

Did the Prevalence of PTSD Following Hurricane Katrina Match a Rapid Needs Assessment Prediction?

A Template for Future Public Planning After Large-Scale Disasters



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Needs assessments are generally developed immediately following disasters to estimate the number of individuals who will develop serious mental health problems, including post-traumatic stress disorder (PTSD), so that necessary treatment resources can be predicted. Following Hurricane Ka-

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TABLE 1.

Population Estimates by Category of Individuals with Incremental Risk for PTSD

Category	Total Number of Individuals	Number of Children and Adolescents	Estimated Percentage (%) that will Develop PTSD	Estimated Number that will Develop PTSD: Total Number/children and adolescents ¹⁴
Category I				
A) Individuals trapped/rescued	8,000 ¹	400 ¹³	40% ⁵	3,200/160
B) First responders (New Orleans Police Department; New Orleans Fire Department)	2,400 police + firefighters	0	30% ⁶	720
Category II				
A) Superdome evacuees	25,000	6,675 ¹⁴	30% ⁷	7,500/2003
B) Convention Center evacuees	19,000	5,073 ¹⁴	30% ⁷	5,700/1,522
C) Trapped hospital personnel and patients;	4,000	100 ¹³	30% ⁸	1,200/30
D) Non-exposed family members to other Category I and II individuals	59,500 ²	15,587 ¹⁴	30% ⁹	17,850/4,766
Category III				
A) Other evacuated persons (not Category I or II) in Orleans area	8,000	400 ¹³	24% ¹⁰	1,920/96
B) Professional caregivers (within impact area) of individuals in Categories I and II	300 ³	0	24% ¹¹	72
Category IV				
Displaced persons with damage to homes or businesses	550,000 ¹	146,850 ¹⁴	15% ¹²	82,500/22,028
Category V				
Displaced persons with no damage to homes or businesses	500,000 ¹	133,500 ¹⁴	10% ¹²	50,000/13,350
Category VI				
Non-displaced persons outside of impact area	1,799,000 ⁴	480,333 ¹⁴	5% ¹²	89,950/24,016
Total	2,975,200	789,218		260,612/67,971

1. Estimate based on New Orleans Times Picayune reports³⁷

2. Number in Category I multiplied by 1^{4,18}

3. Estimate by professional caregivers in the impact area

4. 25 non-impact parishes declared eligible for disaster relief by FEMA

5. Based on studies of dam collapse and flooding following Buffalo Creek⁸; Hurricane Andrew figures in listed studies;⁹⁻¹² and Hurricane Hugo¹³

6. Based on 9/11 data and Oklahoma bombing data⁴⁻¹⁴

7. Based on rates from Oklahoma City bombing¹⁴⁻¹⁶

8. Based on Buffalo Creek disaster⁷

9. Based on multiple studies¹⁸⁻²¹

10. Based on NY 9/11 data¹²

11. Based on Norris²

12. Based on 9/11 data⁴ and Oklahoma bombing data³

13. Estimate based on Times Picayune reports

14. Estimate based on 2000 Louisiana census (26.7% of population younger than 18 years of age)

trina, the authors estimated that approximately 40% of first responders and those most impacted by Katrina would develop PTSD and other mental health problems in the year following the storm. Further, they estimated that among groups of individuals who were less directly impacted, 5% to 30% of individuals would devel-



op PTSD. A review of 10 post-Katrina surveys conducted in New Orleans and southern Mississippi suggests that the needs assessment predictions were in the conservative range. The authors discuss the findings and their ramifications for future need assessments.

When a large-scale disaster strikes, PTSD and related post-disaster mental disorders will develop on a large scale.¹⁻³ The local, regional, and national leaders of governmental, non-governmental, and private mental health agencies will need rapid, fact-based estimates of the prevalence of these post-disaster problems. These estimates are needed for rational and prompt resource allocation. How many individuals will need psychiatric treatment? How many clinicians are needed? Where are these individuals? How do we reach them? What kind of treatments are needed? How much funding is needed? Currently, there is little published guidance in the scientific literature for how to create a

rapid needs assessment in the chaotic aftermath of a disaster. When Hurricane Katrina struck, there was one known template of how to predict the prevalence of PTSD or other post-disaster mental disorders according to different levels of exposure or other disaster characteristics.⁴ A rapid assessment of mental health needs was created immediately following the World Trade Center (WTC) attacks. It was estimated that 520,000 people in New York City

assessment are event-based data such as proximity to and type of life-threatening events. Past research has empirically validated these obvious factors as risks for developing PTSD.^{2,5,6} There are multiple non-event individual and social variables that have also been predictive of mental health outcomes following disasters (eg, pre-existing disorders, locus of attribution style, perception of life threat, and peritraumatic dissociation), but these are inaccessible for immediate predictions.

