

Intervention trial for prevention and management of multirisk events among people living in geriatric facilities

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Abstract

Background: Undesirable risk events, such as falls, aspiration pneumonia and pressure ulcers, are associated with functional decline and cause low quality of life among the elderly. This study analyzed and compared the frequency of major risk events and the effect of standard risk management on their prevention. **Methods:** Subjects: This study recruited elderly persons with disabilities using Japanese geriatric intermediate care facilities (GICFs); these individuals provided written informed consent. **Intervention:** A standardized intervention process of risk management was in place in half of the facilities. The other half provided conventional risk-prevention models. **Outcome variable:** The six-month preadmission incidence and three-month postadmission incidence of undesirable events, including falls, aspiration pneumonia, pressure ulcers, dehydration, and fever, were collected. **Analysis:** The effect of multidisciplinary care management on the reduction of undesirable events was analyzed. **Results:** Overall, 862 elderly persons from 132 facilities using geriatric intermediate care facilities in Japan participated in this study. Falls (35.2%), fever (21.9%), bone fractures (18.2%), and pressure ulcers (12.1%) were frequent undesirable events. There was no reduction in postadmission incidence in the intervention group in any of the patients regardless of the previous incidence. The intervention reduced the occurrence of postadmission pressure ulcers among patients with a previous incidence (odds ratio: 0.34). There were no reductions in falls, fever, or dehydration. **Conclusions:** The effect of standardized risk-management implementation is limited to pressure ulcers. The improvement of risk-management processes is needed to understand their limitations in long-term care facilities.

Background

The public mandatory long-term care insurance law was installed in Japanese care since 2000 to cope with increasing elderly persons with disabilities. This insurance scheme provides facility and at home care and to improve quality of care(1).

As elderly population increase, undesirable risk events, such as falls, aspiration pneumonia, and pressure ulcers, which are associated with functional decline and cause low quality of life among elderly people with disabilities also increased (2–5).

In long-term care insurance, the certified care-manager makes care-plan for each elderly person in both at home and facility settings (6). The care-management process includes planning of daily activities using PDCA cycles for quality improvement of services provided to each elderly person. Risk-management to undesirable events such as fall, aspiration pneumonia, pressure ulcer is considered as a part of care-management, and 93 percent of the care-managers consider quality assurance and risk management as part of their job role (7). At home setting, the advanced care manager system was introduced to improve quality of care management for long-term care recipients (5,8,9) , and it is shown to have effect on elderly survival time (6).

However, effectiveness of risk management by care-manager in the long-term care facilities is unknown. In these facilities, nurses and certified caregivers make efforts to prevent these undesirable events. The frequency of these undesirable risk events is regarded as a quality indicator in geriatric care facilities(10).

Most of the existing studies have examined only one risk factor, such as falls. In reality, care workers deal with multiple risk events at a time, including falls, pressure ulcers or aspiration pneumonia. Furthermore, care workers are not aware of the effectiveness of interventions to prevent these undesirable events.

In previous studies, a history of falls was strongly associated with the recurrence of falls, and simple risk assessment tools, including the history of falls, were developed (11,12). Several studies examined the previous history of risk events and their recurrence in aspiration pneumonia (13) and pressure ulcers (14,15).

Therefore, this study has two purposes. The first purpose is to describe the incidence of multiple risk events in Japanese geriatric intermediate care facilities (16) (GICFs or geriatric health services facilities). The second purpose is to estimate the effects of multidisciplinary preventive measures in elderly persons.

Methods

Participants: There are 3600-member facilities that participate association of GCIF facilities. Initially, 600 facilities were randomly selected from the member facilities. Of these, facilities agreed to volunteered to this study and whose care manager attended the care-management lecture, including the risk-management process, and if they agreed to follow the research protocol were assigned to intervention facility. The control group facilities were selected from the rest of the facility that did not attend the care-management lectures but agreed to participate to the research and agreed to follow the research protocols. In both groups, newly admitted elderly persons (maximum of 10 per facility) between August and September to 2012.

Data collection: Elderly age, gender, activities of daily living (ADL) status as well as six-month histories of undesirable events, such as falls, aspiration pneumonia, pressure ulcers, and dehydration, were collected on admission by care-manager or social worker at intake process from the patient and/or proxy family member by care-manager. After admission, the incidence was monitored regularly during the stay and recorded to the individual medical chart. Incidence information was given to the care-manager and administrative officer in the form of incidence report. In this study the care-manager checked the accuracy of the data using the medical chart and incidence report, which is used as post-admission incidence.

