Coping with Disasters: Estimation of Additional Capacity of the Mental Health Sector to Meet Extended Service Demands

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Abstract

Background: The September 11th disaster in New York City resulted in an increase in mental health service delivery as a vast network of providers responded to the urgent needs of those impacted by the tragedy. Estimates of current capacity, potential additional capacity to deliver services and of potential shortfall within the mental health sector are needed pieces of information for planning the responses to future disasters.

Aims of the Study: Using New York State data, to determine the distribution of clinical service delivery rates among programs and to examine an explanatory model of observed variation; to estimate potential additional capacity in the mental health sector; and to estimate shortfall based on this capacity and data from studies on the need and use of services post September 11th.

Methods: Empirical distributions of weekly clinical service delivery rates in programs likely to be used by persons with post disaster mental health problems were obtained from available data. Three regression models were fit to explain rate variation in terms of unmodifiable program characteristics likely to impact the rates. We argue that rates could not be easily increased if any of the models had good explanatory power, and could be increased if it did not. All models had poor fit. We then assumed that the median and 75th percentile of the clinical service delivery rates were candidates for the minimum production capability of a clinician. The service rates of those clinicians whose rates fell below these quartiles were increased to the quartile value to yield estimates of potential additional capacity. These were used along with data on clinical need to estimate shortfall.

Results: There is substantial variation in clinical service delivery rates within impact regions and among programs serving different age populations. The estimate of the percent increase in services overall based on the median is 12% and based on the 75th percentile is 27%. Using an estimate of need of .03 suggested by available data, and a range of services (1-10) that might be required in a six month period, shortfall estimates based on the median ranged between 22-92% and for the 75th percentile from no shortfall to 86%. A less conservative estimate of need of .05 produces median shortfall ranging between 59-96% and for the 75th percentile between 10-91%.

Limitations: While the program descriptor variables used in the explanatory model of rates were those most likely to impact rates, explanatory power of the model might have increased if other characteristics that are not modifiable had been included. In this case, the assumption that service production can be increased is called into question.

Implications for Health Care Provision and Use: In the first six months post September 11th, in New York State (NYS) 250,000 persons received crisis counseling through Project Liberty. In 1999, NYS served approximately that same number in mental health clinic programs during the entire year. The estimates of this study suggest that additional funding and personnel are needed to provide mental health services in the event of a major disaster.

Implications for Health Policies: A disaster plan is needed to coordinate the use of current and additional personnel including mental health resources from other sources and sectors.

Background

In the aftermath of the September 11th disaster, mental health and other related support systems mobilized to deliver the services needed by persons psychologically or psychiatrically impacted by the event. The New York State (NYS) Office of Mental Health developed a mental health needs assessment report (Herman *et al*.[1,2]) that served as the supporting document for the first emergency budget request to the Federal Emergency Management Agency. Working under understandably tight time constraints, the report provided rough estimates of need and the number of services required to treat those with post traumatic stress disorder and

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identified the likely sources of payment for this care. In that report, extended capacity requirements were not estimated, and capacity of the mental health system was reported only in terms of current service utilization. Subsequently, we have worked to develop an estimate of the ability of the 'formal specialty mental health system' to respond to mental health needs in the wake of disasters in terms of deployment of existing staff. It is fully recognized that this capacity only represents a small part of the professional and 'lay' work force that could be deployed, but understanding the flexibility of the formal mental health system to respond is critical to first response efforts and longer range sound fiscal planning of state mental health authorities.

Aims of the Study

The questions addressed are:

(i)   Can service delivery rates in the specialty mental health system be increased?
(ii) If they can, what is an estimate of the extra capacity that could be achieved?
(iii) Does the extra capacity meet the anticipated need?
(iv) If not what is the estimated shortfall?

Methods

Definitions

Capacity is defined as service units that can be delivered (in a time frame, e.g., per week). The production rate of a clinician is defined as the number of services that he/she provides (in a time frame). The production rate of a program, or program level clinical service delivery rate (CSR), is the average number of services provided by the program per clinical full time equivalent employed by the program. Extended capacity is the additional service units that could be produced if currently employed staff delivered more units of service. Shortfall is the difference between needed services and extended capacity. In this application to NYS, the formal specialty mental health system encompasses programs funded, certified or operated by the NYS Office of Mental Health. Omitted are private practitioners not attached to these programs, and providers delivering mental health services in other sectors (e.g., primary care physicians). In this analysis, the focus is on individual service units that can be delivered and not on group delivered services. The methodology could be adjusted to deal with group visits.