It has been shown that individuals with PTSD have at least one comorbid psychiatric disorder approximately 80% to 90% of the time.

would develop PTSD. However, the accuracy of this assessment as judged by subsequent post-disaster surveys has not been reported. This report on a Hurricane Katrina rapid needs assessment and follow-up empirical validation of the estimates is meant to fill that gap for planners, clinicians, and researchers of future large-scale disasters.

Less than 1 month after Hurricane Katrina hit New Orleans, the authors were asked by the Louisiana Office of Mental Health to develop a rapid needs assessment that estimated the number of individuals in Louisiana who would develop PTSD or clinically significant PTSD symptomatology as a result of the hurricane. Following the World Trade Center methodology,⁴ groups of individuals were allocated to categories with different predicted probabilities of developing PTSD based on physical and psychological proximity to life threat.

DEFINING EXPOSED GROUPS AND ESTIMATING THE PREVALENCE OF PTSD AFTER HURRICANE KATRINA

The only epidemiological risk factor data available for a rapid needs as-

Based on previously published findings, especially those studies reporting event-related variables, we created six categories of individuals with incremental risk for PTSD due to incrementally-increased risk exposure from Hurricane Katrina. The categories are presented in Table 1 (see page 135).

Category I represents the most potentially traumatized group. It consists of individuals who were trapped in homes and businesses and rescued subsequently. The rescues occurred between the first and seventh day following the impact of the hurricane. The 40% PTSD rate for this group was derived from figures used in diverse studies. Following the dam collapse and subsequent flooding at Buffalo Creek, the PTSD rate was 44%.^{7,8} Following Hurricane Andrew, PTSD figures of 33%,⁹ 36%,¹⁰ 26%,¹¹ and 25%¹² were reported. Following Hurricane Hugo, 33% of the most affected group of men and 44% of the most affected group of women developed PTSD.¹³

Category I also included the New Orleans Police Department and Fire Department first responders because they shared with the rest of the trapped citizens the

danger to their own families, loss of their own homes, and loss of basic infrastructure (electricity, water, and sewer). They also had to contend with civil unrest and being outnumbered by crowds and without communication. Research following the WTC attack and the Oklahoma City bombing suggested that half of the rescue workers in the WTC attack were extremely exposed and that half were less exposed to the disaster.⁴ Accordingly, the New York needs assessment developed after 9/11 used an average of two Oklahoma City bombing PTSD rates (34% and 14%) to determine the prediction that 24% of NYC first responders would develop subsequent PTSD.¹⁴ Because the conditions for the New Orleans first responders created especially stressful circumstances, the predictive rate of 30% was chosen.

Category II included those who sheltered in the Superdome and the Convention Center. They were in the storm's path and then endured the prolonged and often frightening wait for rescue amidst instances of civil unrest. The derived predictive rates of PTSD were based on rates from Oklahoma City bombings of 34%¹⁴ and shooting episodes that range from 26% to 29%.¹⁵⁻¹⁷

In addition, Category II included healthcare providers and critically ill patients who stayed and were trapped for 5 to 6 days by floodwaters, without power or the ability to communicate. There were break-ins, the constant threat of break-ins, and everywhere the evidence of social disorder. Prolonged exposure to floodwaters and feelings of being trapped were important correlates of PTSD in the Buffalo Creek disaster.⁷ The estimated PTSD rate (30%) represents an average of previous reports.

Non-exposed (ie, they evacuated before the storm) family members of Category I individuals were also included in Category II because they knew their loved ones were in harm's way, and previous reports^{4,18,19-21} on this phenomenon have shown high rates of distress.

