

# Emotional Consequences of Nuclear Power Plant Accidents

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# Disclosures

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# TMI, Chernobyl, Fukushima: Common thread

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After TMI and Chernobyl:

Official consensus was that the biggest short- and long-term public health effect → mental health.

*Yet, little interest in the psychological aftermath by the psychiatry researchers, radiation scientists, or health service providers*

After Fukushima:

Mental health is again emerging as the major health issue (UNSCEAR 2014).

*Important to that policy makers and psychiatry take responsibility and collaborate with affected populations to design effective interventions.*

# 3 plays: settings, actors, plots, back-drops, acts

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- Different settings and actors
  - PA, Ukraine, northeast Japan
- Variation on same plot
  - Nuclear power plant out of control
- Same back-drop panels on the stage
  - Middle: Deeply rooted fear of radiation and lack of understanding
  - Right: Radiation safety experts using jargon to communicate the “facts”
  - Left: Anti-nuclear proponents articulately airing graphic, alarmist the “facts”
- Similar acts
  - Prologue: Lies, half truths, and contradictions by nuclear industry and watchdog organizations
  - Act 1-Scene 1: Evacuation; chaos; stigma toward “contaminated” families
  - Act 1-Scene 2: Contradictions continue; population begins to distrust all authorities
    - academia, gov’t, industry
  - Act 1-Scene 3: MDs indiscriminately attribute health problems to radiation exposure; pregnant women panic
  - Act 2: Rumors/anecdotes spread; large swaths of the pop. believe they were exposed to radiation; ANXIETY ↑
  - Act 3: Government establishes health surveillance programs while telling people that radiation was too low to cause “detectable” cancers
  - Epilogue (5+ years later):
    - Stage left: Affected pop. left with long-term anxiety and health concerns
    - Stage right: Authority figures obsessing about the latest disaster

# Outline of talk

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1. Mental health after toxic disasters in general
2. TMI
3. Chernobyl
4. Fukushima
5. Untapped value of health surveillance programs for risk communication

# Toxic disasters

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## Some 20<sup>th</sup> and 21<sup>st</sup> century toxic disasters

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- Atomic bombs (1945)
- Love Canal (1978) - families relocated from chemical waste dump
- Three Mile Island (1979)
- Bhopal gas leak from Union Carbide (1984)
- Chernobyl (1986)
- Khamisiya ammunition storage facility explosion (1991)
- Sarin attack on Tokyo subway (1995)
- World Trade Center (2001)
- Fukushima (2011)

