Costs of a Public Health Model to Increase Receipt of Hepatitis-Related Services for Persons With Mental Illness

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Objective: **This study examined the costs and impact on receipt of hepatitis and HIV testing and hepatitis immunization services of a public health intervention model that was designed for use by persons with serious mental illness and co-occurring substance use disorders.** ***Methods:*** **Between 2006 and 2008, a random sample of 202 nonelderly, predominantly African-American males with a psychotic or major depressive disorder and a co-occurring substance use disorder was recruited at four community mental health outpatient programs in a large metropolitan area. Participants were randomly assigned at each site to enhanced treatment as usual (N=97), including education about blood-borne diseases and referrals for testing and vaccinations, or to an experimental intervention (N=105) that provided on-site infectious disease education, screening of risk level, pretest counseling, testing for HIV and hepatitis B and C, vaccination for hepatitis A and B, and personalized risk-reduction counseling. The authors compared the two study groups to assess the average costs of improving hepatitis and HIV testing and hepatitis A and B vaccination in this population.** ***Results:*** **The average cost per participant was $423 for the intervention and $24 for the comparison condition (t=52.7, df=201, p<.001). The costs per additional person tested was $706 for hepatitis C, $776 for hepatitis B, and $3,630 for HIV, and the cost per additional person vaccinated for hepatitis was $561.** ***Conclusions:*** **Delivery of hepatitis and HIV public health services to persons with serious mental illness in outpatient mental health settings can be as cost-effective as similar interventions for other at-risk populations. (*Psychiatric Services* 64:127–133, 2013; doi: 10.1176/appi.ps.000852011)**

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Compared with other persons, people with serious mental illness and co-occurring substance use disorders have elevated risk for hepatitis (1–3), but they also have lower rates of testing and vaccination (4). To reduce this unmet need, public health hepatitis services could be offered within public outpatient mental health programs (5,6). Many people with serious mental illness may be more likely to utilize public health hepatitis services at these locations than at non–mental-health programs where these services are usually available (7,8). However, the additional costs to public mental health systems, many of which are already fiscally strained, are a significant barrier to the implementation and sustainability of these services in outpatient mental health programs. At present, information about approaches to minimize the costs of providing these services in such programs is limited.

Nearly 3% of persons with serious mental illness are infected with HIV, and nearly 20% are infected with the hepatitis C virus (HCV) (3), rates that are ten to 15 times the rates of infection for the U.S. population (9,10). The co-occurrence of a substance use disorder greatly increases this level of risk, with almost half of those with a lifetime substance use disorder testing positive for HIV, HCV, or

both (3). However, evidence also indicates that fewer than half of persons with serious mental illness have ever been screened for hepatitis and only 10%–18% have been immunized for the hepatitis B virus (HBV) (4,11,12), rates that are well below average for the U.S. population (13). This pattern is consistent with evidence of lower rates of receipt of a range of preventive medical care services among people with serious mental illness compared with other persons (14–18).

To improve rates of receipt of public health hepatitis and HIV services among persons with serious mental illness and co-occurring disorders, the conventional model of service delivery may require adaptation for delivery in outpatient mental health treatment settings (5,6). However, adaptations of existing service delivery models often require costly reengineering of a clinic's operation or staffing changes (19). These additional costs could critically affect whether already short-staffed, underfunded community mental health programs adopt a service model.

This study examined the costs and impacts on receipt of hepatitis and HIV services of an experimental service delivery approach called Screen, Test, Immunize, Reduce Risk, and Refer, or STIRR (5). STIRR services are delivered and coordinated in three sessions by a nurse who has received training in the STIRR approach (5,20). The first session of the STIRR intervention includes infectious disease education; screening of risk level; pretest counseling; blood draw for testing of HIV, HBV, and HCV; first vaccination with Twinrix (hepatitis A inactivated and hepatitis B recombinant); and personalized risk-reduction counseling. During two follow-up sessions, clients are provided posttest and risk-reduction counseling, medical referral and linkage (if needed), and additional Twinrix vaccinations.

