

CASE REPORT

Extreme snowfall and residential care: A case report of a 2-year-old girl with heart failure

Hirotoyo Miyatake¹  | Kana Yamamoto² | Akihiko Ozaki² | Shogo Kawada³ | Yoshitaka Nishikawa⁴ | Hiroyuki Beniya¹

¹Orange Home-care Clinic, Fukui, Japan

²Medical Governance Research Institute, Tokyo, Japan

³Department of Family Medicine, Faculty of Medicine, General Practice and Community Health, University of Tsukuba, Ibaraki, Japan

⁴Department of Health Informatics, Kyoto University School of Public Health, Kyoto, Japan

Correspondence

Hiroyuki Beniya, Orange Homecare Clinic, Fukui City, Fukui 910-0018, Japan.
Email: beniya@orangeclinic.jp

Abstract

In residential care, the daily use of social networking services with patients (and patients' families) helps prepare for a potential disaster. This enables health workers to continue providing essential care even during disasters, while saving human and medical resources for those who need them the most.

KEYWORDS

disaster preparation, paediatrics, residential care, video teleconference

1 | INTRODUCTION

This report presents the case study of a 2-year-old girl with heart failure whose residential care was interrupted by heavy snowfall. However, video teleconferencing with her family members facilitated the continuation of her treatment. This case suggests the importance of appropriate on-site responses following a disaster.

Residential care refers to care provided at a patient's residence.¹ With a large proportion of high-income countries achieving higher life expectancies, the primary center for chronic disease management is gradually shifting from acute care hospitals to communities.² Thus, residential care has become more important in high-income countries. In Japan, residential care is provided by a team of health workers (eg, nurses and rehabilitation staff) led by primary care physicians, and the cost is covered by the national health insurance.¹ Japanese residential care primarily provides care for sick and vulnerable patients, including children with special

care needs, frail seniors, and patients with life-limiting illnesses such as end-stage cancer and critical heart and pulmonary diseases.¹ To be eligible for residential care, the patients must be unable to go to clinics and hospitals by themselves. In most cases, patients' conditions are relatively stable or only gradually deteriorating, and thus, the patients do not require immediate hospitalization. However, given their underlying conditions, these patients are also likely to suddenly become sick or die (eg, from an infectious disease). Thus, health workers providing residential care are required to respond to the health concerns of patients and their families on a 24-hour basis, and in some urgent cases, emergency visits to patients' residences and/or emergency patients' transfers to tertiary hospitals may be required. Under these circumstances, telemonitoring between home visits may improve the quality of residential care management and potentially enable timely intervention before a patient's condition deteriorates. The usefulness of telemonitoring has been studied, and in some cases, telemonitoring performed by residential care

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2019 The Authors. *Clinical Case Reports* published by John Wiley & Sons Ltd.

nurses has been proven useful.³ Developing a solid framework to provide continued residential care is imperative to the safety of vulnerable patients, and this should include telemonitoring.

It is essential to recognize that residential care is subject to extrinsic factors, such as natural disasters. Disasters may impact transportation and communication infrastructure and reduce the number of available active health workers.⁴ Postdisaster stresses may impair patients' health as well as healthcare provision.⁵ Globally, more than 500 000 people died from 110 000 extreme natural disasters from 1997 to 2016, incurring over \$3 trillion in costs.⁶ The frequency and severity of natural disasters are projected to increase with climate change.⁷

Previous studies have highlighted the importance of disaster-related education for healthcare professionals and patients and their families, as well as the assessment of disaster vulnerability and risk inherent in local communities.⁸ However, little is known about the possible disaster preparations that could reduce postdisaster health risks among patients receiving residential care. The effects of disaster on residential care differ by location, disaster type, and the type of healthcare system involved. Therefore, much of the existing evidence to develop appropriate management plans for specific postdisaster situations are based on case studies of specific disasters.

Presented here is the case of a 2-year-old patient with severe heart failure. The patient was initially referred to our clinic for end-of-life care, but her condition unexpectedly stabilized. Subsequently, she was provided long-term care. Her residential care was partially interrupted due to unprecedented heavy snowfall, but a social networking service (SNS) helped the patient's family and health workers to communicate after the disaster.

