Building Comprehensive Suicide Prevention Policy
Based on Statistical Evidences

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1. Introduction

In this presentation we would like to clarify roles of the Japanese official statistics system to help planning effective evidence based policies for suicide prevention through two illustrative statistical analyses; one is spatial clustering of region by using "Regional statistics about suicide death" and another is data mining to explore significant hazards to accelerate risks of suicide by anonymized microdata of the Japanese National Comprehensive Survey of Living Conditions conducted by the Ministry of Health, Labor and Welfare (2010).

The Deming-Ishikawa's cycle for daily management and improvement (KAIZEN) shown at Figure 1 is not only useful for TQM (Total Quality Management) in industries but also for improving public policies by the central or local governments particularly that systematically collect microdata of their official statistics from the people.

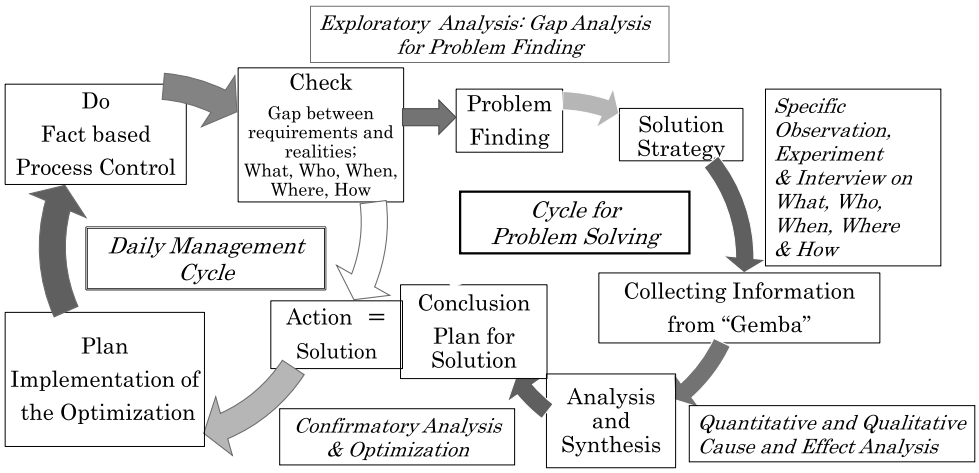

Figure 1 Deming-Ishikawa cycles for Quality Management

Though some trends in leading causes of death shown in "Vital Statistics" may be generally available to verify effects of some implemented policies along the daily

management cycle shown at Figure 1, however, we propose that the government should use official statistics or their microdata more actively and systematically for the problem finding phase by detecting significant regional differences of suicide rates or for risk analysis by exploring direct or indirect risk factors of suicides. We will illustrate several informative analyses on official statistics data to clarify our idea.

2. Detecting Hot Spots of Suicidal Risk Areas

Fujita (2009) developed "Regional Statistics on Suicide Deaths" on the suicide rate in a total of 3318 municipalities over a 30-year period from 1973 to 2002 based on the mortality sheet for the demographic survey conducted by the Ministry of Health, Labor and Welfare, where the regional statistics such as the number of suicide stratified by municipalities, secondary medical care zones and sexes could be utilized. Kubota, Tsubaki, Yamauchi, Tachimori and Kawaguchi (2013) revised Fujita's original statistics. Kubota and Tsubaki (2014) also developed web application for visualization of Japanese suicide statistics by Fujita (2009).

Kubota, Tomita, Ishioka, Fujino and Tsubaki (2013) utilized the regional SMR of suicide death from Fujita's statistics to detect spatial clusters with both high suicidal risks in Kanto Area by using spatial scan statistics (Tango, 2010) as shown at Figure 2.