STIRR services are designed for importation into outpatient mental health programs without significant modification of the programs' service environment or usual service delivery and do not require much up-front investment in personnel, equipment, or administrative overhead. The STIRR nurse need not be an employee of any mental health clinic, and the entire STIRR intervention can take place in a small underutilized space inside a clinic, such as a hallway or small room. Training of the STIRR nurse is led by a physician or nurse who is also an infectious disease expert, focuses on how to provide infectious disease prevention services, and includes information on mental illness. Except for this training, the STIRR nurse does not require any extra training or specialized background. As a result, STIRR services may overcome implementation barriers that have posed difficulty for other models (19).

Prior research studies have indicated that programs providing hepatitis and HIV screening and vaccination against hepatitis A and B achieve acceptable cost-effective ratios if they are targeted to sufficiently high-risk populations (21–29) (Table 1). In a 1993 decision analysis, Bloom and colleagues (21) concluded that screening for and vaccinating against hepatitis B among high-risk adults results in net savings of health care costs and extends life. In 2005, Paltiel and colleagues (28) found that screening for HIV in high-risk adult populations every five years cost $50,000 per quality-adjusted life year (QALY) gained, compared with $71,000 per QALY for a medium-risk population and $169,000 per QALY for the U.S. general population. Greengold and colleagues (27), in 2009, found that a nurse-led screening and risk reduction intervention—a three-part series of vaccinations for hepatitis A and B —improved compliance among homeless adults and resulted in net savings and greater QALYs compared with standard management plus participant tracking.

A scarcity of information about the proximal effects of screening for hepatitis C on case identification, treatment receipt, and future outcomes has impeded consensus on the cost-effectiveness of screening in the United States (29). However, in a 2006 study commissioned for the British National Health Service's Health Technology Assessment Program, Castelnuovo and colleagues (23) concluded that screening for hepatitis C among former injection drug users and patients receiving substance abuse treatment services, both high-risk populations, reached acceptable levels of cost-effectiveness.

The purpose of this assessment was to contextualize the costs associated with implementation of STIRR from the payer perspective by contrasting them with the expected improvements in receipt of hepatitis and HIV testing and hepatitis A and B vaccination. The study data were from a randomized trial that compared outcomes of STIRR and an enhanced treatment-as-usual condition among clients of community outpatient mental health clinics and day treatment programs who were receiving treatment for a serious mental illness between 2006 and 2008 (20). We report estimates of STIRR services' costs divided by the additional numbers of clients who were tested for HCV, HBV, and HIV or vaccinated for hepatitis A and B. These ratios can be interpreted as the estimated incremental reduction of unmet need for these services that is achieved for a given cost, which is a measure of program efficiency. Although these estimates in principle can be incorporated into a decision analysis to obtain estimates of long-term cost-effectiveness, such an analysis is beyond the scope of this study.

Methods

Sample and participants

Between 2006 and 2008, 236 participants were recruited from four publicly funded community mental health programs in Baltimore City that primarily serve persons with serious mental illness. Two programs were freestanding, not-for-profit community clinics, which provide outpatient mental health and substance abuse treatment and rehabilitation services. The third and fourth programs, respectively, were an outpatient mental health clinic and an assertive community treatment program at a university-affiliated teaching hospital. Approval for the study was obtained from the University of Maryland School of Medicine and Dartmouth Medical School and from the institutional review boards associated with each study site.

All participants were English speaking, were aged 18–65 years, and had

Table 1

Decision analyses of the cost-effectiveness of hepatitis and HIV screening and hepatitis vaccination