2 | CASE REPORT

The patient is a 2-year-old Japanese girl with severe heart failure due to noncompaction of the ventricular myocardium and severe cardiac anomaly. She received pulmonary artery banding 6 days after delivery; subsequently, continuous injections of dopamine, dobutamine, furosemide, carperitide, and olprinone hydrochloride hydrate were used to control her condition. At 7 months old, a ductus arteriosus stent was implanted. Despite the treatment, her cardiac condition gradually worsened, and her family wished to spend the remainder of her life with her at their residence. At 12 months old, she was discharged to her residence and referred to our clinic, which is 30 km away (Figure 1), for residential care. In Japan, residential care is generally only permitted for patients living within a 16-km radius from the medical institutions in Japan. In her case, since there were no physicians who could provide pediatric residential care in their region, we were

requested to provide residential care with the support from residential care nursing stations near her residence. The clinic staff initially examined her at home when she was 13 months old. She weighed 4675 g, and she was in poor condition due to edema and cyanosis. Her physical growth was stunted for her age, and she could not turn over or maintain a sitting position unaided.

Since the primary goal of her care was to facilitate a peaceful end-of-life experience, the treatment was simplified to a continuous injection of olprinone hydrochloride hydrate from the peripherally inserted central catheter (PICC); oral administration of digoxin, pimobendan, tolvaptan, furosemide, and spironolactone; home oxygen therapy; and control of diet and water intake/output. Using the extent of her edema and hepatomegaly as the indicators, we regularly worked with her family to monitor her heart failure during home visits, so that they were able to recognize her condition and examine the catheter insertion point with the help of the residential care nurses. We also adjusted her oral medication, diet and water intake/output, and catheter insertion.

In addition, residential care nurses from a nearby residential care nursing station made daily visits to detect any changes in her condition, while physicians and pharmacists visited weekly. Visits by the physicians and residential care nurses often exceeded 1 hour. Physicians and residential care nurses not only evaluated the patient's health condition but also discussed the patient's growth and daily life. For example, physicians and residential care nurses advised on ideal indoor humidity and temperature, safe bathing methods, and diet. They also provided grief counseling and shared their thoughts about the meaning of the patient's life as a way to prepare for her death. Nursery teachers and rehabilitation staff visited monthly and provided developmental support. Information on the patient's condition and developmental process and her parents' anxiety was shared several times per week among the parents and health workers via an SNS-embedded free video conferencing function, used extensively in Japan. The patient was also taken to her heart surgeon once a month to be evaluated and to make any medicine adjustments according to her heart condition. There had been no severe health failure deterioration for 1.5 years after discharge. However, there were repeated short hospitalizations once or twice per month to change her occluded PICC. When she was 21 months old, a right cervical central venous catheter was inserted after failure to change the PICC. By age two, her weight had increased to 6300 g, and she no longer had edema. She could turn over and maintain a sitting position unaided and was sometimes able to go out with her family.

In February 2018, Fukui Prefecture was impacted by blizzard conditions with 147 cm of snowfall (four times the normal average), resulting in 12 deaths in the prefecture and total impairment of the local road networks and transportation