Category III includes those who were temporarily trapped in the flooded city but did not have to endure the extra ordeal of sheltering at the Superdome or Convention Center. Their rates were derived from the lesser-exposed individuals in previously studied hurricanes and the WTC attack.^{1,2}

Category III also included professional caregivers of Category I and II individuals who entered the impact area to provide services within days after the storm. Vicarious traumatization among caregivers is associated with lower levels of PTSD than are seen among victims, but rates of 24% are not unexpected. This is in line with follow-up data from the WTC and Oklahoma City attacks.²

Category IV included all those who evacuated prior to the storm and whose homes and/or businesses were damaged and were not in Categories I, II, or III. Category V included those who evacuated prior to the storm but their homes or businesses were not damaged. Category VI represented the lowest risk exposure and included everyone else in the state of Louisiana who was not in Categories I-V because all citizens potentially had exposure through television and other media, through links to people they knew who were in danger, and other vicarious forms of exposure. Categories IV, V, and VI were derived from reasoning similar to that presented by Herman, Susser, and Felton,⁴ with incrementally decreasing levels of PTSD anticipated for individuals who were incrementally removed from traumatizing events and sites. Of note, Sprang³ reported that about 8% of adults living in Oklahoma City at the time of the bombing had PTSD after, even if they did not see, feel, or hear the explosion.

The sum of all six categories yielded a total estimate of 260,612 individuals in the state of Louisiana who were predicted to develop full PTSD, including approximately 68,000 children and adolescents.

Subthreshold Trauma-based Syndrome

In addition to the 260,612 individuals predicted to develop PTSD, it is worth noting that there would be another sizable group (roughly estimated as half of those with PTSD, or 130,000) that would develop subthreshold trauma-based symptomatology with functional impairment that would require treatment. It was estimated that these individuals would experience clinically disabling post-Katrina signs and symptoms of PTSD, but not the number necessary to satisfy the official PTSD *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV) criteria.²² The number of individuals in this group was difficult to estimate because there is less evidence from previous studies describing outcome for subthreshold problems.

Other Mental Health Problems Precipitated by Disasters

It has been shown that approximately 80% to 90% of individuals with PTSD have at least one comorbid psychiatric disorder.²³ Not all of these comorbid disorders developed post-trauma, but two studies that carefully tracked the onsets of both PTSD and comorbid disorders showed that nearly all non-PTSD disorders that develop after disasters do so only in the presence of PTSD symptomatology. McMillen and colleagues tracked the onsets of disorders of adult flood victims in St. Louis and found that all of the survivors diagnosed with a new non-PTSD disorder also had substantial PTSD symptoms.²⁴ Scheeringa and Zeanah assessed 70 preschool children and their caregivers from New Orleans who experienced Hurricane Katrina and showed: 1) that no child developed a new non-PTSD disorder without new PTSD symptoms and 2) that only two caregivers developed a new, non-PTSD disorder without new PTSD diagnosis or symptomatology.²⁵

In terms of developing a rapid needs assessment, these data indicate that focusing on PTSD is an efficient and com-

TABLE 2.

Ten Studies of Katrina-impacted Samples

Citation	Sample	Category	Measure	Findings and PTSD Rates
Centers for Disease Control and Prevention (CDC) ²⁸	912 NOPD 525 NOFD Adults	First Responders	17-item PTSD Checklist	19% of police and 22% of firefighters with full PTSD algorithm.
Scheeringa et al ²⁵	70 children, ages 3-6 years, and 59 of their caregivers; 34% stayed, 66% evacuated	Children: 34.3% in II and III; 65.7% in IV. Parents: 32.3% in II and III; 67.8% in IV.	Standardized age-appropriate diagnostic interviews (Scheeringa et al, 2003)	Category IV: 42.5% full PTSD. Parents: 35.6% full PTSD (not reported by categories).
Abramson and Garfield ²⁶	665 adults displaced in Louisiana	I-IV	Unnamed screen	"Nearly half" of children and "over half" of female caregivers with new emotional difficulties.
CDC ³²	82 adults in Orleans Parish and 84 adults in Jefferson Parish	I-V	SPRINT-E screen	33.1% endorsed findings indicating probable need for mental health services; 49.8% indicating possible need.
Kessler et al ²³	1,043 adults in impacted areas of LA, MS, and AL	I-V	K6 screen; random digit dialing methodology	11.3% with serious mental illness; 19.9% with mild-moderate mental illness.
Abramson and Garfield ²⁷	576 adults in MS	I-V	Medical Outcome Study SF-12 version 2 screen	53% with at least one child in household with new difficulties; 44% caregivers with clinical-level problems.
Weems et al ²⁹	386 adults in New Orleans and MS	I-V	17-item PTSD Checklist	Estimated in this review as 31.9%-51.2% with full PTSD.
Mills et al ³³	747 adults in New Orleans emergency room	I-V	4-item Primary Care PTSD Screen	38% endorsed 3 out of 4 items, indicative of full PTSD.
Hyre et al ³⁰	391 patients on hemodialysis from New Orleans area	8.2% in I-III; 91.8% in IV or V.	17-item PTSD Checklist	23.8% met full PTSD disorder.
DeSalvo et al ³¹	1,542 Tulane University employees	10.2% in I-III; 89.8% in IV-V.	17-item PTSD Checklist	19.2% met full PTSD disorder.

prehensive method for estimating nearly all individuals with new-onset disorders. The converse is also true. In terms of reviewing post-Katrina surveys when the researchers did not use a standardized measure of PTSD, a measure of any new-onset disorder is a reasonable proxy for PTSD, with the understood limitation that error is involved in the estimate.