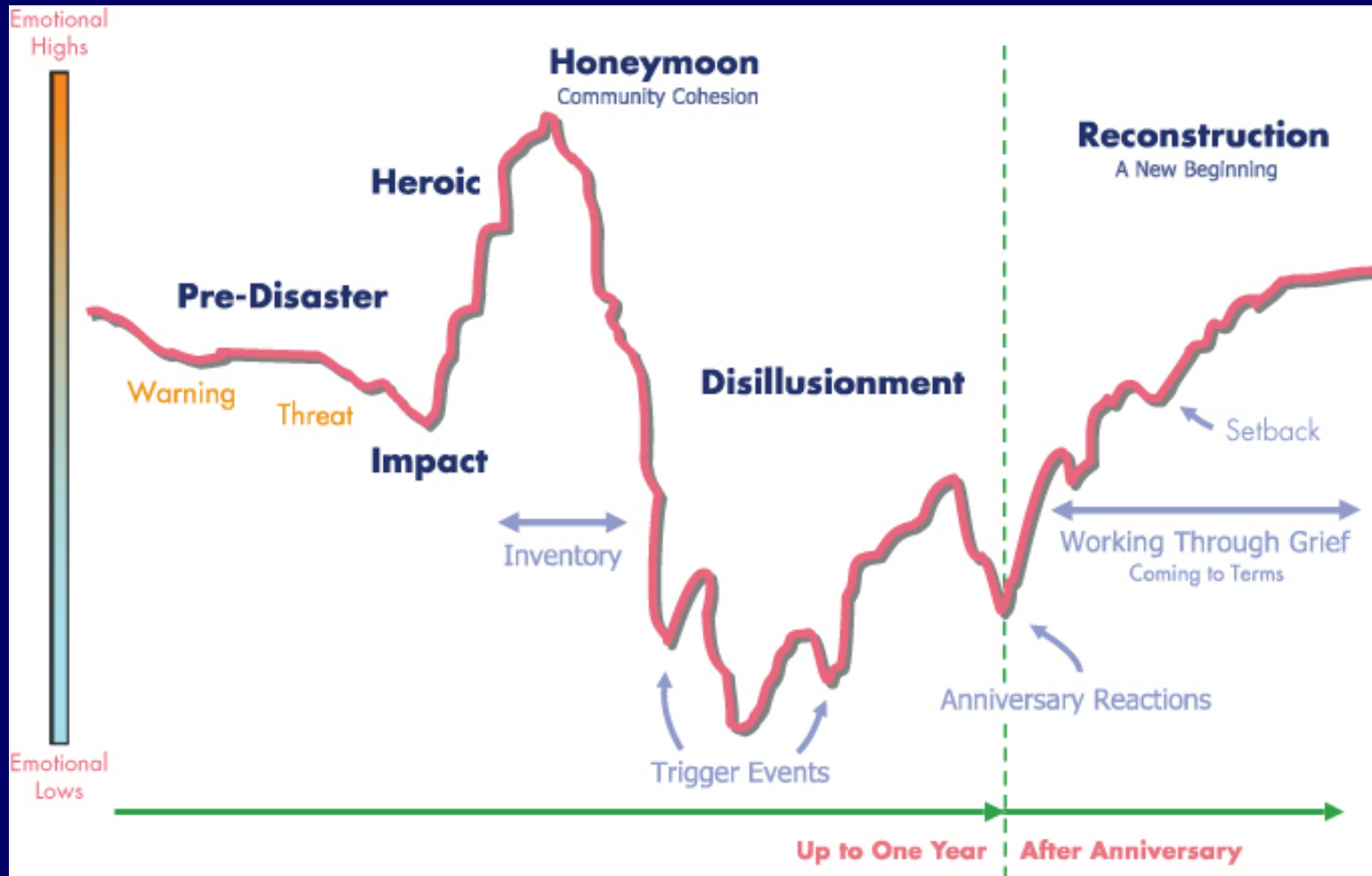
# Emotional consequences

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- Range of consequences
  - \*Depression, grief, extreme distress
  - \*Post-traumatic stress disorder (PTSD)
  - \*Medically unexplained physical symptoms
  - \*Smoking and alcoholism
  - \*Suicide
- Prevalence ranges from 25%-75% in the first year
- Varies due to magnitude of destruction, samples and % with personal involvement, assessment tools, in-person vs phone, rr, case definition, statistical analysis, location... TIMING OF STUDY (disasters have well described phases)



