Key performance indicator*	39	401	729	1,371	2,540
Cost metrics (\$)					
Cost per index case assigned	1,111	1,028	502	524	580
Cost per index case interview	1,609	1,072	608	635	703
Cost per partner notification	1,936	950	1,018	1,214	1,169
Cost per key performance indicator	20,255	1,666	2,666	2,515	2,697

Data sources: Program outcomes from HIV and STD statewide surveillance systems; staff effort estimate from mean effort allocation data (Martin et al. 2015); total program cost from statewide financial management, contract management, and human resource administration systems.

*For HIV, the key performance indicator represents notified partners found to be newly diagnosed HIV-positive. Key performance indicators for syphilis, gonorrhea, and chlamydia represent the number of notified partners who were infected and brought to treatment, or preventively treated for exposure.

[†]Staff effort represents the percentage of staff time devoted to each disease, based on the mean time to process each type of case (Martin et al. 2015) and the total number of cases processed during the year.

[‡]Allocated program area costs based on staff effort spent conducting disease investigations for each type of infection. This represents the percentage of total program costs (\$6.85 million) spent on each disease. All costs are in \$2014 and from the perspective of the New York State Department of Health’s Division of HIV/STD/HCV Prevention.

DISCUSSION

This analysis is unique in integrating cost, effort, and outcomes data, providing a meta-perspective of partner services financing from the NYS health department’s perspective. From a programmatic perspective, this analysis considers the indirect costs of managing and sustaining partner services programs, which includes staff downtime and the costs of hiring, training, or re-allocating staff effort to other public health activities. This cost analysis perspective also provides baseline estimates from which to assess the longer-term impact and cost-effectiveness of disease-specific interventions for HIV and STDs.

Higher per assignment costs for HIV and syphilis investigations reflect the more time-intensive nature of those cases, taking on average 2.2 times and 2.0 times longer than a gonorrhea investigation to complete. HIV and syphilis cases often yield more partners needing notification, as men who have sex with men (MSM) comprise a substantive percentage of individuals diagnosed. MSM are more likely to have concurrent partnerships and recently exposed partners in need of follow-up, resulting in additional effort on the part of the DIS to ensure treatment of index and partner cases, and in the case of HIV, linkage to care (Glick et al. 2012; Martin et al. 2015). Although the cost per new HIV diagnosis identified was the highest of all diseases (\$20,255), this estimate is within the ceiling of \$22,909 per new HIV diagnosis that is considered to be cost-saving, due to the high medical costs to treat HIV infection (Farnham, Sansom, and Hutchinson 2012; Owusu-Edusei et al. 2013; Huang et al. 2014). Cost estimates of partner services outcomes for HIV and syphilis fall within the range of other published cost research when adjusted for inflation and costing methodology (Peterman et al. 1997; Shrestha et al. 2009; Shrestha, Sansom, and Farnham 2012).

With most program costs (89.5 percent) allocated to personnel, evaluating costs from the staff allocation perspective allows public health programs to better understand where workers focus their effort. Given the high volume of gonorrhea and chlamydia diagnoses relative to HIV and syphilis, it is unsurprising that DISs spend most of their time investigating these infections. However, a smaller percentage of these diagnosed cases is assigned to partner services staff (95.6 and 89.2 percent of HIV and syphilis cases are assigned, compared to 58.6 and 16.9 percent of gonorrhea and chlamydia cases). These differences in assigning cases reflect internal prioritization grids, which emphasize follow-up for HIV and syphilis cases. Resource constraints make it difficult to follow up on all cases; thus, targeted approaches for gonorrhea and chlamydia are essential to ensuring that partner services are delivered in ways that effectively interrupt disease transmission networks (Golden et al. 2003). Evaluating these prioritization grids and their subsequent process outcomes may identify opportunities to improve operations and reduce costs per outcome within HIV/STD partner services programs. For example, increasing the interview rate for assigned HIV cases (69 percent) to that of syphilis (96 percent) may improve downstream outcomes, such as partners notified and undiagnosed positives identified.

This work has already informed key programmatic and policy changes to NYS partner services programming. Better understanding of the costs and time associated with achieving key performance outcomes for each disease

has contributed to revised internal disease prioritization grids. Among other changes, the new grid deemphasizes some chlamydia investigations, permitting more resources to be dedicated to HIV and STD co-infected cases, and new investigations focused on linking out-of-care HIV-positive persons back to care. This work has facilitated a more data-driven decision-making process to improve program efficiency. A series of region-specific, worker-level data reports were designed and incorporated into a new continuous quality improvement methodology to identify best practices and develop corrective action plans for areas needing improvement. This work has also contributed to standardized partner services protocols, work plans, and job functions between state- and county-funded DISs. Finally, this work has prompted the search for less costly ways to accomplish this evidence-based intervention, including exploring partnering with community-based organizations.

