Balancing the risk of the evacuation and sheltering-in-place options: a survival study following Japan's 2011 Fukushima nuclear incident

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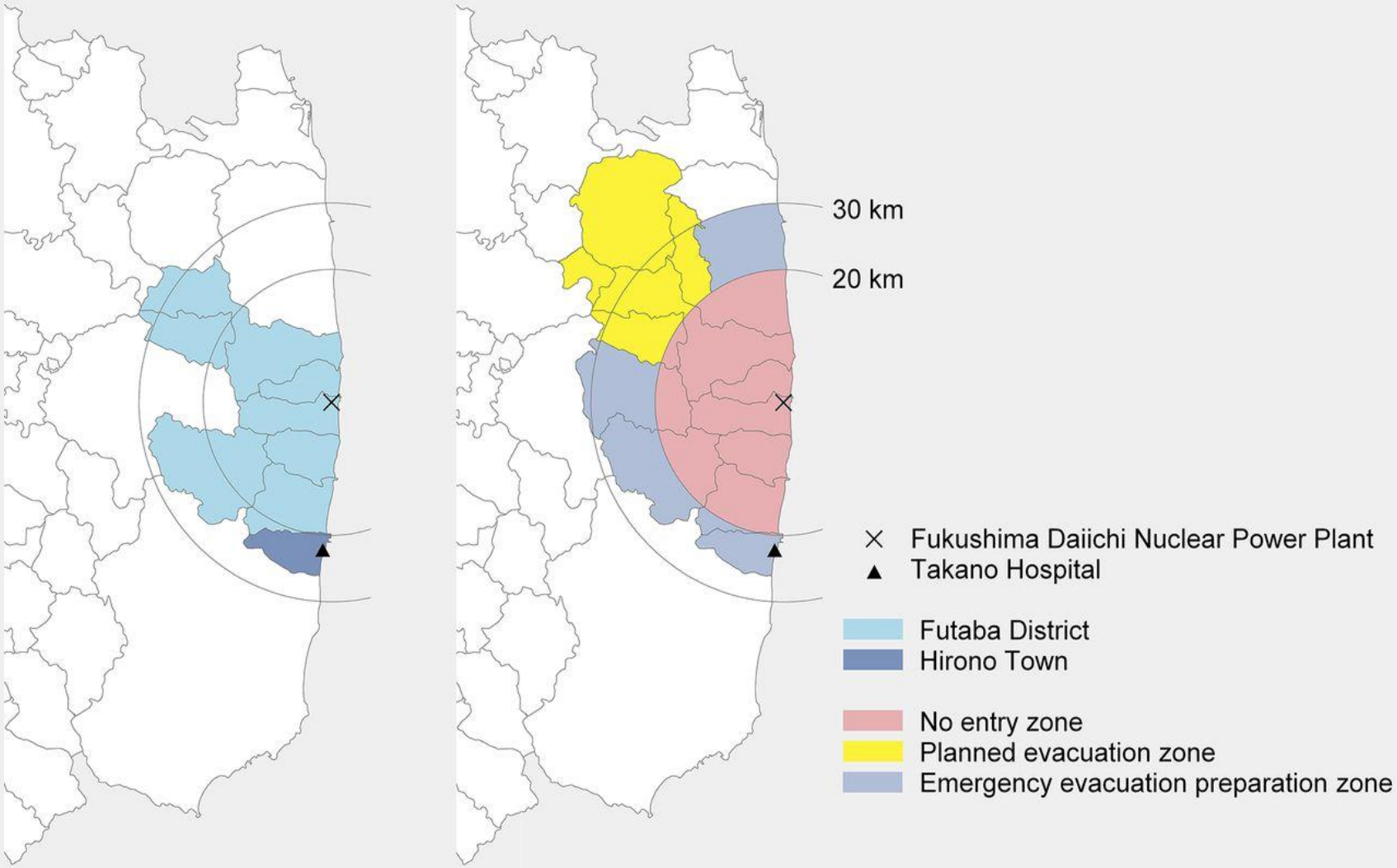
12/13/2018

Introduction

Fukushima Daiichi Nuclear Power Plant

- The **9.1-magnitude** (Mw) undersea megathrust earthquake occurred on 11 March 2011
- Nuclear incident


30 km
20 km
Fukushima Daiichi Nuclear Power Plant
Takano Hospital
Futaba District
Hirono Town
No entry zone
Planned evacuation zone
Emergency evacuation preparation zone

Aim of the study

To assess the mortality in hospital patients who sheltered-in-place following Japan’s 2011 Fukushima nuclear power plant incident.