# Typical description of phases of disaster



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## Three Mile Island (TMI)

## Three Mile Island (March 28, 1979, 4:00 a.m.)



## March 30

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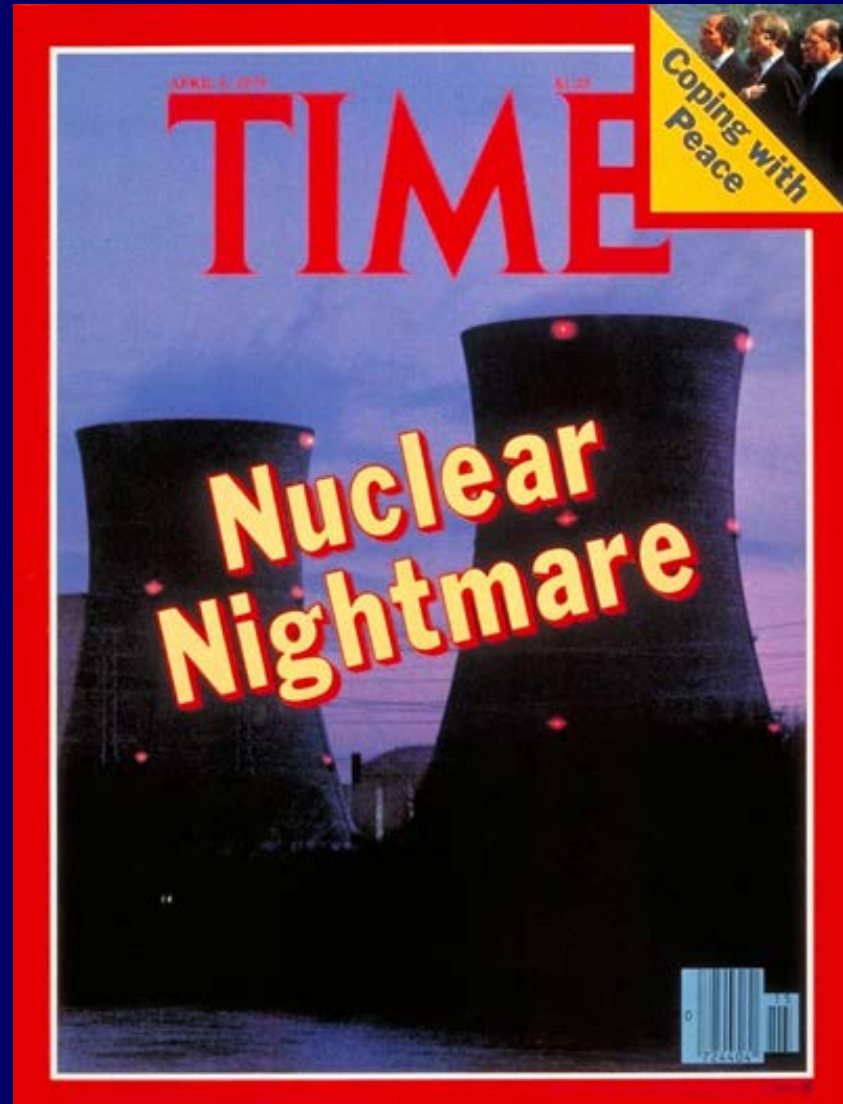
- Advisory by Governor that pregnant women and preschool children evacuate the 5-mile area near TMI (later extended to 20 miles)
- 144,000 (just under half of population) left the area
- Starting on March 28, TMI, Governor's office, NRC, and scientists of various stripes made contradictory statements reported in the media