The definition of each type of incidence is as follows: fall, an event that results in a person coming to rest inadvertently on the ground or floor or other lower level; bone fracture, ranging from cracks in a *bone* to a *bone* that is separated and out of place, as diagnosed by physicians using X-ray or other imaging systems; *aspiration pneumonia*, pneumonia resulting from inhalation of foreign bodies (such as food particles); pressure ulcer, **localized damage to the skin and underlying soft tissue, usually over a bony prominence or related to medical or other devices. In this study, pressure injury of greater than stage 1 (non-blanchable erythema of intact skin) was also counted**; dehydration, diagnosed using common symptoms, including tachycardia (>100 bpm), low systolic blood pressure (<100 mm Hg), dry mucous membrane, dry axilla, poor skin turgor, sunken eyes, long capillary refill time, urine color, and urine specific gravity; and fever, 37.5° Celsius, as measured by a common thermometer.

Intervention

Standardized risk management using the Plan-Do-Check-Assessment (PDCA) cycle and multidisciplinary enrollment were the intervention in this study. This process included the following. 1. Risk assessment of previous undesirable events. 2 Detailed informed consent about risk events to patients and/or proxy persons. 3. Care planning according to the risk profile. 3. Sharing the care plan and risk-management plan among the multidisciplinary care team by posting the plan on the bed side or in front of the patients' chart. 4. Follow-up assessment.

The authors provided a one-day lecture to the intervention group facility staff regarding the PDCA cycle as well as other possible approaches to prevent undesirable events. In comparison, the control group continued their conventional risk management, and no additional lecture was provided to the reference facilities (Figure 1). If

Subjects: Members of the Association of Japanese Geriatric Care Facilities volunteered to participate in this study.

The assignment of either intervention or control group was made by the facility. The intervention facilities were selected among those whose care managers attended the care-management lecture, including the risk-management process, and they agreed to follow the research protocol (Figure 1, left side).

The control group facilities were selected from facilities that did not attend the risk-management lecture. Any measures aimed for preventing undesirable events already in place were not discontinued.

Analysis:

Frequency of each type of pre and post admission events were calculated and stratified with previous events and intervention group.

The effect of history on the occurrence of undesirable events was calculated using an odds ratio. The effect of the risk-management intervention on postadmission incidence was analyzed for all participants, and also selecting person with presence of preadmission incidence of each undesirable event. Absolute risk reduction (ARR) and number need to treat (NNT) was calculated.

Written consent to participate in the study was obtained from each participant or the participant's proxy family member if the participants had cognitive impairment. This study was approved by the Ethical Review Board of the Japanese Association of Geriatric Health Service Facilities and is in compliance with the Declaration of Helsinki; approval number 23 (08/01/2014).

Results

A standardized intervention process of risk-management was in place in 61 of 132 geriatric care facilities. Of 862 elderly persons, 599 (69.5%) were women. The average age was 84.1 for all respondents (85.4 for women and 81.0 for men). The nursing care level (between 1 and 5 based on the assessment of care requirement under Japanese long-term care law) (8) was 12.8% at level 1, 20.3% at level 2, 25.6% at level 3, 24.5% at level 4 and 14.6% at level 5 (3.4% of data missing). The basic mobility on International Classification of Functioning, Disability and Health (ICF) staging (17) was 15.6% at stage 1, 12.6% at stage 2, 19.1% at stage 3, 35.3% at stage 4 and 18.1% at stage 5.

Table 1 shows the incidence of undesirable events prior to and after admission, with odds ratios for predictive power. Of the accident information collected, the incidence of previous falls, aspiration pneumonia, pressure ulcers and fever each predicted the postadmission incidence of the same events. A history of bone fractures and dehydration did not predict future occurrence of the same events.

Table 2 shows the effect of intervention in all cases and with previous incidence.

When the incidence of all patients was compared regardless of previous incidence, the intervention by care management did not improve the occurrence of postadmission incidence in any of the studied undesirable events

(Table 3).

However, when we selected patients with previous incidence, there was some reduction in undesirable events (aspiration pneumonia 25.0% vs 11.1%, pressure ulcer 40.4% vs 18.9%).

The intervention effect on undesirable events with a history is shown in Table 4 with its odds ratio and number needed to treat (NNT).

The decrease in pressure ulcer events was observed in patients with a history of pressure ulcers. The observed decrease in aspiration pneumonia did not achieve statistical significance, but the NNT was significant. The postintervention incidence of other risk types, such as falls, did not achieve statistical significance between patients with and without preadmission incidence.

Discussion

The prevention of undesirable events, such as falls, bone fractures, aspiration pneumonia, pressure ulcers, dehydration, and fever, is considered a quality indicator of geriatric care facilities (18,19).