Methods

Computerized literature searches were conducted in PsycINFO and PubMed with the key words "Hurricane Katrina" and "posttraumatic." The bibliography of each relevant paper was also inspected for additional relevant articles. Inclusion criteria were: 1) the samples were from the population of the Louisi-

ana and Mississippi Gulf Coast area that was affected by Hurricane Katrina and 2) researchers used a standardized measure of any psychiatric symptomatology. Ten articles met these criteria and were included for review.

We reviewed these studies to determine which of our six categories fit their samples and what rates of new-onset

psychopathology were found. The purpose was to determine how accurately the rapid needs assessment predicted rates of new disorders as empirically validated by these post-Katrina surveys.

Results

The 10 studies (see Table 2, page 138) included 7,012 adults. Seven of these studies exclusively assessed Louisiana populations involving 5,077 adults, or 71.7% of the total from all 10 studies. The number of children included is not known for certain. Only the Scheeringa and Zeanah study ($n = 70$) focused on children.²⁵ The two Abramson and Garfield studies^{26,27} involved a total of 1,241 adults (665 and 576, respectively); if half of those households had children, then the status of approximately 600 children was assessed, and if nearly all the households had children, then closer to 1,000 children were assessed.

Only one study used diagnostic interviews that require more comprehensive follow-up probes, educational interviewing, and verifying items with examples.²⁵ Four studies used checklists that included all 17 items of PTSD.²⁸⁻³¹ Two studies^{32,33} used four-item screens for PTSD – the SPRINT-E³⁴ and the Primary Care PTSD Screen.³⁵ The remaining three studies used more general non-PTSD screens for psychopathology.^{23,26,27}

Only one of the studies²⁸ provided enough data about the participants' disaster experiences so that they could be assigned to one and only one of the six rapid needs assessment categories. Police and firefighters in Category I showed rates of 19% and 22% for full PTSD, respectively, which was lower than the expected rate of 30% in the rapid needs assessment.

Several studies provided enough information so that subsets of the participants could be assigned to two "adjacent" categories collapsed together. Of the 70 preschool children in the Scheeringa and Zeanah study, 34.3% were in categories II-III, and they showed a

rate of 62.5% for full PTSD, which was higher than the expected rate of 30% for Category II and the expected rate of 24% for Category III. The other 65.7% of the children were in Category IV, and they showed a rate of 42.5% for full PTSD, which was higher than the expected rate of 15% for Category IV.

No known studies have assessed a substantial sample of the Category VI population.

The remaining eight studies included respondents from a range of categories (I-V) and did not analyze their rates of PTSD or other problems separately. These can be viewed for all intents and purposes as representative of categories IV and V combined, because in the way that individuals were assigned in the rapid needs assessment categories I-V (1,176,200 individuals), categories IV (550,000 individuals) and V (500,000 individuals) constituted 89.3% of that total.

In order to compare the findings from the remaining eight studies to the needs assessment estimates, a weighted mean estimate of projected PTSD from categories I-V was calculated by multiplying the proportion that each category represents of the total population of categories I-V by the expected rate of PTSD for that category, and then summing the individual weighted rates. For example, the proportion that category IV ($n = 550,000$) represents of the sum of categories I-V ($n = 1,176,200$) is 0.47, which when multiplied by the expected rate of 15% is 7.01. Following similar calculations, the weighted rates for categories I through V are 0.33, 2.74, 0.17, 7.01, and 4.25, respectively. The sum of these rates represents the mean expected percentage of 14.5% for categories I-V. This figure was compared with findings from the remaining eight studies to help determine accuracy of the predictions.

