November 2025

Report

From conventional to intelligent diaper – data-driven care, technology and patient safety

A Study conducted by The Deaconess Foundation, Faculty of Nursing, Education, Respite Care Unit, in cooperation with ABENA.

From conventional to intelligent diapers
Report from the VIP study on dignified care for continence.

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Editor: Maj Siercke, RN, PhD, Journal of Nursing Research & Professional Knowledge, Sygeplejevidenskab.dk

Published by SPL-Publishing, Journal of Nursing Research & Professionel Knowledge, Feb. 2026.
Available online at Sygeplejevidenskab.dk http://doi.org/10.62680/E0126

Abstract

Dignified Incontinence Care – the VIP Study. From conventional to intelligent diaper, data-driven care, technology and patient safety.

The report presents findings from a study on the use of electronically intelligent diapers that monitor the need for diaper changes. Results from this study confirm that intelligent diapers improve patient safety, strengthen the professional skills of care staff, and reinforce the ethical aspects of care compared with conventional diapers.
The VIP study on dignified continence care was conducted with eight citizens of both sexes, with a mean age of 83 years (77–90), who were admitted to a respite care unit for rehabilitation for an average of 59.3 days (7–270).

All participants were diagnosed with one or more chronic diseases. A common feature was incontinence requiring assessment, prognosis and use of appropriate diapers.
All participating citizens were in a vulnerable situation that required evaluation of functional level, rehabilitation needs and decisions regarding future support, housing and assistive devices.

The study was conducted as a comparative intervention study in which the use of conventional diapers was compared with intelligent diapers. The following measurements and observations were examined:

- Number of diaper changes per day
- Time consumption and manageability for each change
- Citizen well-being
- Observation of skin and leakages
- Ethics and modesty during diaper change

The staff who provided continence care included one nurse, nine social and health care assistants, one social and health care helper, two nursing students, and one social and health care assistant trainee. All were introduced to both diaper types and to collecting patient-reported outcomes (PRO), both quantitative and qualitative.

Results

The comparative analysis showed an overall improvement in patient safety and satisfaction with the use of resources and time, a better overview of finances and workflows in everyday practice, as well as individual development of health professionals' competencies.

Both citizens and care staff reported improved well-being, as unnecessary diaper changes, burdensome manual checks, leakages and the indignity of lying in a wet diaper could be avoided.

Conclusion

The VIP study, based on care staff's assessments, objective measurements, and patient-reported outcomes (PRO), demonstrates that the quality of care improved and supported citizens' dignity, thereby enabling an entirely new level of data-driven care.

The report is a process and product analysis of the completed VIP study, along with recommendations for the use of intelligent diapers. The study was conducted by Deaconess Foundation, Faculty of Nursing, Respite Care Unit, in cooperation with Abena.

Introduction

At Deaconess Foundation's respite care unit, there are 11 beds for temporary stays for citizens awaiting placement in a nursing home, new housing, or discharge to their own home (1). The respite care unit, as described in its value foundation, aims to provide the best possible care, support, and assistance to the unit's citizens, based on high professional standards and quality, requiring competencies that ensure coherent health and care services in everyday life (1).

Incontinence is one of the challenging care tasks that requires new knowledge about products, aids and technology. Chronic diseases such as osteoporosis, cardiovascular disease, COPD, allergies, diabetes, cancer, and musculoskeletal disorders are well-known challenges in the population over 65 years. In addition, multimorbidity – the fact that half of the Danish population lives with two or more chronic conditions – is common. Incontinence may be an additional condition across these diseases.

It is therefore necessary to investigate intelligent solutions for citizens with incontinence who need to use diapers, fully or partially. The respite care unit assessed that a systematic examination of the use of conventional versus intelligent diapers would indicate which products can be incorporated into future care, both in the current unit and in the forthcoming nursing home (1). The study can also provide Deaconess Foundation with solid knowledge about future product procurement when a new care unit opens in 2026 (1).The current setting with 11 beds allows for close contact with citizens, the collection of robust data, and the generation of systematic knowledge about the use of technology.

Continence aids – conventional versus intelligent diapers

In the VIP study, the use of two diaper types for patients during respite stays was examined in light of the principles of professionalism, patient safety, and ethics.