This study's first purpose was to report the effect of preadmission incidence on postadmission incidence. In most of the accidents, previous accidents were an indicator of postadmission incidence, except for bone fractures and dehydration, because of the lower frequency of these events postadmission. Obtaining preadmission incidence is a simple way to select high-risk patients.

If a history of undesirable events is adequately collected in the long-term care facility and shared among the healthcare professionals working in the facility, a three-step measure can be considered to reduce these undesirable events and hence improve the quality of the facilities.

The second purpose of this paper was to analyze the effect of care-management using previous risk events. The first step was to introduce a standardized risk management process using the Plan-Do-Check-Analysis (PDCA) cycle by collecting adequate information, including the history of undesirable events, and by performing adequate risk prevention planning and follow-up. The second step was to educate the health professionals about the risk management process and to share information about risk factors. The third step was to share information among the multidisciplinary team to adequately implement measures to prevent undesirable events (9).

To the authors' knowledge, this is the first study to analyze the relative effectiveness of care management and multidisciplinary intervention for these events; many previous studies focused only on single risks. We compared the effectiveness of care management stratified by the presence of previous events. Most of the existing studies have focused on a single risk factor, such as falls. This study analyzed the relative effectiveness of prevention across multiple risk factors to understand the relative effectiveness of the intervention.

In this study, a reduction in risk events was not observed when all patients were included. However, the frequency of risk events decreased after selecting patients at high risk for pressure ulcers, an observation that was somewhat less noticeable for aspiration pneumonia. As shown in Table 2, pressure ulcers and aspiration pneumonia recurrence were reduced by approximately one-half with risk management. Using these data, we analyzed the NNT of risk management intervention.

Many studies have used single risk events, such as falls, have and shown higher effectiveness. For example, a meta-analysis by Chang et al. showed an odds ratio of 0.82 and NNT of 11 for a multidisciplinary fall prevention program (20). In this study, the NNT of fall prevention was much larger. This may be because we targeted fall prevention as well as many other undesirable risk events. Care management in real clinical settings must cope with multiple risks, and this figure may be close to reality.

This study is the first to show the relative effects of risk management. Risk management towards pressure ulcers and aspiration pneumonia was more effective, and few effects were observed in other events, including falls, dehydration and fever.

Although the incidence of pressure ulcers was reduced in the intervention group, these events did not completely cease. Therefore, sharing information about risk events between patients and their family is a crucial step in risk management.

Our study has several weaknesses. First, the observation period was short; if there were longer observation periods, the odds ratio and NNT could have been larger.

Second, this was not a truly randomized study. However, the prevalence and odds ratios for undesirable events were similar to those of previous studies.

Thirdly, the recall bias on admission may have also influence on the result. However, relatively short three-month period of history, and also direct interview to the patients and/or proxy family member may have contributed to decrease the recall bias.

Lastly, the result is obtained from LTCIs and may not the same with other settings such as home-based care and other type of facilities, because they may have different type of disability and combabilities.

Additionally, intervention did not significantly decrease all risk events. Thus, more specific interventions or classification approaches may be required to reduce undesirable events.

Our next step is to introduce these more specific interventions for the effective prevention of risk events in nursing homes. Also, it is important to inform not all patients will benefit from preventive measures. Adequate explanation to unpreventable risks on admission is also necessary.

Abbreviations

GICFs Geriatric Intermediate Care Facilities

ADL Activities of Daily Living

PDCA Plan-Do-Check-Assessment

ICF International Classification of Functioning, Disability and Health

NNT Number Needed to Treat

ARR Absolute Risk Reduction

Declarations

Ethics approval and consent to participate

Written consent to participate in the study was obtained from each participant or the participant's proxy family member if the participants had cognitive impairment. This study was approved by the Ethical Review Board of the Japanese Association of Geriatric Health Service Facilities and is in compliance with the Declaration of Helsinki; approval number 23 (08/01/2014).

Consent for publication

Written consent for publication was obtained from the Japanese Association of Geriatric Health Service Facilities; approval date 08/06/2018.

Availability of data and materials

All data and materials are preserved by the Japanese Association of Geriatric Health Service Facilities.

Competing interests

None

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Author contributions

J.O. designed and directed the project. H. M. supervised the whole project. N. I. supervised the analytical work. S. I. analyzed the data and wrote the article. All authors discussed the results, read and approved the manuscript.