## Also on March 30: NY Times

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### “The Credibility Meltdown”

“Credibility was not enhanced by public statements... Was it a little leak, a bigger leak – or a general emergency? The reactor’s operators said one thing, state officials another, Federal officials yet another, not to mention the contributions of equipment manufacturers and politicians. ... Who is to be believed? The profusion of explanations and of contradictory statements has meant troubling confusion.”



## Fear vs Fact

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- Anti-nuclear comm. predicted >300 cancers would occur
- PhD physicist from U-Pitt showed data indicating there was an increase in still births downwind of TMI
- Rumors about 3-legged cows, kittens born without eyes, etc.
- President's Commission Report, December 1979:
- Max. individual dose estimate = <1 mSv
- 1-2 excess cancers possible (workers)
- Biggest impact was on mental health which was subsiding by autumn of 1979

## TMI mental health research

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- Our U-Pitt research focused on the long-term psychological aftermath among 3 groups (based on Pres. Commission report):
  - Mothers of young children living in the 10 mile radius of TMI
  - TMI workers
  - Psychiatric outpatients in the public mental health system



# TMI study: focus on depression and anxiety

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## Assessments 9, 12, 30, 42 months post-TMI

- ~400 mothers of children born just before the accident
- ~175 workers from TMI and same 2 control plants
- ~90 psychiatric outpatients and controls from the other sites
- ~150 11-year old children of workers and mothers

7 and 10 years after TMI: Mail-out questionnaires to TMI mothers (response rate ~50%) [no funding]

# Main findings

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## Mothers

- 25% of TMI moms vs 14% of controls had clinical depression or generalized anxiety in year after TMI.
- Symptoms of distress on SCL90 remained high over 10 years.
- Mothers continued to worry about health impact.
  - 10 years later:
    - 42% believed their health was affected by TMI
    - 68% were concerned abt their children's health because of TMI
- Risk perceptions were significantly correlated with distress and poor self-rated health