Health Problem

- Comparing hospital mortality in patients who are sheltered-in-place after the incident, with baseline pre-incident mortality and articulated post-incident circumstances while sheltering-in-place.
- Planned and unplanned evacuation
- Data from Takano Hospital (located 22 kms south of Fukushima Daiichi nuclear plant, Japan)

Knowledge Gap

- Safe sheltering-in-place.
- Safe emergency response for vulnerable people.

Hypothesis

They did not hypothesize the effect of the nuclear incident in the study

Methods

Research design

- Study: Retrospective study
- Sample size: 484
- Population : All patients admitted to Takano Hospital from 1 January 2008 to 31 December 2016
- Patient population are not described.

Variables of interest

- Dependent variables: time to death
- Independent variables:
  - Post-incident (non-evacuees, evacuees, new admittees)
- Covariates:
  - Sex, age at endpoint, primary disease, medical condition
- All the relevant covariates are not included (cause of death).
- Authors did not mention how they handled missing data.

Statistical Test

- Start time: 1 January 2008
- End time: 25 June 2017
- Censoring is not mentioned.
- Survival probability using the Kaplan-Meier product limit method
- Bayesian multivariate Weibull regression.
- No statistical assumption were tested.

Results

Study population

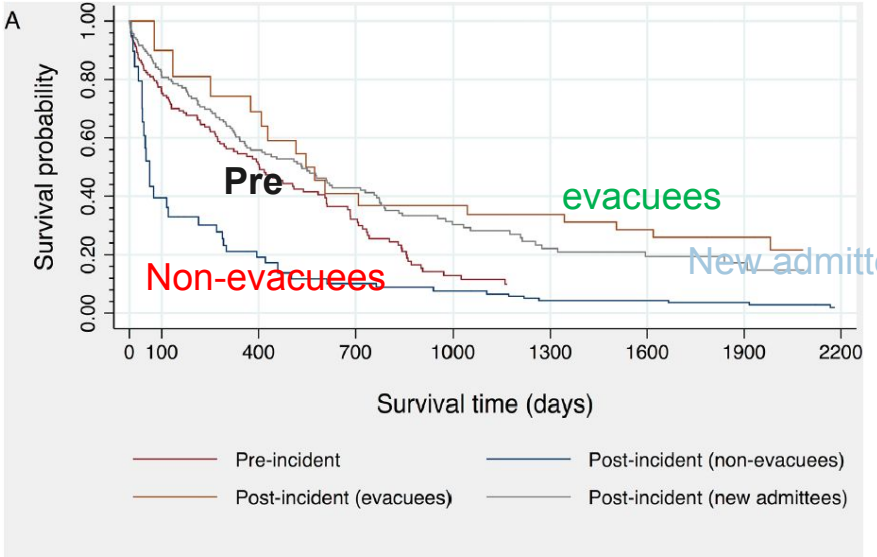
- 484 patients admitted between January 2008 and December 2016
- Female 269 (55.6%) versus Male 215 (44.4%)
- Internal: 356 (73.3%) and psychiatry: 128 (26.3%)
- Percent of deaths: 261 (73.3%) in internal versus 32 (25.0%) in psychiatry
- Experienced incident: 63 (58.3%) in internal versus 45 (41.7%) in psychiatry