Empirical Framework and Statistical Approach

The distribution function of CSRs was obtained for programs grouped into categories defined by the predominant age group served: children, adult and mixed ages; and by broad geographical regions defined by proximity to the World Trade Center: New York City (NYC), surrounding counties of NYC, remainder of NYS. Programs included only those likely to serve persons with disaster-related problems and excluded programs for forensic and chronic care populations. The quartiles and means of the distribution were calculated and variation in rates was observed. An explanatory model of the CSRs was fit to see if in addition to region and age group served, other program characteristics representing features of the program that could not be modified, would explain rate variation. We argued that if the R^2 of the model was high, there would be little chance of increasing CSRs. But if there is substantial unexplained variance, in addition to random error, there may be other program or clinician level variables, some of which may be modifiable, that explain variance. In this case, there is a possibility of increasing productivity by making modifications (e.g., by improving program operational features such as streamlining reporting requirements).

An ordinary least squares regression model was fit to the log of the CSRs, the log used because of the non-normality of the dependent variable. In addition, a Weibull model and a median regression model (not reported on here) were also fit. Explanatory variables for inclusion in the models were selected from available data and describe features of the program, all of which are essentially unmodifiable. The variables selected covered a set of 'likely suspects' of rate variation among programs. They were the geographical regions used by the State in service planning, clinical characteristics of the population served that included predominant age group served, percent on disability insurance, percent with severe and persistent mental illness; and characteristics of the programs that included number of clinical full time equivalents (as a surrogate measure of size of the program), percent on Medicaid, Medicare, private insurance, in managed care programs, and whether or not the program received NYS Office of Mental Health funding. All models had poor fit to the data.

To estimate potential additional capacity in the mental health sector, we assumed, respectively, that the median and 75th percentile of the CSRs represented the minimum production capability of a clinician in any program. The 25th quartile was not used in estimates of additional capacity, since the distance between percentiles was large and the 25th percentile was quite low. The mean was close in value to the median, so it too was not used. Examining the differences provided by the use of the median and 75th percentile in estimates of potential extended capacity provides a sensitivity analysis of the importance of the assumption used for the minimum production rate. Clinicians whose CSR fell below the quartile were assumed able to deliver services at the minimum production level. The extra services that a program could provide if they produced at the minimum production level were aggregated among programs within a category to yield an estimate of potential extended capacity.

To examine whether the potential extended capacity is sufficient to meet need, two epidemiological studies conducted subsequent to September 11th, and utilization figures for the use of the specialty mental health sector for crisis counseling six months post September 11th were used to provide estimates of the number of persons that would

require services for a six month period post a disaster. Service need was calculated across a range of the number of services that might be required per person. An estimate of capacity shortfall is the number of services predicted to be required minus an estimate of potential extended capacity. The epidemiological data were from surveys carried out on samples of the NYC population and provide estimates of the numbers expected to have diagnoses severe enough to require specialty mental health services. Utilization data for NYC are from reports on Project Liberty providers who were funded through Federal Emergency Management Agency monies to provide crisis counseling post September 11th and were provided to us by the NYS Office of Mental Health.

Data

Two data sources were used to develop CSRs. The first is the biannual NYS Office of Mental Health Patient Characteristic Survey that collects data on every patient served in the NYS specialty mental health system receiving services in a typical week of the year (usually October). The most recent year available for this study was 1999. Data used included the number of clinic visits in the week, characteristics of the service recipient and characteristics of the program. Clinic visits were in programs most likely to be used for disaster related services. Excluded, therefore, were programs geared to populations with longstanding illness and those in the criminal justice system. The second data source was the NYS Consolidated Fiscal Report, an annual budget report required of all mental health specialty providers in NYS except hospitals providing psychiatric services. Information used from the Consolidated Fiscal Report was the number of clinical full time equivalents within a program. The two data sets could be linked based on a common program identifier code. To examine consistency of the data sets, Patient Characteristic Survey weekly service data multiplied by 52 were plotted against an available Consolidated Fiscal Report annual service figure. A 45° regression line fit the data amazingly well. CSRs were calculated for individual clinic services delivered in a week, the Patient Characteristic Survey providing the numerator data on the number of services, and the Consolidated Fiscal Report providing the denominator data on the number of clinical full time equivalents within the program. Consolidated Fiscal Report data on service use was not used as the primary source of data for the numerator, since the Patient Characteristic Survey data was considered more reliable. Patient Characteristic Survey data are collected in a systematic manner on each person using a program in a week, whereas the Consolidated Fiscal Report relies on program self reports of aggregated annual utilization. Outpatient programs of hospitals had to be excluded from analyses (n = 170) to obtain the distribution functions of the CSRs, since they are not required to report clinical full time equivalents' data. However, for subsequent shortfall estimates, the additional capacity of these hospitals was extrapolated from the available data.