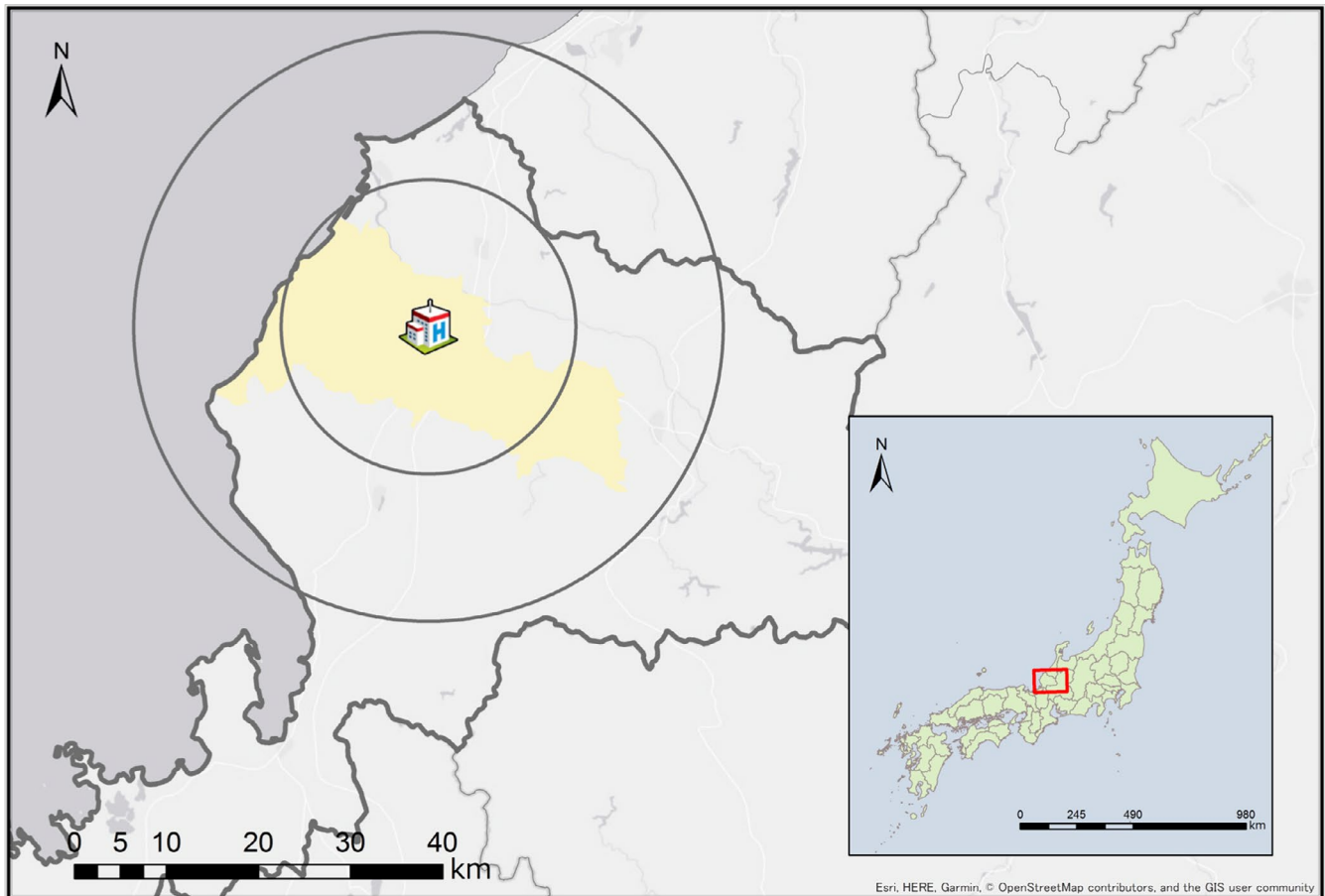


FIGURE 1 Geographical map of Fukui Prefecture. The yellow zone is Fukui city. The inner and outer circles show a radius of 16 and 30 km, respectively, from the clinic. Clinic personnel can visit residences within 16 km for patients who have national insurance and beyond 16 km for patients in areas where there are no clinics to make house visits. The plotted point is representative based on the patient's and clinic's zip codes

systems, although the Internet and telecommunications were maintained throughout the disaster. Because of the snowfall, the road network was mostly closed from February 6 to 15. The roads and transportation systems were partly available during the snowfall, but traffic jams were severe in many places. Nevertheless, we were able to drive at a low speed. Using the clinic's car, we visited the residences of a limited number of patients with severe and/or unstable conditions. Since the parking spaces at patients' residences could not be used due to heavy snowfall, we had to halt the car on the sidewalk. An additional accompanying staff member therefore stayed in the car during the visit. On February 16, normal operations resumed.

During the snowfall, the patient's parents and health workers frequently contacted one another via SNS to confirm whether there was a deterioration of her heart failure and carefully assess the need for home visits. Nurses from a residential care nursing station located close to the patient's residence were able to visit the patient's residence by car throughout the disaster period. Using SNS on tablet devices and laptop computers, the parents and the physician participated in video teleconferences supported by the residential

care nurses on February 7 and 14. On February 7, the physician visually examined the patient's condition to determine whether her body weight had increased or the reading on the oxygen monitor had decreased and evaluated that the patient did not have respiratory distress, cough, or weight gain, which would suggest heart failure deterioration. However, there was a suggestion of inflammation at the catheter insertion site. Therefore, the physician judged the patient's heart condition to be stable but prescribed antibiotics. The pharmacy was located a long distance from the patient's house in Fukui City. Thus, due to the harsh weather and road conditions, the pharmacist was unable to directly visit the patient's residence for a week. On February 7 (day 2 of the snowfall), a few roads were available for driving, and the patient's father managed to drive to Fukui City to meet the pharmacist and was thus able to obtain additional medication. On February 14, the physician remotely checked the color of the catheter insertion site on her neck to examine whether inflammation was present and instructed the residential care nurse to change the dressing via video teleconference on a laptop computer. Fortunately, there was no exacerbation of hepatomegaly or edema during this period.