An intelligent diaper is equipped with built-in sensors and a clip linked to a monitor used by care staff. In this way, each citizen's urination is continuously monitored, allowing assessment of when a diaper change is needed. A red, yellow or green status indicates whether it is time to change the diaper and whether the diaper size is appropriate. Changes can thus take place as needed, and it becomes possible to plan them to avoid leakage. It is recommended that nighttime sleep be scheduled with a diaper change in the evening and again early in the morning (2).

The assumption is that monitoring and care are thereby improved, and that patient safety is optimised, since the status of each citizen's urination and individual need for diaper changes is continuously documented.

About Abena

Abena is a Danish, family-owned manufacturing and trading company founded in 1953 and headquartered in Aabenraa. The company has over 2,000 employees and a wide range of health and care products that are continuously developed and adapted to users' needs, including in-house production of baby diapers and incontinence products certified to international quality and environmental standards. Several products carry ecological labels such as the Nordic Swan (2). A significant part of the product range is produced at Abena's own factories, supplemented by global production of other items (2).

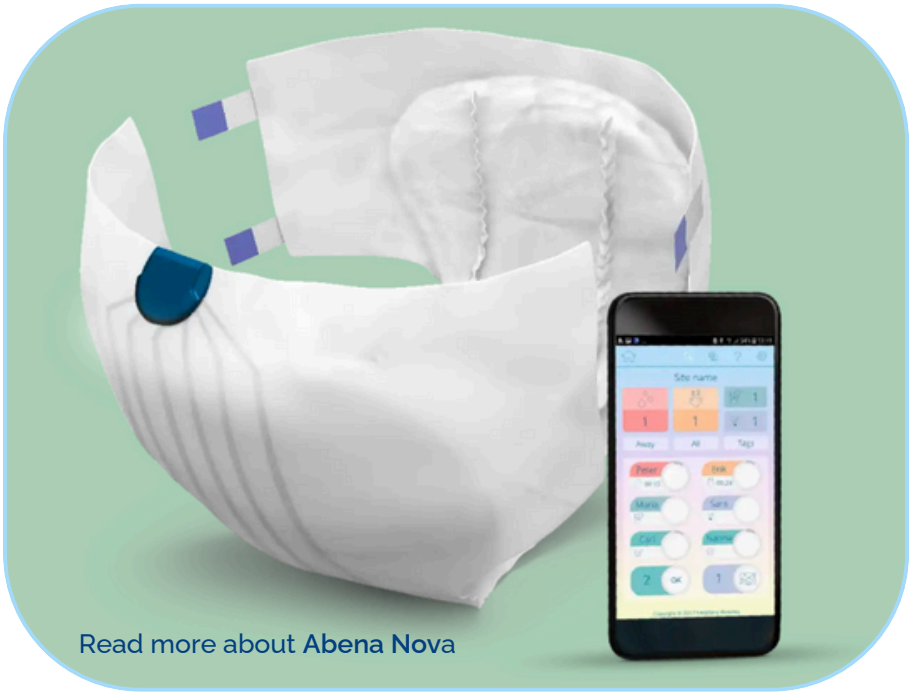
Abena Nova – digital incontinence solution

Abena Nova is a digital solution comprising an incontinence diaper with integrated sensors and a personal clip that measures the diaper's utilisation level. The clip transmits information via Bluetooth to a 4G or WiFi network. The data is received in the WetSens Monitor app installed on the care staff's mobile devices. Using the app, staff can receive notifications and follow the utilisation level of the diaper and thus change the citizen's diaper at an appropriate time (2).

The solution supports continence care across the health and care sectors and aims to provide a more straightforward overview of citizens' needs and reduce unnecessary manual checks. This allows resources and working time to be allocated more purposefully while safeguarding citizen comfort and dignity through more needs-based care (2).

Use in partnerships

Abena Nova can be used in partnerships as a welfare technology, providing data to support care efforts. The solution can be included in trials or implementation projects to illuminate effects on patient safety, workflows, resource use and the citizens' perceived security and comfort, as exemplified by the VIP study.