Pre-school and 11-year old children no differences

Workers > disorder in first year only

Patients No diff. from comparison site

*Other studies showing long-term psychological impacts.*

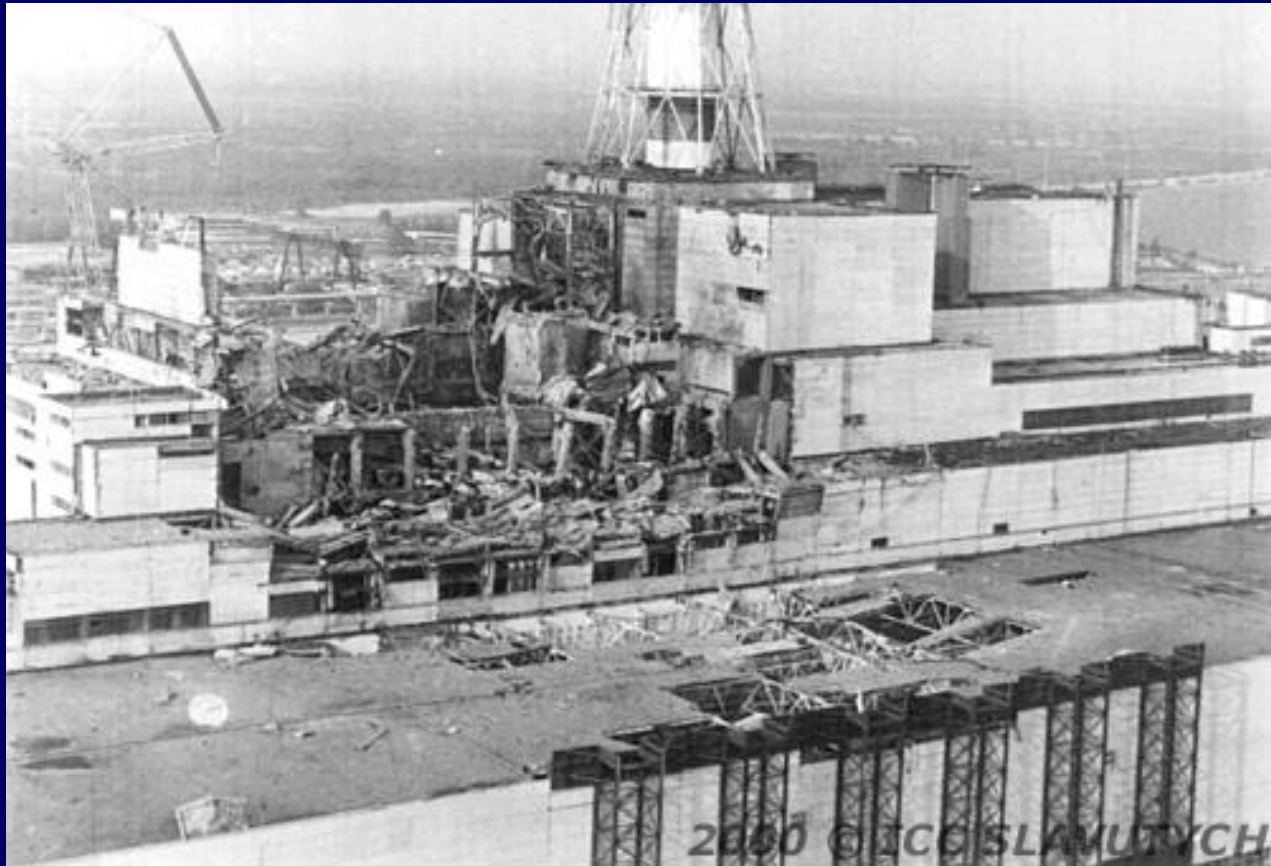
*Little to no interest in TMI aftermath until recently...*

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Chernobyl

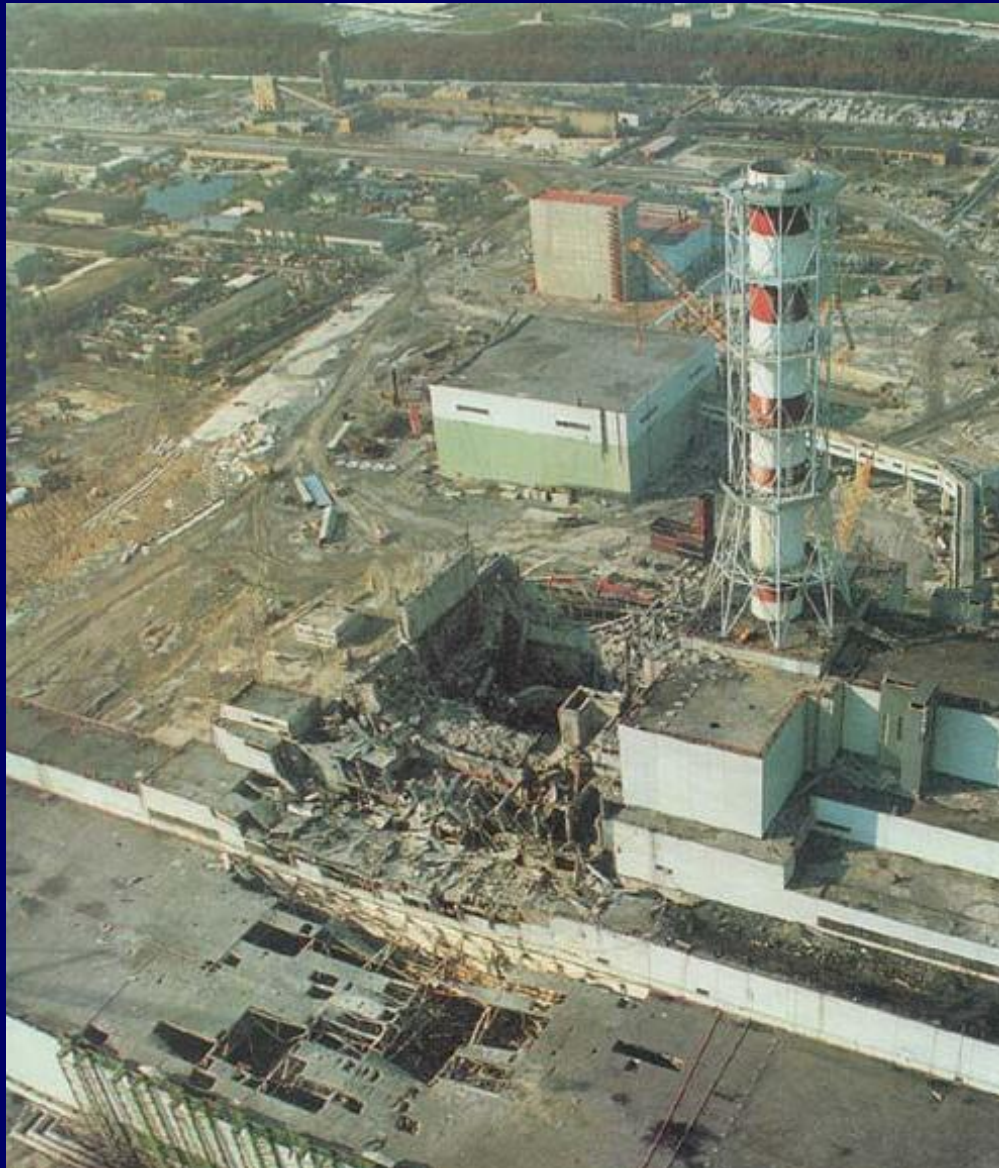
7 years later (Apr 26, 1986), Chornobyl exploded