3 | DISCUSSION

In this study, the health of a patient with severe heart failure did not worsen despite a partial interruption of residential care during the unprecedented snowfall. The condition of patients with severe diseases often deteriorates due to disasters, which could lead to further deterioration. Thus, it is meaningful to consider the reasons for this patient's condition remaining stable.

The most probable reason for this patient's stability was that the patient's family worked with health workers and used SNS to ensure continuity of care during the snowfall, taking advantage of the fact that SNS communication infrastructure allowed for continuous communication during the snowfall. Furthermore, this would still be the case even if it were other infrastructure, such as water or electricity affected. Thus, the health workers were able to regularly examine the patient's condition. During disasters, the usual forms of communication are often interrupted, but SNSs may facilitate uninterrupted communication between physicians and patients as well as timely intervention by physicians when necessary.

Regular SNS use during residential care in nonemergency situations may become an effective disaster preparation mechanism. In ordinary circumstances, SNS may decrease communication barriers between physicians and patients' families.⁹ Indeed, for this specific patient, SNS was used as a daily tool by her parents and health workers without consideration for potential disasters. However, as shown in the case report, regular use of SNSs could be considered a part of disaster preparation. It can function as a backup system if physicians are unable to visit their patients. Few previous studies have reported similar incidents, so the results of this case study may provide unique and important lessons for preparing for a disaster. Particularly, this report suggests that familiarity with SNS among physicians and patients' families during regular care facilitates residential care triage during a disaster.¹⁰ It is specifically important to identify the factors affecting SNS use, such as the proximity of a residential care nursing station to the patient's residence and the level of digital literacy among patients.

Social networking service has another advantage for residential care in disaster situations. In general, during disasters, the overall capacity of health services is likely to decline.¹¹ This, along with the fluctuation of infrastructure and lack of resources, as well as postdisaster stresses, impairs patients' health and well-being.¹¹ Thus, to provide basic care to all patients in need, proper triage is imperative.¹² SNSs would enable examination and provision of interventions over long distances, potentially reducing the number of patient visits.

Recent estimates indicate that average snowfall will decrease as global warming progresses, although the frequency of localized heavy snowfall will not change much.¹³ Therefore, preparations for heavy snowfall are likely to become more

difficult worldwide, particularly in regions that do not experience routine snowfall. Consequently, unexpected local heavy snowfall will continue to create hazardous situations impacting local residential care like in this case. Given the global increase in natural disasters and the enhanced need for residential care,¹⁴ the lessons learned in this case need to be widely disseminated among residential care health workers. In our clinic, this case triggered the launch of a disaster countermeasure department, and clinic staff members have taken steps to prepare for disasters, including visualizing patient information on a map, creating a ventilator list, and updating patient information monthly.

From a financial perspective, the Japanese government's Ministry of Health, Welfare, and Labor promotes residential care because it is considered less costly than regular hospitalization.¹ In Japan, both depopulation and population aging have been rising.¹⁵ Such rapid demographic change requires a fundamental overhaul of the healthcare system. In such a context, an increasing number of patients will need residential care in the future. The Japanese population is often affected by major natural disasters; thus, an appropriate plan to mitigate their health effects on residential care is required.

In conclusion, the health of the patient with severe heart failure did not worsen during the heavy snowfall despite the partial interruption of residential care. In residential care, daily use of communication tools, namely SNS, by health workers and patients and their families is important for disaster preparation. Since the average life expectancy has been globally on the rise, the importance of residential care has become apparent in many countries. Moreover, the incidence of extreme weather events, including snowfalls, has been on the rise because of climate change. Given that SNS is heavily used all across the world, the lessons of this report can be used to mitigate the aftermath of various types of disaster in the future.

ACKNOWLEDGMENTS

The authors express their sincere gratitude to all the staff members involved in this case.

CONFLICT OF INTEREST

Dr Yamamoto received a personal fee from NAGATANIEN Co., Ltd. and ROHTO Pharmaceutical Co., Ltd. outside of the submitted work. Dr Ozaki received a personal fee from MNES INC. outside of the submitted work. Dr Nishikawa received a personal fee from MRT Inc outside of the submitted work. The other authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

HM, KY, and AO wrote the initial draft of the manuscript. HM, AO, YN, SK, and HB: interpreted the data and assisted in the preparation of the manuscript. HM is the lead author and responsible for submission. All authors critically

reviewed and revised the manuscript. HM and HB had full access to the data, and controlled the decision to publish, and accept full responsibility for the work.