Results

Prior to obtaining the summary statistics of the distribution of the CSRs, we trimmed the data to remove outliers. Since some programs deliver substantial amounts of group therapy, CSRs that exceeded 50 visits per week per clinician were eliminated (n = 28). Unreliable data interpreted as CSRs of 4 or less services per week per clinician were also eliminated (n = 12). The analyses sample consists of 335 programs and 2856 clinical full time equivalents providing 52,143 services across NYS. **Table 1** presents, for this sample, the number of services delivered and clinical full time equivalents by programs grouped according to the predominant age group served and impact region. **Table 2** presents for these same groupings, the weekly quartile and mean CSRs.

Based on all summary statistics, there is substantial variation in CSRs both within and across impact regions and among the programs serving different age populations. For example, across regions median service rates ranged from 12.9 to 14.9 for programs predominantly serving children, from 16.8 to 22 for programs predominantly serving adults, and from 14.2 to 19 for programs serving mixed populations. Twenty five percent of clinicians had CSRs that ranged between 10.8 and 16.8 services per week, the peak rate achieved in NYC programs that predominately serve adults. The mean CSRs were similar to the median CSRs.

Table 3 presents the regression model for log CSRs. These varied significantly by clinical full time equivalents, region and percent persons on Medicaid. The model has minimal explanatory power, $R^2 = .116$ supporting an hypothesis that service rates can be increased.

Table 4 presents the estimated percent increase in services based on the median and 75th quartile. Using the median as the minimum production rate, the estimate of the percent increase in services ranged between 5 and 12 % for children's programs, between 12 and 17% for adults and between 10 and 12 % for mixed age group programs. The estimate across all programs and regions is 12%. By elevating lower producers to the 75th quartile, overall in these NYS programs, they would produce 27% more services.

We estimated shortfall for the NYC population for a six month period post September 11th, since estimates on the number of persons who might require services was available for this time period and for this region. Illness incidence rates along with percents using services were obtained from two epidemiological studies (Galea et al.[3] and De Lisi et al.[4]) conducted post September 11th on adult populations. Utilization data, also used here to estimate need, were collected by Project Liberty and cover all age groups. **Table 5** summarizes these data. Galea et al. report on the incidence of post traumatic stress disorder and depression combined, while the De Lisi et al. figure is for post traumatic stress disorder only. The reported rates in the adult studies are not entirely consistent, most likely due to the way in which the populations were sampled. The former study used randomly selected telephone informants who lived south of 110th Street in Manhattan, while the latter solicited subjects from the streets of mid town Manhattan. Project Liberty's data are for persons receiving

Table 1. Sample* Used to Estimate Clinical Service Rates by Impact Region and Predominant Age Group Served (1999)

| | Numbers of Programs, Services Delivered/Week and Clinical Full Time Equivalents (FTEs) | | | | | | | | | | | |
| | < 18 | | | 18 + | | | Mixed Ages | | | All | | |
	Programs	Services/week	Clin FTEs	Programs	Services/week	Clin FTEs	Programs	Services/week	Clin FTEs	Programs	Services/week	Clin FTEs
NYC	23	2891	174	44	6796	323	78	14548	726	145	24235	1223
Close Counties	5	492	30	16	2466	120	60	9452	599	81	12410	749
Rest of State	21	2104	160	39	4172	249	49	9222	475	109	15498	884
Total	49	5487	364	99	13434	692	187	33222	1800	335	52143	2856

* Includes programs in which 4 < CSR < 50; excludes hospital programs; N = 335 programs, n = 2856 clin FTEs.