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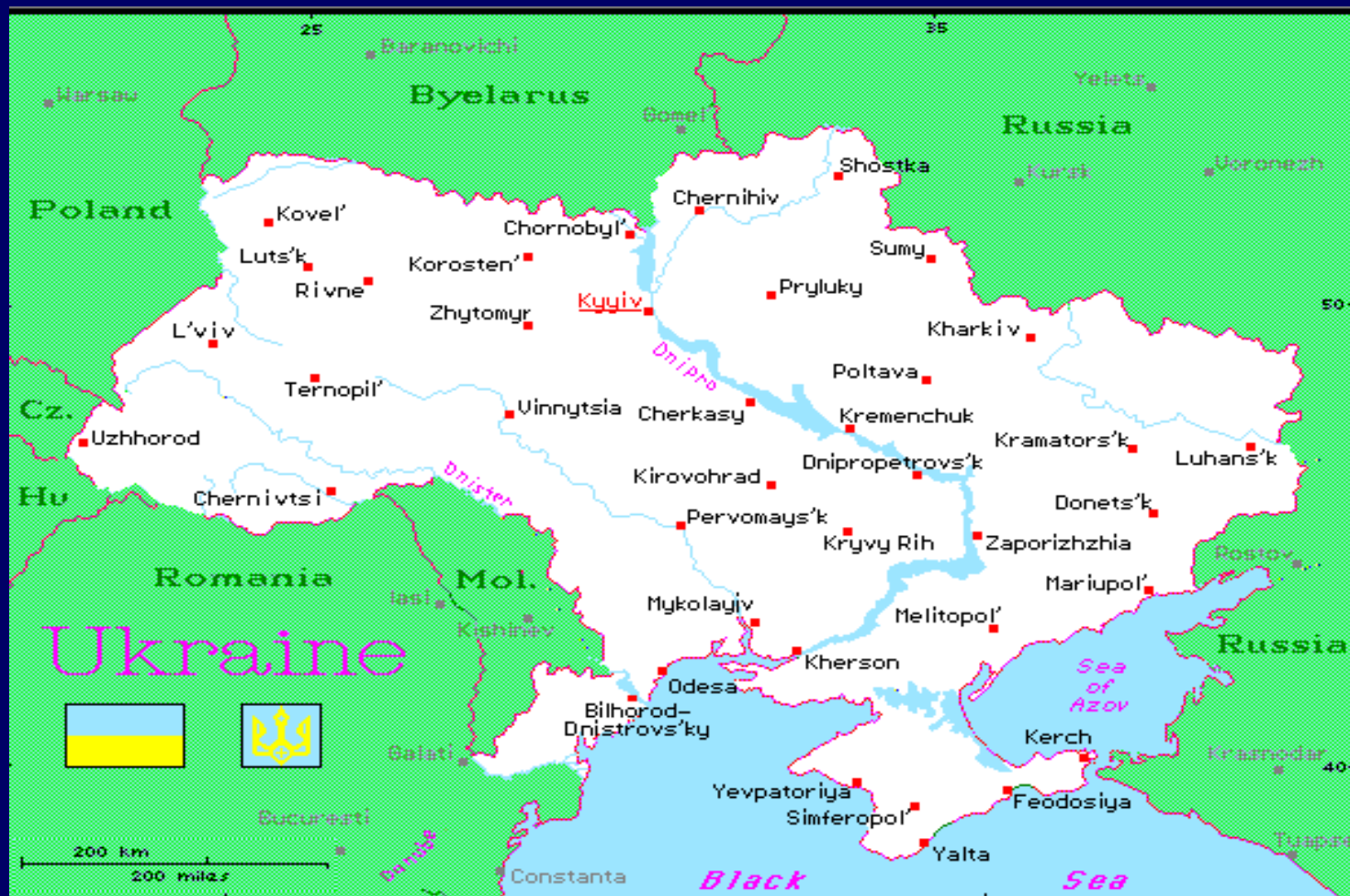