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References

1. Ministry of Health L and W. Long-Term Care Insurance System of Japan. *Journal of Digital Convergence*. 2016;(November).
2. Barry M, Nugent L. Pressure ulcer prevention in frail older people. *Nursing Standard*. 2015;
3. Inagawa T, Hamagishi T, Takaso Y, Hitomi Y, Kambayashi Y, Hibino Y, et al. Decreased activity of daily living produced by the combination of Alzheimer's disease and lower limb fracture in elderly requiring nursing care. *Environmental Health and Preventive Medicine*. 2013;
4. Leijon S, Bergh I, Terstappen K. Pressure ulcer prevalence, use of preventive measures, and mortality risk in an acute care population a quality improvement project. *Journal of Wound, Ostomy and Continence Nursing*.

2013;

5. Puisieux F, D'Andrea C, Baconnier P, Bui-Dinh D, Castaings-Pelet S, Crestani B, et al. Swallowing disorders, pneumonia and respiratory tract infectious disease in the elderly. *Revue des Maladies Respiratoires*. 2011.
6. Itoh S, Hikichi H, Murayama H, Ishimaru M, Ogata Y, Yasunaga H. Association Between Advanced Care Management and Progression of Care Needs Level in Long-Term Care Recipients: Retrospective Cohort Study. *JMIR Aging*. 2018;1(2).
7. Matsuda S, Yamamoto M. Long-term care insurance and integrated care for the aged in Japan. *International Journal of Integrated Care*. 2016;1(3).
8. Tsutsui T, Muramatsu N. Care-needs certification in the long-term care insurance system of Japan. *Journal of the American Geriatrics Society*. 2005;53(3).
9. Nicolay CR, Purkayastha S, Greenhalgh A, Benn J, Chaturvedi S, Phillips N, et al. Systematic review of the application of quality improvement methodologies from the manufacturing industry to surgical healthcare. *British Journal of Surgery*. 2012.
10. Saliba D, Solomon D, Rubenstein L, Young R, Schnelle J, Roth C, et al. Quality indicators for the management of medical conditions in nursing home residents. *Journal of the American Medical Directors Association*. 2004;
11. Barker AL, Nitz JC, Low Choy NL, Haines T. Measuring fall risk and predicting who will fall: Clinimetric properties of four fall risk assessment tools for residential aged care. *Journals of Gerontology - Series A Biological Sciences and Medical Sciences*. 2009;
12. Okochi J, Toba K, Takahashi T, Matsubayashi K, Nishinaga M, Takahashi R, et al. Simple screening test for risk of falls in the elderly. *Geriatrics and Gerontology International*. 2006;
13. Sue Eisenstadt E. Dysphagia and aspiration pneumonia in older adults. *Journal of the American Academy of Nurse Practitioners*. 2010;
14. Crumbley DR, Kane MA. Development of an Evidence-Based Pressure Ulcer Program at the National Naval Medical Center: Nurses' Role in Risk Factor Assessment, Prevention, and Intervention Among Young Service Members Returning from OIF/OEF. *Nursing Clinics of North America*. 2010.
15. Uzun O, Tan M. A prospective, descriptive pressure ulcer risk factor and prevalence study at a university hospital in Turkey. *Ostomy/wound management*. 2007;
16. Ishizaki T, Kobayashi Y, Tamiya N. The role of geriatric intermediate care facilities in long-term care for the elderly in Japan. *Health Policy*. 1998;
17. Okochi J, Takahashi T, Takamuku K, Escorpizo R. Staging of mobility, transfer and walking functions of elderly persons based on the codes of the International Classification of Functioning, Disability and Health. *BMC Geriatrics*. 2013;
18. Arling G, Kane RL, Lewis T, Mueller C. Future development of nursing home quality indicators. *Gerontologist*. 2005.
19. Zimmerman DR, Karon SL, Arling G, Clark BR, Collins T, Ross R, et al. Development and testing of nursing home quality indicators. *Health care financing review*. 1995;
20. Chang JT, Morton SC, Rubenstein LZ, Mojica WA, Maglione M, Suttorp MJ, et al. Interventions for the prevention of falls in older adults: systematic review and meta-analysis of randomised clinical trials. *BMJ*. 2004;

Tables

Table 1 the incidence of undesirable events prior to and after admission

type of incidence	respondants	Incidence				odds ratio (95% Confidence Interval)	
		before admission		after admission			
		n	%	n	%		
fall	735	259	35.2%	191	26.0%	4.1(2.9-5.8)	*
bone fracture	734	134	18.3%	19	2.6%	1.1(0.24-5.3)	
aspiraton	713	42	5.9%	23	3.2%	10.3(4.1-25.9)	*
pneumonia							
pressure ulcer	694	84	12.1%	67	9.7%	6.2(3.6-10.9)	*
dehydraton	712	61	8.6%	8	1.1%	1.5(0.2-12.7)	
fever	695	152	21.9%	120	17.3%	5.2(3.4-8.0)	*
infection	704	53	7.5%	42	6.0%	4.5(2.1-9.8)	*