Table 2. Estimates of Weekly Clinical Service Rates by Impact Region and Predominant Age Group Served (1999)

| | Quartiles and Means | | | | | | | | | | | | | | | |
| | < 18 | | | | 18 + | | | | Mixed Ages | | | | All | | | |
	25th	50th	Mean	75th	25th	50th	Mean	75th	25th	50th	Mean	75th	25th	50th	Mean	75th
NYC	12.4	14.0	16.6	20.6	16.8	22.0	21.0	25.7	16.0	19.0	20.0	23.5	15.5	19.1	19.8	23.5
Close Counties	12.4	14.9	16.1	21.8	15.8	18.9	20.6	25.9	11.1	14.2	15.8	18.1	11.5	15.0	16.6	19.5
Rest of State	10.8	12.9	13.1	15.6	11.5	16.8	16.7	20.8	14.9	18.9	19.4	21.8	12.4	16.5	17.5	21.1

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Table 3. Regression Model for Clinical Service Delivery Rate

Variable	OLS model (CSR) parameter estimate	P value
Intercept	2.644	< .0001
Clin FTEs	− .008	.018
Region		
Western	− .148	.047
Central	.069	.443
Hudson	− .060	.442
LI	.079	.349
OMH funding		
No	.123	.172
Yes	− .087	.193
% SSI/SSDI	.065	.702
% Managed care	.041	.830
% SPMI	.030	.865
% Medicaid	.362	.022
% Medicare	.177	.387
% Private Ins.	.302	.219
% Young	− .082	.483
R^2 = .116		

Table 4. Estimated Percent Increase* in Services for Production at Median and 75th Quartile Rate by Impact Region and Predominant Age Group Served (1999)

	% Increase in Services							
	< 18		18 +		mixed ages		All	
	Median	75th Q	Median	75th Q	Median	75th Q	Median	75th Q
NYC	5.0	3.0	14.0	26.0	11.0	25.0	12.0	26.0
Close Counties	5.0	3.6	12.0	36.0	10.0	25.0	11.0	28.0
Rest of State	12.0	2.5	17.0	31.0	12.0	21.0	12.0	28.0
NYS							12.0	27.0

* Increase calculated as Sum [(quartile - CSR) x clinFTES], CSR < quartile.

Table 5. Available Estimates of NYC Mental Health Need Post September 11th

Data Source	Period	Sample characteristics	N*	Population Rate**
Project Liberty	6 month enrollment	All ages; all diagnoses; received at least one crisis counseling visit; received care possibly in group session	250,000	.03
De Lisi *et al.*	Sampled 3-6 months post September 11th	Adults; 18.5% post traumatic stress disorder; 26.7% of these received services	400,000	.05
Galea *et al.*	Sampled 1-2 months post September 11th	Adults; 8.7% post traumatic stress disorder or depression; 29% of these received services	200,000	.025

* N = Cases requiring services.
** Population rate = N/NYC Population = $N/8 \times 10^6$.

Table 6. NYC Sample Used in Shortfall Estimate

NYC Clinic Programs (1999)	Number	Weekly Services	Clinical FTEs
Non-hospital based	180*	34,676	1345
Hospital based	108	20,530	796**
Total	288	55,206	2141**

* Includes 40 programs with CSR < 4 or > 50; excludes chronic care and forensic programs.

** Data extrapolated using non-hospital ratio.

Table 7. Estimates of NYC Weekly Services Capacity Shortfall

Assumption			Weekly Shortfall							
Required Services Per person in 6 mos.	Total per week		Median increase (6,625)				75th Q increase (14,354)			
	Incidence = .03	Incidence = .05	Incidence = .03		Incidence = .05		Incidence = .03		Incidence = .05	
			n	% rqmt.	n	% rqmt.	n	% rqmt.	n	% rqmt
1	10,000	16,000	3,375	34	9,375	59	−4,354	−44	1,646	10
2	20,000	32,000	13,375	67	25,375	79	5,646	28	17,646	55
3	30,000	48,000	23,375	78	41,375	86	15,646	52	33,646	70
4	40,000	64,000	33,375	83	57,375	90	25,646	64	49,646	78
5	50,000	80,000	43,375	87	73,375	92	35,646	71	65,646	82
6	60,000	96,000	53,375	89	89,375	93	45,646	76	81,646	85
7	70,000	112,000	63,375	91	105,375	94	55,646	79	97,646	87
8	80,000	128,000	73,375	92	121,375	95	65,646	82	113,646	89
9	90,000	144,000	83,375	93	137,375	95	75,646	84	129,646	90
10	100,000	160,000	93,375	93	153,375	96	85,646	86	145,646	91

one episode of crisis counseling from mental health service providers in NYC who applied for Project Liberty monies and cover any age group. It may be the case that some of these persons received their service as part of a group. The estimates across the studies range between .025 and .05. To estimate shortfall, we consider, based on these studies, both a conservative overall incidence rate of .03 and a possibly high incidence rate of .05.