A study in dignified continence care

- Conventional versus intelligent diaper
- The total number of registered measurement points was 809, including:
- Attachment of the clip, detachment of the clip
- Registered urination
- Notifications of the need for a diaper change
- Notifications of a risk of leakage

Aim

To develop new professional knowledge for everyone with an interest in data-driven care, technology and patient safety in relation to older adults who require professional continence care.

The study measured:

- Number of diaper changes per day
- Time spent on diaper changes
- Leakages
- Professional observation of the skin
- Manageability
- Ethics and modesty
- Citizens' self-rated health at admission
- Citizens' self-rated health at discharge
- Citizens' evaluation of conventional versus intelligent diaper
- Staff's evaluation of conventional versus intelligent diaper

Study design

Inclusion

Citizens with incontinence were, upon admission to Deaconess Foundation's respite care unit, invited to participate in the study. Eight citizens were included.

Ethical considerations

Borgerne deltog i studiet efter mundtligt og skriftligt informeret samtykke, hvor de blev informeret om, at det var frivilligt at deltage, og at de når som helst kunne trække sig ud af studiet uden konsekvenser for deres ophold i aflastningsafdelingen.
Både de kvantitative og kvalitative data blev anonymiseret. De anvendte spørge-skemaer opbevares efter gældende dataregler. Data fra sensorer på de intelligente bleer og spørgeskemaer blev forsynet med en kode, der sikrer anonymitet (3,4).
Both quantitative and qualitative data were anonymised. The questionnaires were stored in accordance with applicable data protection rules. Data from sensors in the intelligent diapers and questionnaires were coded to ensure anonymity (3,4).

Method

Patient-reported outcomes (PRO) were collected about age, sex, housing, home help, physical abilities, social circumstances and relevant support measures to manage everyday life (see **Table 1**).
Citizens in the respite unit were offered participation in the VIP study for as many days as they stayed in the unit, to compare the conventional diaper type with the new intelligent sensor-equipped diaper.
Data collection was carried out using questionnaires and observations of the citizens (see **Appendix 1**). Care staff were instructed in data collection and had a clinical development nurse as a daily supervisor (5).

Participants

Care staff

- 14 employees: 12 women and 2 men
- 1 nurse, two nursing students, 9 social and health care assistants, 1 social and health care helper, 1 social and health care assistant trainee
- Mean age: 51 years (20–62 years)
- Mean seniority: 13.5 years (5 months – 30 years)

Citizens

- 4 men and 4 women out of 11 possible admitted citizens in the period
- Mean age men: 81 years (77–90 years)
- Mean age women: 83.5 years (79–90 years)

TABEL 1. PRO-DATA. Baseline and discharge (n=8)

Lived alone	Yes: 6	No: 2		
Admitted from the hospital	Yes: 8	No: 0		
Self-rated health at admission	Good: 2	Less good: 4	Poor: 2	_____
Compared with one year earlier	Somewhat worse: 8			
Physical activities in everyday life	Walked with assistive devices: 8	Needed help to move around: 2	Needed help with both bathing and dressing: 8	_____
At discharge				
Compared with one year ago, how is your health in general now?	Somewhat worse than one year ago: 8			
Physical activities in everyday life	Walked with assistive devices: 7	Needed help to move around: 7	Needed help with both bathing and dressing: 7	_____
Discharge destination	Nursing home: 2	Own home: 4	Hospital: 1	Municipal place: 1

OVERALL CONCLUSION

The citizens' stay in the unit averaged 59.3 days (7–270). Implementation of the sensor-controlled intelligent diaper ABENA Nova in eight citizens showed clear benefits for both citizens and staff.

Fewer diaper changes

From August 2024 to August 2025, use of the intelligent diaper ABENA Nova reduced the number of diaper changes by 30–45%, which meant:

- From 4 changes per day to 2–2.5
- From 2 changes per day to approximately 1
- From 80 changes to 34 in the same period among citizens, with the most significant effect

Gains

- Improved dignity for citizens in terms of fewer leakages, fewer clothing and bedding changes, less physical discomfort and less waiting time for changing wet diapers
- Fewer interruptions and reduced material consumption
- Considerable time savings and fewer physical strains associated with diaper changes
- Time spent on diaper handling was reduced by 40–50%, corresponding to 2–3 hours saved per week per citizen – a real and noticeable resource gain.