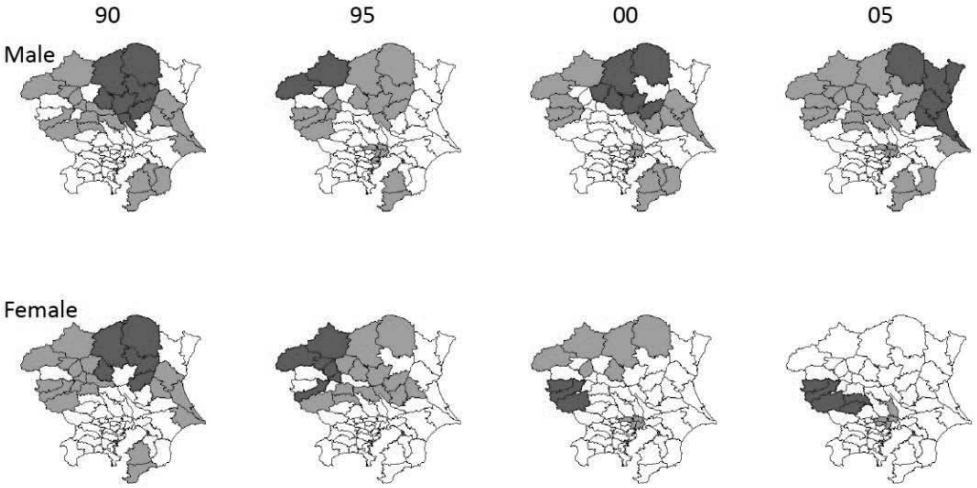

Figure 2 Hotspot Transition of Suicide in Kanto Region from1990 to 2005

Tomita, Kubota and Ishioka (2015) visualized the regional and temporal features of Bayes adjusted suicide rates in Japan from 1973 to 2007 by the spatial clustering. They also detected clusters in terms of increase/decrease rate between 1988-1992 and 1993-1997, between 1993-1997 and 1998-2002 and between 1998-2002 and 2003-2007.

Theses analyses suggest some similar causes of suicides within same clustered regions and necessity of common preventive actions among the regions.

3. Cause and Effect Analysis using Official Statistics

Takebayashi, Kubota and Tsubaki (2016) analyzed the anonymized data including Kesseler 6 (K6) for assessing serious psychological distress from the Japanese National Comprehensive Survey of Living Conditions which is conducted by the Ministry of Health, Labor and Welfare (2010) to obtain basic data such as health, medical care, welfare, pension, and income for the planning and management for the health, labor and welfare administration. They extracted the three sub-datasets of high suicidal risk: psychiatric disorders (n = 259), unemployment (n = 550), and caregivers for relatives (n = 505) and excluded observations with missing outcome from their analyzing dataset and consequently sample size were reduced (psychiatric disorders: n = 198, unemployment: n = 428 caregivers for relatives: n = 304). The K6 scores, which can be regarded as surrogate outcome variables for suicide risk, were divided into three mental health problem severity of low (0 to 4), moderate (5 to 9), severe (>9) based on recommended cut-off values by Sakurai, Nishi, Kondo, Yanagida and Kawakami (2011). We could also extract a lot of variables related to socio-demographic, financial, and health condition from the dataset and generated 63 potential explanatory variables to classify the outcome categories as shown in Table 1.

Table 1. List of Explanatory Variables for Suicide Risk
from the Japanese National Comprehensive Survey of Living Conditions

Demographic/Financial status		Medical staus (yes/no)/Subjective stress(continuous)			
1	gender	22	diabetes	43	dental
2	age	23	obesity	44	atopy
3	marital status	24	hyperlipidemia	45	dermatitis
4	education level	25	thyroid disease	46	gout
5	numbers of household members	26	psychiatric	47	rheumatosis
6	types of household	27	dimentia	48	arthritis
7	total houshold expenditure	28	perkinson	49	stiff shoulders
8	total income	29	neurologic disease	50	low back pain
9	amounts of contributions	30	eye	51	osteoporosis
10	premium payment	31	ear	52	kidney disease
11	amounts of savings	32	hypertension	53	prostatomegaly
12	loss of saving	33	stroke	54	menopausal disorder
13	amounts of loans	34	cardiovascular disease	55	fracture
14	medical expenses	35	circulatory organ	56	injury
15	job	36	cold	57	anemia
16	childcare expenses	37	rhinitis	58	malignant neoplasm
17	person requiring care	38	asthma	59	pregnant
18	living with person requiring care	39	Respiratory disease	60	infertility treatment
19	types of a person requiring care	40	gastroduodenal disease	61	other
20	smoking	41	liver or gallbladder disease	62	unknown
21	numbers of smoking	42	gastrointestinal disease	63	subjective stress

To predict the categorized K6 we used a basic data mining tool, CART (Classification and Regression Tree) proposed by Breiman and Friedman (1984) whose algorithms, “rpart,” version 4.1-9 are implemented to the R language by Therneau, Atkinson, and Ripley (2015).