# Melt-down of Unit 4

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## Permanent evacuation of 30-km exclusion zone

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- ~135,000 people were permanently evacuated (over time, evacuated = 350,000)
- Unlike contradictions after TMI, no (Belarus) or misleading (Ukraine) disclosure by authorities
- 1990: feasibility \$ from NIMH to see if we could do a study similar to TMI
- In the end, studied mothers evacuated to Kiev, their children, and a sample of liquidators (clean-up workers)

Semyon  
Gluzman,  
MD in  
front of  
KGB

June  
1992







# Pripyat







## 2-phase Chernobyl study of moms and kids

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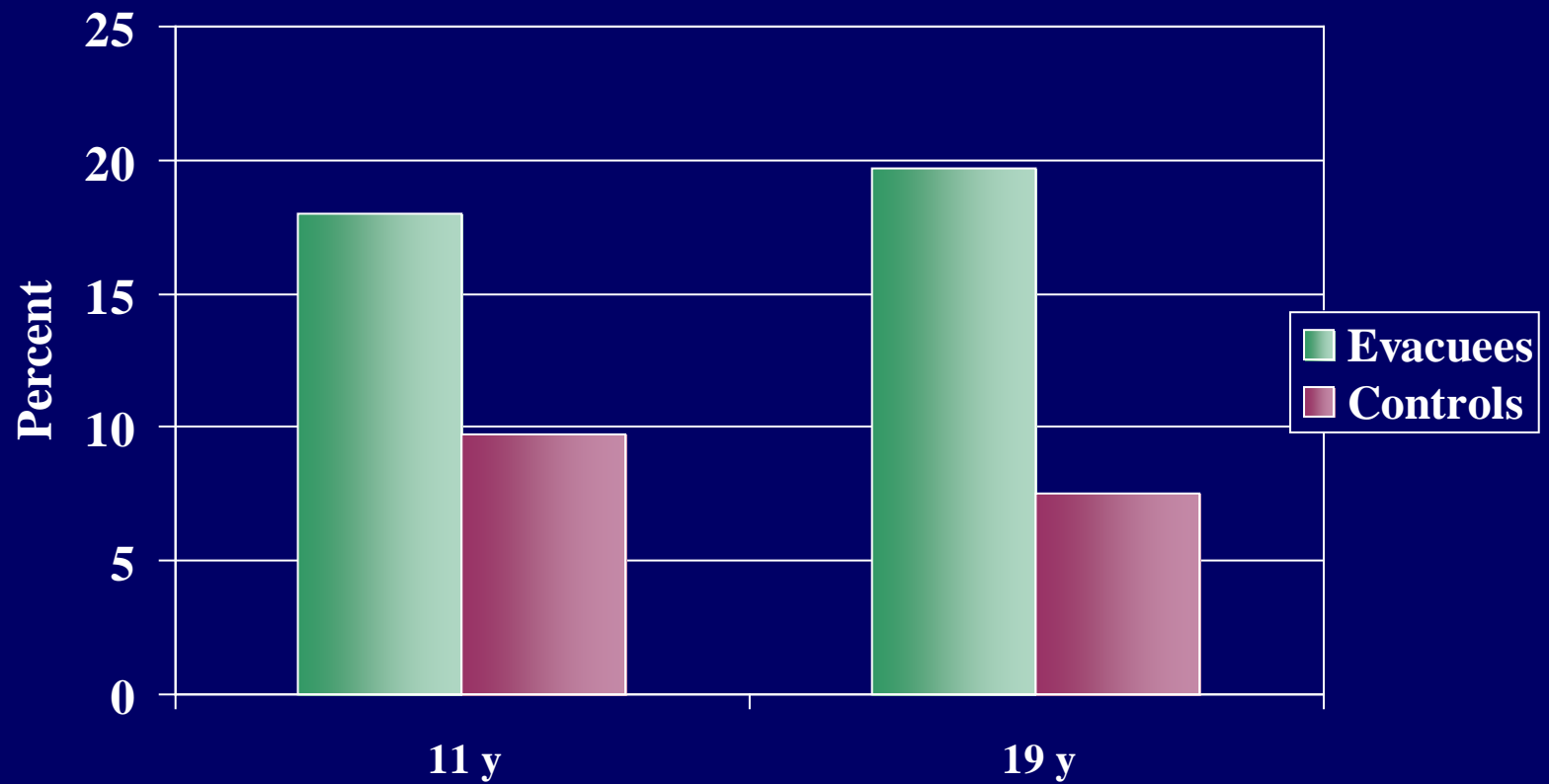
- 11 and 19 years after Chernobyl
- 300 evacuee children born shortly before or after accident and 300 gender-matched classmate controls
- Phase 1: Mothers and children were interviewed simultaneously in their homes
- Phase 2: Children had medical exams and blood tests at a clinic
- At year 11, school records and teacher reports
- At year 19, we added population-based control group