Death records

	Internal department		Psychiatry department		Total	
	No of deaths	Mortality rate*	No of deaths	Mortality rate*	No of deaths	Mortality rate*
Preincident	104	1.90	10	0.22	114	1.14
Postincident						
Non-evacuees	35	2.27	1	0.43	36	2.03
Evacuees	16	0.74	8	0.27	24	0.47
New admittees	106	1.19	13	0.42	117	0.99

Kaplan-Meier Plots

Internal department



Psychiatry department

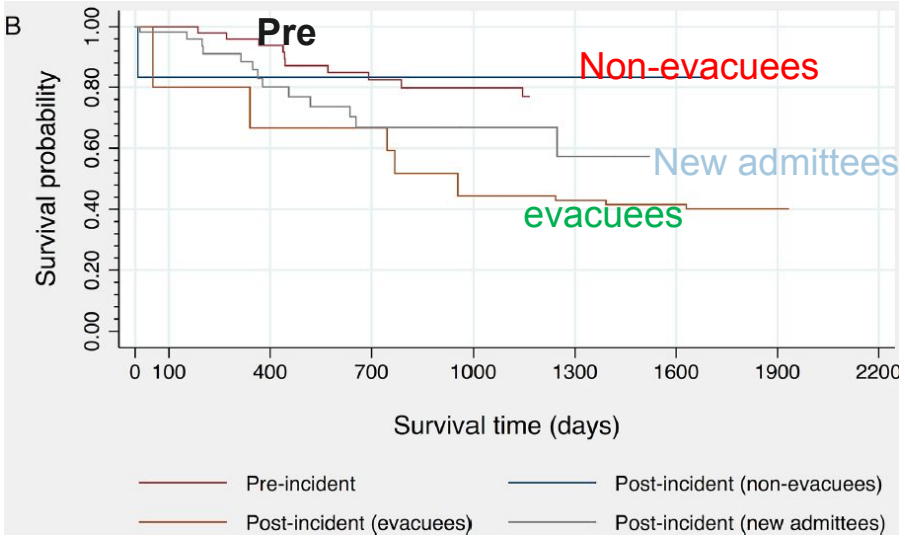


Table 3 Bayesian estimates of HRs with 95% credible intervals by department

	Internal department	Psychiatry department
Study population		
Preincident	1.00	1.00
Postincident		
Non-evacuees	1.57 (1.11 to 2.18)	3.83 (0.08 to 15.75)
Evacuees	0.53 (0.42 to 0.66)	1.36 (0.45 to 3.29)
New admittees	0.64 (0.49 to 0.82)	1.39 (0.53 to 2.99)
Sex		
Male	1.00	1.00
Female	0.91 (0.77 to 1.06)	0.32 (0.10 to 0.66)
Age at endpoint*	1.04 (1.04 to 1.04)	1.04 (1.01 to 1.06)
Primary disease†		
Cardiovascular disease‡	1.00	–
Lifestyle disease§	0.83 (0.57 to 1.21)	–
Nervous disease¶	0.67 (0.53 to 0.86)	–
Mental illness	0.42 (0.31 to 0.55)	–
Other**	1.22 (0.94 to 1.58)	–
Medical condition†		
1	1.00	–
2	1.91 (1.55 to 2.28)	–
3	4.51 (3.37 to 5.80)	–

Hazard ratios and credible intervals reported.

Discussion

Interpretations

- Age is an important factor that affects survival in disasters; younger patients are more likely to survive hazardous events than older ones
- Survival time was entirely different between the internal and psychiatry department both pre-incident and post-incident

Strengths

- This is the first study to assess the mortality in hospital patients who sheltered-in-place (non-evacuees)
- This study also added new insights into the post-disaster mortality risk of psychiatric patients.
- Bayesian analysis allows for intuitive interpretation of estimates

Limitations

- The findings could not be applied to older psychiatric patients.
- The results were not generalisable.
- Able to obtain data only from one hospital (Takano hospital) instead of six other hospitals around the site.
- While doing analysis, they did not consider patient's medical conditions which could have changed overtime at the endpoint of the study.


QUESTIONS?


MERRY
CHRISTMAS
& Happy New Year