NOTE: Odds ratio of incients with asterisk* indicates the incidencet before addmision predicted the recurrence of the same incidence with p<0.05

Table 2 the effect of intervention in all cases and with previous incidence

incidence	All cases						With previous incidence					
	Intervention		total		Intervention		total		Intervention		total	
	n	%	n	%	n	%	n	%	n	%	n	%
no	283	75.1%	261	72.9%	544	74.0%	68	55.3%	77	56.6%	145	56.0%
yes	94	24.9%	97	27.1%	191	26.0%	55	44.7%	59	43.4%	114	44.0%
no	376	98.4%	348	98.9%	724	98.6%	57	100.0%	75	97.4%	132	98.5%
yes	6	1.6%	4	1.1%	10	1.4%	0	0.0%	2	2.6%	2	1.5%
no	358	96.0%	332	97.6%	690	96.8%	18	75.0%	16	88.9%	34	81.0%
yes	15	4.0%	8	2.4%	23	3.2%	6	25.0%	2	11.1%	8	19.0%
no	325	89.5%	302	91.2%	627	90.3%	28	59.6%	30	81.1%	58	69.0%
yes	38	10.5%	29	8.8%	67	9.7%	19	40.4%	7	18.9%	26	31.0%
no	373	98.7%	331	99.1%	704	98.9%	28	96.6%	32	100.0%	60	98.4%
yes	5	1.3%	3	.9%	8	1.1%	1	3.4%	0	0.0%	1	1.6%
no	294	80.5%	281	85.2%	575	82.7%	51	61.4%	41	59.4%	92	60.5%
yes	71	19.5%	49	14.8%	120	17.3%	32	38.6%	28	40.6%	60	39.5%
no	347	93.5%	316	94.6%	663	94.0%	31	86.1%	12	70.6%	43	81.1%
yes	24	6.5%	18	5.4%	42	6.0%	5	13.9%	5	29.4%	10	18.9%

Table 3 the effect of intervention regardless of incidence before admission

type of incidence	total n	intervention n	incidence		odds ratio (95% C.I.)	ARR	NNT
			intervention (-)	intervention (+)			
fall	774	373	111(51.6%)	104(48.4%)	1.0(0.7-1.4)	-0.01	-496.0
bone fracture	740	355	6(60.0%)	4(40.0%)	0.7(0.2-2.6)	-0.25	-4.0
aspiration pneumonia	728	348	15(62.5%)	9(37.5%)	0.7(0.2-1.5)	0.01	73.5
pressure ulcer	724	345	43(52.4%)	39(47.6%)	1.0(0.6-1.6)	0.00	2421.4
dehydration	729	345	5(55.6%)	4(44.4%)	0.9(0.2-3.3)	0.00	701.0
fever	741	349	86(58.1%)	62(41.9%)	0.8(0.5-1.1)	0.04	24.0
infection	731	345	30(56.6%)	23(43.4%)	0.8(0.5-1.5)	0.01	90.5

Table 4 the effect of intervention regardless of incidence before admission with previous risk incidence

type of incidence	total n	intervention n	incidence		odds ratio (95% C.I.)	ARR	NNT
			intervention (-)	intervention (+)			
fall	259	136	55(48.2%)	59(51.8%)	0.9(0.6-1.6)	0.01	75.0
bone fracture	134	77	0(0.0%)	2(100.0%)	n.a.	-0.03	-38.5
aspiration pneumonia	42	18	6(75.0%)	2(25.0%)	0.4(0.1-2.1)	0.14	7.2
pressure ulcer	84	37	19(73.1%)	7(26.9%)	0.34(0.1-0.9)	0.22	4.6
dehydration	61	32	1(100.0%)	0(0.0%)	n.a.	0.03	29.0
fever	152	69	32(53.3%)	28(46.7%)	1.1(0.6-2.1)	-0.02	-49.4
infection	53	17	5(50.0%)	5(50.0%)	2.5(0.6-11.0)	-0.16	-6.4

Figures

	Intervention group
Prior to the program	A half day lecture about risk management
Prior to admission	· Obtain the previous history of undesirable events
	· Explain the risk management to each users
On admission	· Fill in the risk management sheet
	· Construction of risk management plan
After admission	· Sharing among the care staff and practice the plan
	· Count type and number of undesirable events
End	Summarize

Figure 1

Flow of the intervention program