The most efficient classification rule generated by CART for the psychiatric disorder group is shown in Figure 3, where 6 groups are configured at the 6 terminal nodes within which 3 groups were categorized as having severe mental health problem. These groups are characterized based on interactions between subjective stress (standardized factor score from IRT model), type of household, amount of saving, and total income. People who have high subjective stress was tend to be have more severe mental health problem when they are one-person household in the dormitory (categorized as 1), single-parent family (categorized as 5), three generation household (categorized 6). Even though they are other type of household, it tend to have severe mental health problem when they have fewer amount of saving. Interestingly, there may exist a few patients with severe mental health problem even when their total income is high.

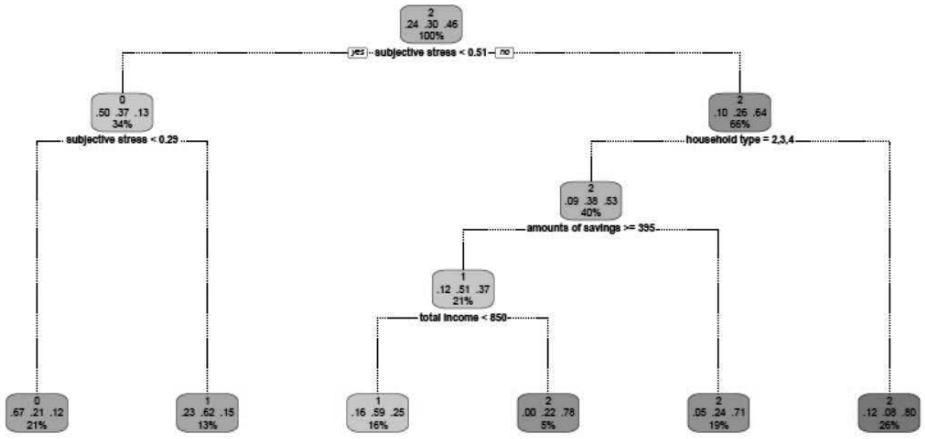

Figure 3 Classification tree on main causes of severe mental health difficulty in the psychiatric disorder group

Thus Microdata from “Japanese National Comprehensive Survey of Living Conditions” are so informative for causal analyses of mental health that systematic and periodical analysis should be designed for effective policy making in Japanese government.

4. Discussion

Beside “Vital Statistics” and “Japanese National Comprehensive Survey of Living Conditions” conducted by the Ministry of Health, Labor and Welfare, other micro data from official statistics may be available for risk analyses on suicides, for example in microdata from “Survey on Time Use and Leisure Activities conducted by the Ministry of Internal Affairs and Communications, we can find individuals with severe life conditions without sports and leisure due to working so hard, nursing alone long time etc.

Japanese government should systematically design comprehensive exploratory analyses of micro data from its official statistics to make evidence based policies for preventing different types of suicides more effectively.

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Suicide Prevention: Insights from Economics

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1. Introduction

In recent years, suicide has become one of the major social problems in many countries but is particularly a serious problem in Japan, where more than 30,000 people killed themselves each year from 1998 to 2011. A cross-national comparison of suicide rates in the 2000s indicates that the suicide rate in Japan for men and women combined ranks eighth in the world and third among the OECD countries. Thus, not to mention, suicide is a serious social problem characterizing contemporary Japan.

But is suicide really a policy issue that needs to be addressed by the entire society? On what grounds does society need to prevent individuals' suicides? Ritual suicide, called seppuku or jiketsu (hara-kiri), has a long history in Japan and some people tolerate or even affirm suicide.[1] Historically, there is a deep-rooted perception in Japan that suicide is a matter of personal choice and is to be left to an individual's judgement as their decision.[2] There is also a strong perception even today that suicide is a personal problem attributable directly to factors such as mental illness. Thus, no full-scale discussions have been attempted until recently about the socioeconomic context or causes leading to suicide, nor about the efforts that should be made by the entire society toward addressing mental illness and suicide.