Shortfall estimates are obtained for a range of service requirements in the mental health sector of from one to 10 services in a six month period. One visit would correspond to persons receiving immediate crisis counseling only. The NYS Office of Mental Health's needs assessment plan assumed that to treat post traumatic stress disorder seven outpatient visits and a six month supply of medication at a cost of $1500 would be required (Jack et al.[5]). We examine shortfall covering a range of from one to 10 services in a six month period. In calculating the shortfall, we included the capacity of the outlier programs and extrapolated the number of clinical full time equivalents that outpatient programs in hospitals could provide in order to obtain a more realistic figure of current capacity. Including these programs, we estimate that in 1999, current capacity was 55,206 services per week provided by 2,141 clinical full time equivalents (See **Table 6**).

Table 7 displays the estimates of shortfall across the range of services that might be needed assuming the median and 75th percentile as possible minimum production rates. Based on an incidence rate of .03, using the median, there is a substantial shortfall ranging from 34-93%, and for the 75th percentile, ranging from no shortfall (for one visit) to 86%. If the incidence rate is .05, the median shortfall range is 59-96% and for the 75th percentile, it ranges from 10-91%. If we assume that incidence is .03, that 60% of the population will require one service, 25% five services and 15% seven services, based on the median, the shortfall is 77%. This translates into 22,375 additional services required per week. Valuating a service reimbursement at a low rate of $50 results in a six month budget estimate of approximately 28 million dollars. If the incidence is .05, the budget estimate for this mix of services increases to approximately 50 million dollars. These figures can be extrapolated to longer time frames under tenable service use assumptions such as declining rates of service use over time. However, data from Project Liberty (personal communication) indicate that while there is a general decline over time, it is not linear. The non-linearity is accounted for by the new users who appeared several months after the disaster. As more data become available, these trends will be modeled and estimates made of changing costs over time.

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Discussion

The finding that production rates varied inversely with labor force size (clinical full time equivalents) was unexpected but those related to funding are consonant with hypotheses concerning the role of funding incentives: fee-for service (Medicaid) increases production rates, although alternative clinical explanations are possible. The finding of significantly lower production rates in the Western region as compared to NYC is worthy of further exploration. But germane to this analysis, these variables explained little of the variation in CSRs, and while there may be other plausible reasons that account for variation in service delivery rates, we did make the assumption that service production can be increased. If the explanatory power of the model could be substantially increased based on other measurable or latent characteristics that are not modifiable, this assumption is called into question.

Assuming the median as minimum production rate, service output in NYC can be augmented by 12% and leads to an estimate of a 77% shortfall under a conservative incidence rate and reasonable service utilization assumptions. Federal Emergency Management Agency monies provided to the State as a whole were 23 million dollars for the first 6 months post September 11th (personal communication) and were intended for crisis counseling only to cover persons with all diagnoses. Our estimates suggest that higher levels of funding are required particularly to meet the needs of those with severe diagnoses such as post traumatic stress disorder or depression. It may also be possible to deploy clinicians from other than the specialty mental health services. For example, private practitioners are not covered in our estimates of extended capacity and many of these we know made their services available through consortiums they formed in response to the disaster. An additional possibility is the deployment of personnel from other sectors if proper training is provided, especially for the treatment of disaster related depression, e.g., primary care physicians.

Policy Significance

In the first six months post September 11th, 250,000 persons received one visit of crisis counseling in NYS in Project Liberty programs funded by the Federal Emergency Management Agency. In 1999, NYS served approximately that number in clinic programs during the entire year. The September 11th crisis highlights that mental health systems are working near capacity and need additional resources to be able to respond to disaster situations. While additional monies may become available, additional staff needs to be identified prior to the occurrence of a disaster, trained and in readiness for deployment. Some of these additional personnel may be situated outside of the formal mental health system (Siegel, *et al.*[6]).

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