## Basic findings

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- No differences betw evacuee and control kids in mental health, neuropsychological performance, academic performance, physical health, blood tests
- Only diff's were evacuee children more often absent from school and rated their health less positively
- Large differences in mothers' mental health and self-reported medical conditions, almost entirely explained by Chernobyl risk perceptions and MDs' dx health conditions as C-related.
  - NOT explained by other forms of life stress, economic strains, marital problems, or demographic factors

## Proxy PTSD (from IES-R)



*P* values <0.001 At year 19, second control group had same rate as classmates' mothers

# Liquidators

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- Liquidators being monitored for cancer, but not mental health
- Mortality study from Estonia showed that excess suicide
- Descriptive papers show “chronic fatigue-like” effects and cognitive issues
- In 2002, Ukraine-World Mental Health national survey
- Russian & Ukrainian CIDs and trained interviewers
- Collaborated with the Kiev Radiation Medicine Institute
- Interviewed 295 liquidators in 3 geographic areas of Ukr
- Compared with 397 age/geographic matched controls from the Ukraine-WMH

## Liquidators were more impaired

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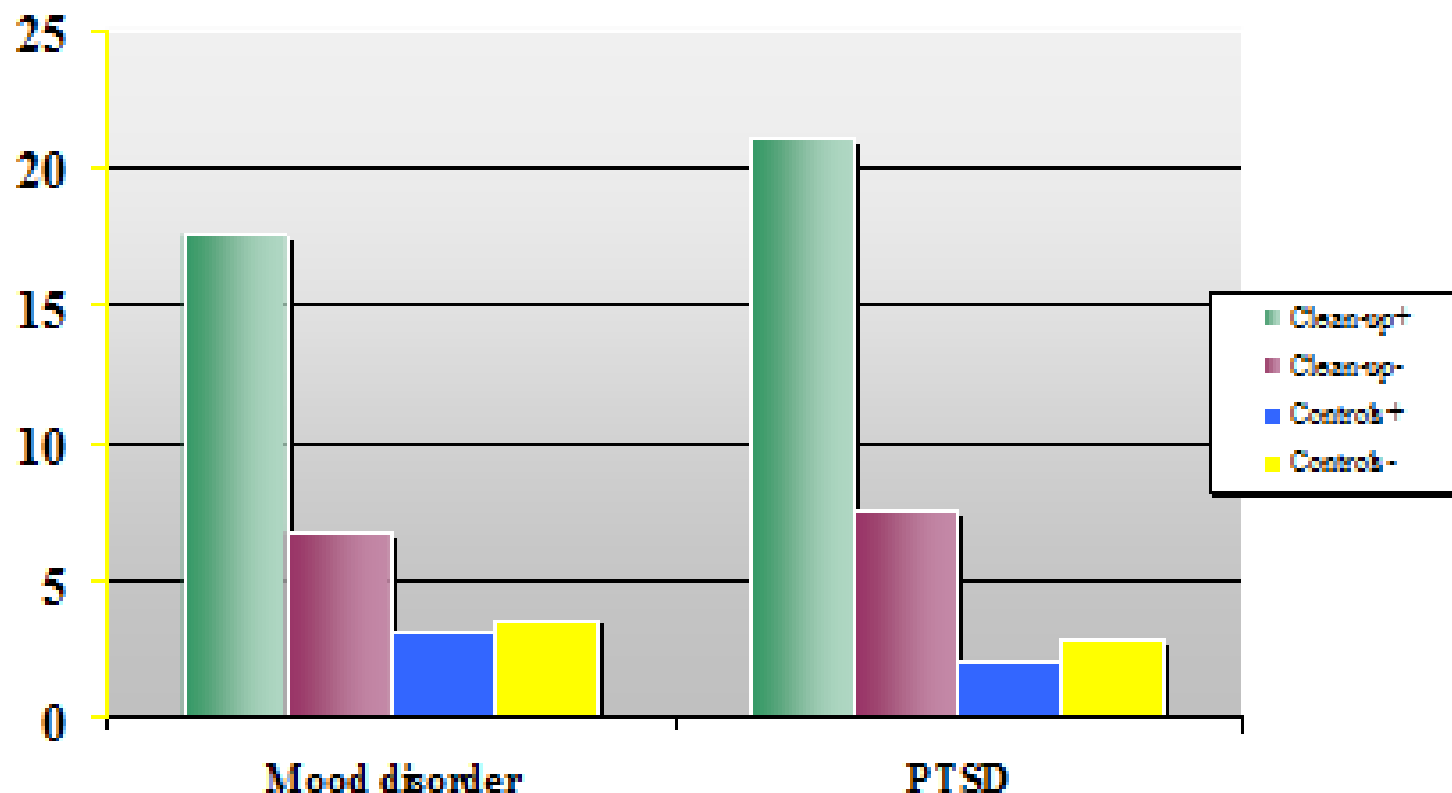
	<u>aOR</u>	<u>95% CI</u>
•		
• Mood disorder	1.8	(1.1-2.9)
• Suicide ideation	2.3	(1.2-4.5)
• PTSD	3.5	(1.0-12.1)
• Anxiety disorder	4.1	(1.3, 12.7)
• Severe headaches	16.6	(9.4-29.5)

aORs adjusted for age in 1986 and onset of disorder < Chornobyl

- No difference on alcoholism



## Days lost from work in past month: clean-up workers and controls with and without disorder in past 12 months



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Like TMI,

*Other studies showing long-term psychological impacts of Chernobyl.*

*Little to no interest in its psychological aftermath until recently...*

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Fukushima: March 11, 2011



# Fukushima myths and reality

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- Myths:
  - Evacuation was too small and too late.
  - Children have developed thyroid disease
  - Northeast Japan is contaminated by radiation, and products from Fukushima prefecture are radioactive.
- Reality:
  - Safety measures were instituted promptly; evacuation was timely
  - Tested 360,000 children. 99.3% no abnormalities. Some had small cysts and nodules (rate similar to another area). 26 children had surgery for papillary thyroid carcinoma (average age 15). **Screening effect (not Fukushima effect)**
  - Outside the evacuation zone, the radiation levels are close to background radiation exposure in Japan (2 mSv/y; PNAS 2/2014)

# Early reports from Fukushima studies

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- **Fukushima Medical University surveys**
  - Postal survey (very large N; very small RR)
  - Distress in adults: 14% women, 10% in men
  - PTSD in adults: 20% in women; 17% in men
  - Increase in suicides in Fukushima prefecture
  - Increase in alcoholism (unemployment)
- **TEPCO worker study (Shigemura, JAMA, Aug 2012)**
  - Questionnaire surveys of 885 Daiichi and 610 Daini workers in May-June 2011 (Shigemura et al., JAMA August 2012)
  - K6 distress: 44% vs 33%
  - IES PTSD: 27% vs 15%
  - Associated with discrimination/slurs from general public

# Untapped value of health surveillance

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Can have enormous value to affected communities, if...

- Partner with natural community leaders and local organizations
  - Incorporate local concerns into questionnaires
  - Present results in person clearly and consistently to local stakeholders in open forums
  - Actively engage study participants about radiation risk (rather than elicit perceptions and leave a pamphlet)
1. Use findings to de-stigmatize mental health problems
  2. Reach out to the angriest communities
  3. Force scientists to think about better communicating science which in the end might lower the level of distrust toward them, and ultimately help people know how to judge good from bad information and what questions they should be asking.

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