In this presentation, we would like to keep a distance from the notion that "suicide is a personal problem." Instead, we will argue based on scientific evidence that suicide is a policy issue, and therefore must be formally addressed: suicide's social or economic context and its mechanism must be elucidated, and policy interventions by society in its entirety are required. Before discussing suicide prevention policies, a broad framework of market, government, and community, similar to Hayami (2009), could be adopted as a theoretical foundation for our arguments on suicide prevention policies (see Appendix).

2. Rationale and Policies for Suicide Prevention

What are the grounds for stopping suicide? In this chapter, we discuss rational behind suicide prevention policies. Article 25 (1) of the Constitution of Japan stipulates, "All people shall have the right to maintain the minimum standards of wholesome and

[1] A typical example is Chapter 12, "The Institutions of Suicide and Revenge," of *Bushido* by Inazo Nitobe.
[2] A typical example of such thinking is the first defense of suicide in Europe by poet John Donne, who lived in the 16th and 17th centuries.

cultured living." However, the data on suicide suggest the possibility that not all people necessarily enjoy this right. For example, according to "About deaths by suicide among recipients of livelihood assistance," a report released by the Ministry of Health, Labor and Welfare in July 2011, the suicide rate among recipients of livelihood assistance was 54.8 per 100,000 people in 2008, 62.4 in 2009, and 55.7 in 2010, more than twice the national average of 25.3, 25.8, and 24.9 respectively (Public Assistance Division, Social Welfare and War Victims' Relief Bureau, Ministry of Health, Labour and Welfare 2012). According to data based on the National Police Agency's suicide data forms, the suicides caused or triggered by "economic and livelihood issues" in 2010 totaled 7,438. Of these, the number of suicides caused or triggered by "hardships in life" totaled 1,649 (National Police Agency 2011). Of the 1,649 people who committed suicide due to "hardships in life," 1,049 were unemployed. The suicide rate among unemployed people, including the jobless and pensioners, is much higher than among those who have a job. These facts indicate the possibility that destitution poses an obstacle to attaining the "minimum standards of wholesome and cultured living." From the viewpoint of the Constitution, therefore, policy interventions are perhaps justified for non-economic reasons as well.

In this presentation, we will also argue that suicide prevention is necessary from three economic viewpoints; first, from the viewpoint of negative externalities and social costs; second, from the viewpoint of social losses caused by the loss of an individual; and third, from the viewpoint of market imperfections and incentive distortions.

To start, we must examine why suicide prevention measures are necessary from the viewpoint of negative externalities and social costs. First, suicide produces bereaved family members and causes them to experience "negative externalities," i.e., serious psychological and mental effects, as well as economic burdens. Yet, the "negative externalities" of suicide not only affect bereaved family members and acquaintances, but can also affect an extremely broad range of people outside of the deceased's immediate circle of influence. In particular, suicides by celebrities, family suicides, or suicides resulting from bullying, which receive considerable media coverage, may induce a series of related suicides once they are publicized. This "Werther effect," is the second source of negative externalities, named after a novel by Goethe, has been confirmed by other subsequent studies (e.g., Wasserman 1984; Stack 1987). Third, the existence of large social costs of suicide is one of the externalities. Fourth, market failure and distorted incentives are the source of negative externalities which necessitate suicide prevention measures through correction of market failures. Fifty, we illustrate several possible suicide prevention policies empirically. Finally, the role of community mechanism in preventing suicides is discussed based on Matsubayashi, Sawada, and Ueda (2013).

Appendix: Market, government, and community framework in Economics

According to Hayami (2009), the market represents a mechanism, which coordinates between profit-seeking individuals and firms through competition under the price signals. Naturally, the market has an advantage in matching the demand and supply of private tradable goods. In economics, there is a well-known "welfare theorem" which says that competitive equilibrium achieves Pareto optimality, i.e., the best resource allocation, under the frictionless market assumptions. Yet, market fails in achieving this optimal outcome due to legitimate reasons such as public goods, externalities, and imperfections of information and competition. These "market failures" necessitates public interventions

The government constitutes a mechanism that forces people to adjust their resource allocations by the command or legal enforcement of the government through taxation, subsidizations, and imposing regulations. Typically, the state plays an important role in supplying global or pure public goods. Yet, we need to recognize the strengths and weaknesses of government interventions aimed at correcting market failures (Stiglitz, 1989). The government also fails due to reasons such as corruption and weak administrative capacities. Politicians solve a maximization problem of re-election probability and bureaucracy maximizes the interests of their ministries at least partially.