Three of these studies²⁹⁻³¹ were more rigorous than the other five because they used checklists for all 17 PTSD items and ought to be given stronger consideration. Their rates of full PTSD were 19.2%,³¹ 23.8%,³⁰ and 31.9% to 51.2%.²⁹ The two studies that used brief four-item PTSD screens found probable rates of full PTSD of 33.1%³² and 38%.³³ The three less precise studies that used more general, non-PTSD screens found problem rates of 11.3% for severe illness, 19.9% for mild-to-moderate illness,²³ and approximately 50% with new problems for both children and caregivers.^{26,27} Overall, the more rigorous studies converged around rates of 20% to 30%, the studies using brief screens produce somewhat higher rates, and the studies using non-PTSD screens produce widely divergent results. Nearly all of these produced rates higher than the expected weighted mean for categories I-V from the rapid needs assessment of 14.5%.

No known studies have assessed a substantial sample of the Category VI population.

DISCUSSION

The 10 studies conducted to date on Katrina victims mostly affirm the robustness of the rapid needs assessment methodology as a conservative estimate of PTSD and suggest the need for some important revisions. The empirically derived rates of PTSD were nearly always greater than the expected rates from the needs assessment, with the exception of the study of police and firefighters. Despite the fact that several of the studies revealed emotional difficulties instead of PTSD, these findings can be considered reflective of significant PTSD symptomatology. Research has consistently shown that while non-PTSD disorders clearly develop after traumatic events, they nearly always develop concurrently with full or subthreshold PTSD.²⁴

Data analyzed in this report do not indicate why needs assessment PTSD

predictions were less than the actual rates suggested by the 10 post-Katrina surveys. Possible reasons include the impact of non-event variables, which were not considered in this needs assessment, and the underestimation of



the complexity and seriousness of the disaster's impact.

Our original estimate, that over 260,000 people in Louisiana would develop PTSD following Katrina, seemed large to us at the time. If we subtract Category VI, which contributed 89,950 cases of PTSD (because no known studies have assessed the Category VI population yet), this leaves 170,050 projected cases of PTSD. If we use the lowest rate found in all of these studies of approximately 11%, this projects 129,382 cases of PTSD. If we use the upper bound found in these studies of approximately 50%, this projects 588,100 cases of PTSD. Our projection of 170,050 cases is closer to the lower-bound estimate, and therefore represents a reasonably conservative estimate. This is indeed disturbing news given the continued lack of adequate mental health services for this region.³⁶

We recommend maintaining categories that divide and organize the trauma-exposed population as finely as possible in future rapid needs assessments for two reasons. First, our experience was that the

six categories we used were enormously useful for organizing our thinking in the chaotic aftermath of such a massive disaster. Six categories made sense for Louisiana following Hurricane Katrina, but fewer or more categories may make sense for future large-scale disasters. Second, although PTSD cannot be predicted with the level of precision that we projected for each category, nonetheless,

sive, complex disasters need to track the disaster experiences of the survivors in finer detail than previous studies have done to determine if the conventional thinking of what constitutes more or less severe exposure actually predicts differential rates of PTSD and other disorders. Also, future studies will be easier to interpret if they use standardized measures in common with one another.

In terms of developing a rapid needs assessment, these data indicate that focusing on PTSD is an efficient and comprehensive method for estimating nearly all individuals with new-onset disorders.

maintaining finely divided categories can help spur future research that is needed to explore this question.

A simpler method would be to estimate a lower-bound rate and an upper-bound rate for all individuals in harm's way, regardless of their category, and this would give two working estimates for planning resource allocation in the early stages of a disaster. The lower and upper bounds in our needs assessment that were based on prior research were 10% and 40%. The lower and upper bounds from actual post-Katrina studies were 19% to 62.5%, with most rates more in the 20% to 30% range if we only include studies that used PTSD measures. This simpler method would be much faster than the process that we went through of meticulously reviewing the literature of individual studies. This simpler method is also more consistent with the data that, at present, cannot support precisely graded differential rates of PTSD for different levels of exposure.

Research implications include our strongest recommendation that large-scale population-based studies should be among the most important governmental imperatives following future disasters. Epidemiological studies of mas-

Policy implications include that administrative and clinical infrastructures must be created before disasters strike to develop sufficient treatment capacity before it is actually needed. In order to address effectively the public health crisis predicted by the needs assessment, public and private service providers must be prepared to implement evidence-based assessment and treatment practices for an unprecedented number of people. Service provision outcomes must be measured and findings used to plan for future events.

CONCLUSIONS

Practice implications include that clinicians must focus on PTSD in their own training to be prepared for competent screening, assessment and treatment of patients. They must be able to recognize the various ways in which clinical signs and symptoms of PTSD present. Evidence-based practices exist for treating PTSD for all ages and those who are willing to treat disaster victims are obligated to use modern practices.

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