Author	Study intervention	Populations	Key assumptions	Results
Bloom et al., 1993	Hepatitis B vaccination (screen and vaccinate)	High-risk adults with hepatitis B incidence of 5% per year; general population of US adults	3-part vaccination series completion rate of 33% among high-risk adults and 50% among US adults; vaccination costs of $225 per person, in 1989 dollars	For high-risk adults, net savings per case prevented and per year of life saved; for US adults, costs of $16,274 per case prevented and $279,184 per year of life saved, in 1989 dollars
Kim et al., 2006	Hepatitis B vaccination	Patients at HIV counseling and testing sites	Routine vaccination costs less and prevents more hepatitis B cases compared with screen and vaccinate	Routine vaccination costs $4,400 per quality adjusted life year (QALY) gained, in 2000 dollars
Castelnuovo et al., 2006	Hepatitis C screening	Multiple populations	Screening 1,000 former injection drug users at general medical practices identifies 77 persons with hepatitis; screening 1,000 patients at drug and alcohol treatment facilities identifies 106 persons with hepatitis C	For former injection drug users, screening costs £20,059 per QALY gained, in 2004 pounds; for patients receiving alcohol and drug treatment, screening costs £17,515 per QALY gained, in 2004 pounds.
Greengold et al., 2009[a]	Hepatitis A and B vaccination using four strategies: nurse case management plus incentives and tracking (NCMIT), standard case management plus incentives and tracking (SIT), standard case management plus incentives only (SI), and usual care (UC)	Homeless adults	Hepatitis B prevalence among homeless adults is 30.8%, and hepatitis A prevalence among high-risk homeless adults is 30%; completion rates for 3-part vaccination range from 54%–67% depending on the intervention; intervention costs: $431.90 for NCMIT, $425.00 for SIT, $315.00 for SI, and $241.90 for UC, in 2006 dollars	NCMIT was less expensive and more effective in terms of QALYs than all other intervention models, including UC; lifetime total costs per person were $849.20 for NCMIT and $2,153.30 for UC, in 2006 dollars
Paltiel et al., 2005	Routine HIV counseling, testing, and referral (HIVCTR)	High-risk adults, adults meeting Centers for Disease Control (CDC) and Prevention threshold risk of 1.0% prevalence, and general population of US adults with .1% prevalence	High-risk adults have 3.0% prevalence of undiagnosed HIV and 1.2% annual incidence of HIV; adults meeting CDC threshold risk have .12% incidence of HIV; and US adults have .01% incidence of HIV	For high-risk adults, receipt of HIVCTR every 5 years resulted in cost-effectiveness ratios of $50,000 per QALY gained, in 2001 dollars; the same strategy resulted in ratios of $71,000 per QALY for the CDC threshold population and $169,000 per QALY for US adults

[a] Informed by randomized trial

a current or lifetime diagnosis of a substance use disorder. Most participants were African American (N=170, 72%) and male (N=146, 62%). Their mean±SD age was 46.6±8.1 years. Forty-two percent (N=136) had not completed high school. All participants had been given an *ICD-9-CM* diagnosis based on chart review and confirmation by clinic staff of a schizophrenia spectrum disorder (codes 295.1–7; N=165, 70%), a bipolar disorder (codes 296.0x, 296.4–7, 296.80, and 296.89; N=40, 17%), or a major depressive disorder (codes 296.20–36; N=31, 13%). Participants gave written informed consent after receiving a complete description of the study.

Design

At each study site, participants were randomly assigned to receive STIRR (N=118) or enhanced usual care (N=118). Persons assigned to STIRR proceeded directly to the first session of the intervention.

The enhanced treatment-as-usual condition was similar to services typically offered to clients with serious mental illness by publicly funded mental health service systems in the United States. Participants in both conditions were offered the same

educational materials about bloodborne diseases. For testing and vaccination, participants in the comparison condition were directed to their current medical care provider. If participants were not engaged with a physician or medical group, they were given a list of accessible public clinics that offered blood testing and vaccination for hepatitis A and B.

Clinical outcomes

Outcomes were measured by the numbers of persons who reported having received hepatitis B or C testing, HIV testing, and vaccination for hepatitis A and B during the six months after randomization (20). We used outcomes data only from study participants who had a clinical need for screening or vaccination (no HIV or hepatitis blood test for six months preceding the study or no prior vaccination for hepatitis A and B). Therefore, 34 participants who recently had been tested and were already immunized were not included in the sample for this study because they were not eligible for blood testing or vaccination. Of the 202 participants with clinical need, 105 were in the STIRR condition and 97 were in the comparison condition. Even though study records documented vaccinations and blood tests provided by STIRR, only self-reported measures were available for the comparison condition. Consequently, to be consistent across conditions, only self-reported measures of testing and vaccination were used.

Costs

Total implementation and delivery costs included the costs of training and setting up STIRR services within the four programs, blood draws and tests, vaccine supplies, consumer products provided to clients, and counseling and case management around referral to medical care and reminders about upcoming appointments. Using standard methods to assign costs, we multiplied the quantity of each resource by either an observed or an imputed unit cost value (30). Unit costs in 2008 dollars and sources are shown in Table 2. In the enhanced usual care condition, unit costs for vaccine administration ($20.00) and blood draw ($3.00) were based on the 2008 Medicare fee schedule for Maryland.