In this respect, community enforcement mechanisms are supposed to fill the gaps regarding market and government failures, at least partially. The importance of complementarities of the market, government, and community mechanisms have been emphasized by Hayami (2009) and Mansuri and Rao (2013, Chap 2). The community is a mechanism that guides community members toward voluntary cooperation based on intensive social interactions, facilitating supply of local public goods such as the provision of reciprocal social safety nets, conservation of commons, and the enforcement of informal transactions. The resource allocation process through community mechanisms is based on the social capital, typically referring to the structure of social relationships and networks, or the resulting outcomes of such a structure, that is, mutual trust, solidarity, implicit rules, and social norms. These include not only community-based ties, such as those observed within rural villages and companies or among school alumni, but also relationships formed via social network sites (SNS).

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Community Profile Data on Suicide: A Key Tool for Promoting Community Suicide Policy

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In Japan, there are 1741 local public entities and those population size is various from hundreds of people to millions of people. There are 84 large-scale local public entities of more than 300,000 people, which include 43% of the population and 41% of suicide in 2015. On the other hand, there are 1183 small-scale local public entities of less than 50,000 people, which include 16% of the population and 17% of suicide. The suicide rate of the small-scale local public entities is higher than large-scale local public entities, but the implementation rate of the various suicide countermeasures in small-scale local public entities is lower than large-scale local public entities. It is important to promote suicide policy in small-scale local public entities.

We have developed a community profile data on suicide as the key tool to promote suicide policy in local public entities. This indicates the suicide status of the local public entities clearly to the local authorities and stakeholders. We are also developing policy packages which corresponds to the various background of the suicide. This is a guideline of suicide countermeasure in local public entities. We are looking forward to promotes a suicide policy in local government by providing the profile and the policy package.

Components for Suicide Prevention
among the Community Medical Care Resources

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Results of recent researches in Japan suggest key components for suicide prevention among the community medical care resources as follows:

1. Key components of population approach (targets)
   - Leadership involvement (local government)
   - Education and awareness programs (public)
   - Gate-keeper training (Community or organizational gatekeepers)
   - Supporting individuals at high risk (Individuals at high risk)
   -

   Reference: Ono Y, et al. Effectiveness of a multimodal community intervention program to prevent suicide and suicide attempts: a quasi-experimental study. PLoS One 8: e74902, 2013.

2. Key components of assertive case management for people who had attempted suicide
   - Periodic contact (either face-to-face or by telephone) with participants during their stay in the emergency department and after discharge
   - Collection of information about each participant's treatment status and social problems that could disturb their treatment adherence
   - Encouragement of participants to adhere to psychiatric treatment
   - Coordination of appointments with psychiatrists and primary care physicians
   - Encouragement of participants who discontinued psychiatric treatment to return to treatment
   - Referrals to social services and private support organisations, and coordination for use of these resources to accommodate the individual needs of patients
   - Provision of the psychoeducation content and information about social resources through a dedicated website
   -

   Reference: Kawanishi C, Aruga T, Ishizuka N, et al. Lancet Psychiatry 1: 193-201, 2014.

3. Training program for staff in emergency medicine (gate-keeper training)

- First-aid training package for patients who had attempted suicide and were admitted to hospital emergency departments

URL: Japanese Society for Emergency Medicine Home page (http://jsem.me/training/peec.html)

4. A network system with primary care physician and psychiatric services

- Depression network meeting (6 times a year) and training programs (twice a year)
- Referral of patients with depression to psychiatric services by primary care physicians
- Follow-up by psychiatric social workers as coordinators
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Reference: Report of research on suicide prevention in 2015 (Principal Investigator: Yutaka Motohashi, MD, Ph.D)