As with most economic evaluations, this analysis has important limitations. Cost estimates are presented from the state perspective and do not reflect local health department costs related to supporting or sustaining HIV/STD partner services programs outside of contractual budgets, thus underestimating the true cost of maintaining these programs at the local level. Indirect costs were inconsistently claimed by local health departments; this also underestimates the cost to contracted agencies. Administrative costs for higher-level management were excluded, due to the challenges of allocating their time to specific programmatic activities. DISs funded on these initiatives are hired and assumed to spend 100 percent of their time on HIV/STD partner services activities, thus not accounting for outreach or educational interventions, which may have indirect public health impacts. The extent to which variations in program costs are due to differences in local health department funding, demographic characteristics of cases assigned, and/or regional morbidity is not analyzed but represents an important avenue of future inquiry. Finally, the key performance indicators (number of notified partners infected and treated for STDs or newly diagnosed for HIV) do not capture the benefits of counseling, notification, and testing among partners who test negative, which may reduce risky behavior (Kamb et al. 1998).

Cost analyses and program assessments help local decision makers target program improvements, and they lay the foundation for more robust cost-effectiveness and return on investment research. This evaluation can serve as a point of comparison for other states undertaking cost analyses. Similar data from other settings would allow us to better understand how differences in resource allocation, funding, and intervention strategies influence program outcomes. Continued research on the long-term economic and public health impact of HIV/STD

prevention programs is needed, but practice-based cost and program evaluation research is essential to accurately estimate the value of partner services and other public health interventions at local, state, and national levels.

ACKNOWLEDGMENTS

Joint Acknowledgment/Disclosure Statement: The authors are grateful to the staff of the New York State Department of Health AIDS Institute's Division of HIV/STD/Hepatitis C Prevention and HIV/STD Field Services Bureau for technical assistance and comments on earlier drafts, to partner services staff in participating local health departments, and to the Institute's Bureau of STD Prevention and Epidemiology for providing program performance data.

This work was supported by a grant from the Robert Wood Johnson Foundation's National Coordinating Center for PHSSR [grant ID# 71130 to E.G.M. and J.M.T.] and does not represent the views of the funding agencies or the New York State Department of Health.

Disclosures: None.

Disclaimer: None.

REFERENCES

- Aral, S. O., and J. F. Blanchard. 2012. "The Program Science Initiative: Improving the Planning, Implementation and Evaluation of HIV/STI Prevention Programs." *Sexually Transmitted Infections* 88 (3): 157–9.
- CDC. 2008. "Recommendations for Partner Services Programs for HIV Infection, Syphilis, Gonorrhea, and Chlamydial Infection." *MMWR. Recommendations and Reports* 57 (RR-9): 1–83; quiz CE1-4.
- CDC. 2010. "Partner Services Evaluation Field Guide." DHAP and DSTDP.
- CDC. 2015a. "HIV Surveillance Report, 2014."
- CDC. 2015b. *Sexually Transmitted Disease Surveillance, 2014*. Atlanta, GA: U.S. Department of Health and Human Services.
- Chesson, H. W., P. Harrison, C. R. Scotton, and B. Varghese. 2005. "Does Funding for HIV and Sexually Transmitted Disease Prevention Matter? Evidence from Panel Data." *Evaluation Review* 29 (1): 3–23.
- Du, P., F. B. Coles, T. Gerber, and L.-A. McNutt. 2007. "Effects of Partner Notification on Reducing Gonorrhea Incidence Rate." *Sexually Transmitted Diseases* 34 (4): 189–94.
- Farnham, P. G., S. L. Sansom, and A. B. Hutchinson. 2012. "How Much Should We Pay for a New HIV Diagnosis? A Mathematical Model of HIV Screening in US Clinical Settings." *Medical Decision Making* 32 (3): 459–69.