The duration of staff participation in training and setup—training the STIRR nurse in the delivery of STIRR services, orienting staff at outpatient programs, and arranging for space at the programs—was recorded by a research assistant. We included the costs of the time spent by the STIRR nurse and other providers in encounters with clients and administrative time spent by the nurse interfacing with staff at each clinical site, completing referrals of patients to external providers, record keeping and preparing clinical encounter notes, and attending staff meetings. In addition, the nurse spent some amount of time waiting for patients who were late for or who missed an appointment. We estimate that the STIRR nurse spent 1.5 minutes in administrative and other activities for each minute spent in clinical encounters. The STIRR nurse also sometimes consulted with a physician who was an infectious disease specialist, a psychiatrist, and a doctoral-level psychologist, who were available on an ad hoc basis, and the costs of their time were included.

In this randomized trial, a research administrator obtained medical supplies and contacted clients to remind them of upcoming STIRR appointments, and the cost of this time was included. In calculating costs for personnel, we counted salary plus a 34% markup for fringe benefits. We also applied an administrative overhead cost of 15% of personnel time, a typical rate in many nonprofit health care organizations (31). In terms of other cost components, the number of blood tests was abstracted from billing invoices from the laboratory that processed the blood samples and was confirmed by study checklists. Vaccinations were recorded by the STIRR nurse. Equipment costs for using a previously owned centrifuge to collect blood samples were estimated by using the straight-line depreciation method. Yearly costs for the use of space at each clinic ($60) were imputed.

Table 2

Unit costs associated with implementation of STIRR services, in 2008 dollars[a]

Item	Cost ($)	Source
Hourly salary and fringe benefits[b]		
Nurse	37.41	Study records
Infectious disease physician	126.30	Study records
Physician (psychiatrist or other)	120.60	Study records
Ph.D.-level psychologist	63.65	Study records
Appointment and supplies coordinator	22.78	Study records
Social worker at mental health clinic	40.20	Bureau of Labor Statistics, Occupational Employment Statistics, 2008
Vaccine dose	38.64	Centers for Disease Control and Prevention, 2008
Information packet with razor and condoms	5.20	Study receipts
Blood test		
Hepatitis B		Maryland Medicare[c]
HBsAb	14.17	
HBsAG	14.43	
HBcAb	16.84	
Hepatitis C antibody	19.94	Maryland Medicare[c]
Hepatitis C RNA, amplified probe confirmation	43.42	Maryland Medicare[c]
HIV-1 and HIV-2, single assay	19.17	Maryland Medicare[c]
Centrifuge	284.00	Study receipts

[a] STIRR, Screen, Test, Immunize, Reduce Risk, and Refer

[b] Fringe benefits costs were calculated as 34% of salary

[c] Data from the clinical diagnostic laboratory fee schedule

Results

The average total cost of the STIRR intervention was $423±$90 per

participant (Table 3). The average total cost of enhanced usual care—$24±$22 per participant—was $399 less than the cost of STIRR ($p<.001$).

Table 3 also shows the average costs per additional person tested or vaccinated in STIRR compared with the comparison condition. We calculated these costs by dividing the total costs for participants assigned to STIRR by the improvement (that is, difference) in numbers of participants achieving each study outcome. The cost per additional participant tested was $706 for hepatitis C, $776 for hepatitis B, and $3,630 for HIV. The cost per additional participant who was vaccinated against hepatitis A and B was $561.

To interpret these average costs, it is helpful to extrapolate the predicted effects on STIRR services achieved by a given dollar expenditure. These improvements can be calculated by dividing a hypothetical level of expenditure by each average cost. For example, suppose a public agency spends $482,000 on STIRR services, the approximate annual cost of a STIRR program including blood testing and hepatitis vaccination. If a STIRR nurse sees 1,140 clients during a year (22.8 clients per week worked)—assuming 760 hours total annual nurse clinical time and STIRR encounters lasting an average of 40 minutes—on average, the STIRR program would be expected to test an additional 683 persons for hepatitis C, 621 persons for hepatitis B, and 133 persons for HIV and to vaccinate an additional 859 persons for hepatitis A and B during the first year of operation. However, if the nurse sees two-thirds that many clients (752 clients per year or 15 per week), the cost per additional person tested or vaccinated would increase by 50%. Thus the program's cost-effectiveness is sensitive to whether the volume of new clients remains consistent.