ETHICAL APPROVAL

This research meets the ethical guidelines and adheres to Japan's local legal requirements. An ethical review is not required for this type of article.

CONSENT OF PUBLICATION

Written informed consent was obtained from the patient's family for publication of this case report and any accompanying images.

ORCID

Hiroto Miyatake  <https://orcid.org/0000-0002-3091-9910>

REFERENCES

1. Kinjo K, Sairenji T, Koga H, et al. Cost of physician-led home visit care (Zaitaku care) compared with hospital care at the end of life in Japan. *BMC Health Serv Res*. 2017;17:40.
2. Orozco-Beltran D, Sánchez-Molla M, Sanchez JJ, Mira JJ; ValCrònica Research Group. Telemedicine in primary care for patients with chronic conditions: the ValCrònica Quasi-Experimental Study. *J Med Internet Res*. 2017;2017(19):e400.
3. Chaudhry SI, Phillips CO, Stewart SS, et al. Telemonitoring for patients with chronic heart failure: a systematic review. *J Card Fail*. 2007;13:56-62.
4. Ryan BJ, Franklin RC, Burkle FM Jr, et al. Reducing disaster exacerbated non-communicable diseases through public health infrastructure resilience: perspective of Australian disaster service providers. *PLoS Curr Disaster*. 2016;8. PMID 28239511. <https://doi.org/10.1371/currents.dis.d142f36b6f5eeca806d95266b20fed1f>
5. The Hurricane Katrina Community Advisory Group, Kessler RC. Hurricane Katrina's impact on the care of survivors with chronic medical conditions. *J Gen Intern Med*. 2007;22:1225-1230.
6. Eckstein D, Künzel V, Schuäfer L. Global climate risk index 2018: who suffers most from extreme weather events? Weather-related loss events in 2016 and 1997 to 2016. <https://germanwatch.org/sites/germanwatch.org/files/publication/20432.pdf> Published November 2017. Accessed February 6, 2019.
7. Forzieri G, Cescatti A, Batista e Silva F, Feyen L. Increasing risk over time of weather-related hazards to the European population: a data-driven prognostic study. *Lancet Planet Health*. 2017;1:e200-e208.
8. Fernandes GCM, Treich RS, da Costa MFBNA, de Oliveira AB, Kempfer SS, Abeldano RA. Primary health care in disaster situations: systematic review Atención primaria de salud en situaciones de desastre: revisión sistemática. *Rev Panam Salud Publica*. 2019;43:e76.
9. Moorhead SA, Hazlett DE, Harrison L, Carroll JK, Irwin A, Hoving C. A new dimension of health care: systematic review of the uses, benefits, and limitations of social media for health communication. *J Med Internet Res*. 2013;15:e85.
10. Burdese E, Testa M, Raucci P, et al. Usefulness of a telemedicine program in refractory older congestive heart failure patients. *Diseases*. 2018;6:10.
11. Ruskin J, Rasul R, Schneider S, Bevilacqua K, Taioli E, Schwartz RM. Lack of access to medical care during Hurricane Sandy and mental health symptoms. *Prec Med Rep*. 2018;10:363-369.
12. Sharief S, Freitas D, Adey D, Wiley J. Disaster preparation in kidney transplant recipients: a questionnaire-based cohort study from a large United States transplant center. *Clin Nephrol*. 2018;89:241-251.
13. Järvi L, Grimmond CSB, Mcfadden JP, et al. Warming effects on the urban hydrology in cold climate regions. *Sci Rep*. 2017;7:5833.
14. Bell SA, Horowitz J, Iwashyna T. Home health service provision after hurricane Harvey. *Disaster Med Public Health Prep*. 2019;20:1-7.
15. Statistics Bureau, Ministry of Internal Affairs and Communications, Japan. The elderly population in Japan. <https://www.stat.go.jp/data/topics/topi1131.html>. Accessed February 6, 2019. [in Japanese].

How to cite this article: Miyatake H, Yamamoto K, Ozaki A, Kawada S, Nishikawa Y, Beniya H. Extreme snowfall and residential care: A case report of a 2-year-old girl with heart failure. *Clin Case Rep*. 2020;8:950–954. <https://doi.org/10.1002/ccr3.2633>