Precise management of diaper use time

Staff were able to move from manual practice without measurement points to specific, documented intervals based on valid data, which made it possible to:

- Avoid unnecessarily short use times
- Avoid overly long use times
- Plan changes according to actual utilisation rather than routine

Improved skin care and fewer leakages

Early indicator signals enabled staff to act before skin problems or leakages occurred. Changes were carried out at the right time – neither too early nor too late.

There was a marked improvement in data quality: from "almost no data" to a complete, automated log. The intelligent diaper in the ABENA Nova pathways provided objective information that could not be obtained manually (for example, approximate millilitres, use time, utilisation).

IN SHORT

The intelligent diapers reduced diaper changes and time spent on care by about 40%, improved the quality of care and citizens' dignity, and enabled an entirely new level of data-driven care. The system provided information on diaper status, urine volume, and usage time, delivering both a quality boost and a measurable resource gain in care.

Results – Part 2

Care staff assessed that the intelligent diapers led to a more professionally grounded practice regarding diaper changes that was inspiring and relevant. The intervention increased patient safety and perceived dignity and ethics. Staff listed the following advantages:

- Less leakage – the sensor alerted staff to signs of leakage
- Diapers were changed at appropriate intervals, and the sensor reminded staff when to change
- No unnecessary diaper changes; changes were carried out according to need
- Prevention of urinary tract infections and possibilities for bladder training
- Patients were spared unnecessary exposure of their bodies
- Opportunity to motivate patients for regular diaper changes
- Appropriate use of resources, prevention of pain and discomfort in the diaper area
- Improved history-taking related to incontinence
- Better adjustment of diaper size and type

Staff greatly appreciated the nurse attached to the VIP study. They recommend that future similar projects include a daily health professional supervisor during the implementation phase. This allows for training, safety and confidence when introducing new technology. All new technology requires initial supervision until staff feel confident and can subsequently train new colleagues themselves (6).
No disadvantages were reported regarding the intelligent diapers; only satisfaction among staff, who also perceived satisfaction among citizens.

Perspectives

The VIP study's results raise the question of whether other interventions or technologies can also support the delivery of care and support. During the study, knowledge emerged about initiatives to prevent urinary tract infections by using disposable bathing wipes for perineal hygiene. Another new initiative is the possibility of using intelligent drinking glasses that can monitor the citizen's fluid balance and introduce data-driven fluid therapy in care.

Recommendations

It is recommended to initiate further studies that include intelligent diapers and drinking glasses, with a view to qualifying data-driven care. Such initiatives can provide a better overview of individually tailored diaper choices, fluid balance management, fluid therapy, and prevention of urinary tract infections by using bathing wipes for perineal hygiene during diaper changes (6).

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Appendix – Questionnaire. Patient-Reported Outcomes (translated)

Baseline data at admission **Date:** **Patient code:**
Admitted from:
Male: □ Female: □ Age:

Housing conditions
Type of housing
Apartment: Floor: Elevator: yes □ no □
Other: □ Which:

Do you live alone? yes □ no □
Is there someone nearby who can help you with everyday life? yes □ no □
Is there a person nearby whom you help in everyday life? yes □ no □

How would you rate your health in general?
1. Very good
2. Good
3. Fair
4. Poor

Compared with one year ago, how would you rate your health in general now?
1. Much better than one year ago
2. About the same
3. Somewhat worse than one year ago

Physical activities in everyday life
Walks with assistive devices? yes □ no □
Needs help to move around? yes □ no □

Bathing and dressing
1. Always receives help
2. Receives help occasionally
3. Always receives help with both bathing and dressing

Baseline data at discharge Date:
Discharged to:
Type of housing
Apartment: Floor: Elevator: yes □ no □
Other: Which:

Is there someone nearby who can help you with everyday life? yes □ no □
Is there a person nearby whom you help in everyday life? yes □ no □
How would you rate your health in general?
1. Very good
2. Good
3. Fair
4. Poor

Compared with one year ago, how would you rate your health in general now?
1. Much better than one year ago
2. About the same
3. Somewhat worse than one year ago

Physical activities in everyday life
Walks with assistive devices? yes □ no □
Needs help to move around? yes □ no □

Bathing and dressing
1. Always receives help
2. Receives help occasionally
3. Always receives help with both bathing and dressing