Discussion

On average, the cost per client at the four test sites was $399 more for STIRR services than for education and referral to offsite testing, but STIRR services resulted in improvements in hepatitis and HIV testing and hepatitis vaccination among persons with serious mental illness and a co-occurring substance use disorder (20). These results suggest that during the first year of operation, a full-time STIRR program may cost around $482,000 and may result in testing of an additional 683 persons for hepatitis C, 621 persons for hepatitis B, and 133 persons for HIV and in vaccination for hepatitis A and B of an additional 859 persons. Evidence from past research suggests that STIRR services may achieve acceptable levels of cost-effectiveness if they are targeted to sufficiently high-risk populations and a program sustains a sufficient volume of clients (21–25,27–29).

STIRR services cost slightly less and achieved a higher rate of hepatitis A and B vaccination than a similar nurse case management intervention for vaccinating homeless adults (6,27). Compared with STIRR, that intervention cost $10 more per person ($432) and had vaccinated 10% fewer clients for hepatitis A and B after six months (68%) but was nonetheless deemed cost-saving by a decision analysis (20,27). Risk levels for hepatitis and HIV infections among persons with serious mental illness and co-occurring substance use disorders are similar to risk levels for other high-risk groups (23,28). Consequently, future hepatitis-related medical care costs are likely to be high in this population. Published prevalence estimates suggest that 8.4%–16.9% of persons with serious mental illness and co-occurring substance use disorders may develop chronic hepatitis C (persistent hepatitis C RNA in the blood for six or more months) (3). Discounted lifetime treatment costs

Table 3

Costs and receipt of services for STIRR and enhanced usual care (control)[a]

	STIRR (N=105)[b]		Control (N=97)[c]		Difference			
Variable	N	%	N	%	M	SD	t[d]	p
Costs per participant (mean±SD $)								
Total	423±90		24±22		399	93	52.7	<.001
Personnel	168±89		2±10		166	90	26.2	<.001
Blood tests, vaccine, and other supplies	196±13		22±20		174	24	71.5	<.001
Fixed costs								
Training and setup	50±0		50±0					
Equipment	3±0		3±0					
Clinic space	6±0		6±0					
Receipt of services								
Testing								
Hepatitis C	70	86	10	14				
Hepatitis B	69	86	14	19				
HIV	18	86	6	46				
Immunization for hepatitis A and B	82	78	7	7				
Costs per additional person (mean±SD $)[e]								
Testing								
Hepatitis C	706±165							
Hepatitis B	776±181							
HIV	3,630±846							
Immunization for hepatitis A and B	561±131							

[a] STIRR, Screen, Test, Immunize, Reduce Risk, and Refer

[b] A total of 81 participants needed a hepatitis C test, 80 a hepatitis B test, 21 an HIV test, and 105 vaccination (20).

[c] A total of 69 participants needed a hepatitis C test, 73 a hepatitis B test, 13 an HIV test, and 97 vaccination(20).

[d] df=201

[e] Costs of implementation and operation plus additional costs for testing and vaccination divided by additional participant

per person treated for chronic hepatitis C are estimated to exceed $100,000 (32). Thus expected costs of hepatitis C could be as much as $8.4–$16.9 million for every 1,000 persons at risk. STIRR services, consequently, would be cost-neutral if they reduced costs by only 2.4%–4.8%.

Whether STIRR would produce this level of savings is unknown, but decision analyses indicate the prospect of substantial savings (21,23,27). Besides future savings resulting from vaccination and the benefits of hepatitis C treatment, additional savings might accrue from STIRR's other clinical effects, which include reduced alcohol and illicit drug use and increased knowledge of risk reduction when sharing needles and engaging in other risky behaviors (20). Finally, recent advances in hepatitis C treatment and discoveries regarding the clinical benefits of early HIV treatment may improve the savings from STIRR and other prevention programs.

Two novel medications recently approved for use in hepatitis C treatment—boceprevir and telaprevir—have been shown to be more efficacious than other medications (33–35), and early treatment for HIV has been shown to reduce HIV transmission and improve clinical outcomes among people who are HIV positive (36).