- Frick, K. D. 2009. "Micro-Costing Quantity Data Collection Methods." *Medical Care* 47 (7 Suppl 1): S76–81.
- Glick, S. N., M. Morris, B. Foxman, S. O. Aral, L. E. Manhart, K. K. Holmes, and M. R. Golden. 2012. "A Comparison of Sexual Behavior Patterns among Men Who Have Sex with Men and Heterosexual Men and Women." *Journal of Acquired Immune Deficiency Syndromes* 60 (1): 83–90.
- Golden, M. R., M. Hogben, H. H. Handsfield, J. S. S. Lawrence, J. J. Potterat, and K. K. Holmes. 2003. "Partner Notification for HIV and STD in the United States: Low Coverage for Gonorrhea, Chlamydial Infection, and HIV." *Sexually Transmitted Diseases* 30 (6): 490–6.
- Haddix, A. C., S. M. Teutsch, and P. S. Corso. 2003. *Prevention Effectiveness: A Guide to Decision Analysis and Economic Evaluation*. New York: Oxford University Press.
- Hogben, M., D. Collins, B. Hoots, and K. O'Connor. 2016. "Partner Services in Sexually Transmitted Disease Prevention Programs: A Review." *Sexually Transmitted Diseases* 43 (2 Suppl 1): S53–62.
- Honore, P. A., and J. F. Costich. 2009. "Public Health Financial Management Competencies." *Journal of Public Health Management and Practice* 15 (4): 311–8.
- Honore, P. A., R. L. Clarke, D. M. Mead, and S. M. Menditto. 2007. "Creating Financial Transparency in Public Health: Examining Best Practices of System Partners." *Journal of Public Health Management and Practice* 13 (2): 121–9.
- Hoots, B. E., P. D. MacDonald, L. B. Hightow-Weidman, P. A. Leone, and W. C. Miller. 2012. "Developing a Predictive Model to Prioritize Human Immunodeficiency Virus Partner Notification in North Carolina." *Sexually Transmitted Diseases* 39 (1): 65–71.
- Huang, Y. L., A. Lasry, A. B. Hutchinson, and S. L. Sansom. 2014. "A Systematic Review on Cost Effectiveness of HIV Prevention Interventions in the United States." *Applied Health Economics and Health Policy* 13 (2): 149–56.
- Kamb, M. L., M. Fishbein, J. M. Douglas, Jr., F. Rhodes, J. Rogers, G. Bolan, J. Zenilman, T. Hoxworth, C. K. Malotte, M. Iatesta, C. Kent, A. Lentz, S. Graziano, R. H. Byers, and T. A. Peterman. 1998. "Efficacy of Risk-Reduction Counseling to Prevent Human Immunodeficiency Virus and Sexually Transmitted Diseases: A Randomized Controlled Trial." *Journal of the American Medical Association* 280 (13): 1161–7.
- Lasry, A., S. L. Sansom, K. A. Hicks, and V. Uzunangelov. 2012. "Allocating HIV Prevention Funds in the United States: Recommendations from an Optimization Model." *PLoS ONE* 7 (6): e37545.
- Macke, B. A. 2000. "Predictors of Time Spent on Partner Notification in Four US Sites." *Sexually Transmitted Infections* 76 (5): 371–4.
- Macke, B. A., M. Hennessy, M. M. McFarlane, and M. J. Bliss. 1998. "Partner Notification in the Real World: A Four Site Time-Allocation Study." *Sexually Transmitted Diseases* 25 (10): 561–8.
- Martin, E. G., W. Feng, F. Qian, and B. Johnson. 2015. "Delivering Partner Services to Reduce Transmission and Promote Linkage to Care: Process Outcomes Varied for Chlamydial Infection, Gonorrhea, HIV, and Syphilis Cases." *Journal of Public Health Management and Practice* 23 (3): 242–46.

- Mays, G. P., S. A. Smith, R. C. Ingram, L. J. Racster, C. D. Lamberth, and E. S. Lovely. 2009. "Public Health Delivery Systems: Evidence, Uncertainty, and Emerging Research Needs." *American Journal of Preventive Medicine* 36 (3): 256–65.
- Owusu-Edusei Jr, K., H. W. Chesson, T. L. Gift, G. Tao, R. Mahajan, M. C. Ocfemia, and C. K. Kent. 2013. "The Estimated Direct Medical Cost of Selected Sexually Transmitted Infections in the United States, 2008." *Sexually Transmitted Diseases* 40 (3): 197–201.
- Peterman, T. A., K. E. Toomey, L. W. Dicker, A. Zaidi, J. E. Wroten, and J. Carolina. 1997. "Partner Notification for Syphilis: A Randomized, Controlled Trial of Three Approaches." *Sexually Transmitted Diseases* 24 (9): 511–8.
- Rahman, M. M., M. Khan, and D. Gruber. 2015. "A Low-Cost Partner Notification Strategy for the Control of Sexually Transmitted Diseases: A Case Study From Louisiana." *American Journal of Public Health* 105 (8): 1675–80.
- Rorie, M., H. Zhang, J. Zhu, W. Song, K. Cesa, A. Essuon, M. Mulatu, and N. Duffy. 2014. "Monitoring and Evaluation of HIV Partner Services Programs in the United States: Approaches, Structures, and Lessons Learned." *Sexually Transmitted Diseases* 41 (S1) (2014 STD Prevention Conference).
- Shrestha, R. K., S. L. Sansom, and P. G. Farnham. 2012. "Comparison of Methods for Estimating the Cost of Human Immunodeficiency Virus-Testing Interventions." *Journal of Public Health Management and Practice* 18 (3): 259–67.
- Shrestha, R. K., E. B. Begley, A. B. Hutchinson, S. L. Sansom, B. Song, K. Voorhees, A. Busby, J. Carrel, and S. Burgess. 2009. "Costs and Effectiveness of Partner Counseling and Referral Services with Rapid Testing for HIV in Colorado and Louisiana, United States." *Sexually Transmitted Diseases* 36 (10): 637–41.
- Smith, M. W., and P. G. Barnett. 2003. "Direct Measurement of Health Care Costs." *Medical Care Research and Review* 60 (3): 74–91.
- Sullivan, S. D., J. A. Mauskopf, F. Augustovski, J. Jaime Caro, K. M. Lee, M. Minchin, E. Orlewska, P. Penna, J. M. Rodriguez Barrios, and W. Y. Shau. 2014. "Budget Impact Analysis-Principles of Good Practice: Report of the ISPOR 2012 Budget Impact Analysis Good Practice II Task Force." *Value Health* 17 (1): 5–14.

SUPPORTING INFORMATION

Additional supporting information may be found online in the supporting information tab for this article:

Appendix SA1: Author Matrix.