In relation to dissemination, one of the advantages of the design of the STIRR model is that the STIRR team has little impact on direct or indirect costs of the host organization (5). Nevertheless, new dedicated financing would be needed to implement and sustain STIRR programs in a city, county, or state system. Managed care organizations that cover general medical care for STIRR's target population may be willing to finance STIRR services, given that these organizations are likely to incur the future health care costs resulting from hepatitis- and HIV-related morbidity, especially when care is financed by using a population capitation rate. Conversely, managed behavioral health care organizations may have little financial incentive to provide STIRR services, unless the same managed care entity is financially at risk for both mental health and general medical care.

In any implementation of STIRR programs, several factors may cause average costs and client outcomes to deviate from estimates presented in this study. First, the number of clients seen by the STIRR nurse in a given period could be more or less than estimated. This study's cost estimates implied that the STIRR nurse completed 1,140 encounters per year. A usual care implementation could achieve higher client volumes though routinization of the STIRR schedule at clinics, outreach to potential clients, and integration of STIRR services within clinics' usual care processes. However, inefficiencies that are due to care coordination problems or poor planning could result in lower volumes of clients and higher costs per person for vaccination or blood testing.

Over time, the proportion of STIRR clients receiving hepatitis A and B vaccinations would also depend on the overall number of unvaccinated people in a target population. This number could either increase or decrease depending on the balance between the number of unvaccinated high-risk persons entering the target population, the number of hepatitis vaccinations given by STIRR and other programs, and attrition. Second, the STIRR programs' administrative expenses for bookkeeping, managing supplies, complying with regulatory requirements, patient outreach, and payment of invoices could be more or less than estimated. Over time, training and set-up expenses ($50 per participant, $5,231 total) would be distributed over an increasing number of clients. However, there could be additional training expenses because of staff turnover and changes in medical practice requiring additional education. Finally, although the STIRR nurse would likely serve multiple clinics on a rotating schedule, we did not explicitly include travel costs in our estimates. Travel costs were subsumed in the nurse's salary because the nurse was not reimbursed for travel to study sites.

The finding that STIRR services cost $3,630 to test each additional person for HIV is attributable to the lower level of unmet need for HIV testing reported by participants. Only 21 of the 105 STIRR participants reported that they had not been tested for HIV in the six months prior to the study. This pattern, which has been identified in at least one other sample (4), suggested that many persons with serious mental illness either do not receive hepatitis tests when they are tested for HIV or they underreport hepatitis testing or overreport HIV testing. To the extent that persons in this population already were regularly tested for HIV, cotesting for hepatitis at HIV testing sites would improve hepatitis detection and add only approximately $65 in costs.

A limitation of this study was that the primary measures of clinical outcome (testing and vaccination) could have been unreliably reported. To check their validity, self-reported data were compared with the research study's internal records of vaccinations and laboratory invoices for participants in the STIRR condition. The two independent sources produced nearly identical rates. Another limitation was the unavailability of information about future costs and benefits of hepatitis C treatment for persons with serious mental illness and cooccurring substance use disorders. Although follow-up medical care for chronic hepatitis C is considered cost-effective (23), some medical care providers have reservations about treating people with serious mental illness with interferon (37), partly because of its adverse psychological side effects. Finally, idiosyncratic features of this sample—predominantly low-income African-American patients receiving mental health services at four programs in one urban area—could have either worsened or improved the cost-effectiveness of STIRR services.

Conclusions

Investments in service delivery approaches such as STIRR may improve receipt of recommended infectious disease services, including screening, hepatitis A and B vaccination, and risk reduction counseling, among persons with serious mental illness and cooccurring substance use disorders, an underserved, high-risk population. Dissemination of STIRR services in outpatient mental health programs may especially reduce the future costs and morbidity associated with treatment of

hepatitis B in this population. Those benefits alone may be expected to exceed the costs of STIRR services, especially in higher-risk areas where persons with serious mental illness are underserved by other providers.

However, the effect of disseminating STIRR services on overall health care costs depends critically on unknown or variable quantities, including the preventive effects of risk reduction counseling, the likelihood that STIRR clients successfully complete medical treatment for chronic hepatitis C, and the ability of a STIRR program to sustain a sufficient volume of clients.

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