Process optimisation in nursing with VENDLET V5 in Germany, Great Britain and Denmark

Reduction of costs and loads when moving patients

Authors:	Prof. Dr. Hans-Günter Lindner, TH Köln Dipl.-Kauffrau Michaela M. Tittmann, IwP
Telephone:	+49 163 799 8503
E-mail:	hans-guenter.lindner@th-koeln.de michaela.tittmann@iw-pflege.de
Address:	von-Loe-Str. 24, 53840 Troisdorf

Management Summary

In this study the IwP Institute for Economic Nursing and Health Care examines the use of VENDLET V5 for the nursing and health care market in Germany, Great Britain and Denmark.

VENDLET V5 is an electromechanical system which supports the moving of bedridden patients in nursing beds. For the study, four nursing moving processes were recorded and analysed in detail in several series of trials. One series of trials examined the procedure with VENDLET V5, the others respectively the usual scenarios in Germany, Great Britain and Denmark. The series of trials were used for modelling and simulation of repeatable observations and analyses of the processes. Measurements and key performance curves can be found in direct comparison during the simulation.

The study shows that VENDLET V5 helps to move the patient more economically and more gently physically. At the same time, it also creates clearances so that it can be devoted more intensely to the patient. The estimated financial savings are significantly different in the individual countries. They are influenced by the very different procedures for moving and the usual full costs per working hour in the respective countries

In Germany, the estimated savings are about €4,025 per patient per year at a full cost of €50/hr for an expert nursing attendant. This means that VENDLET V5 is already amortised with the selected scenarios in approx. one year.
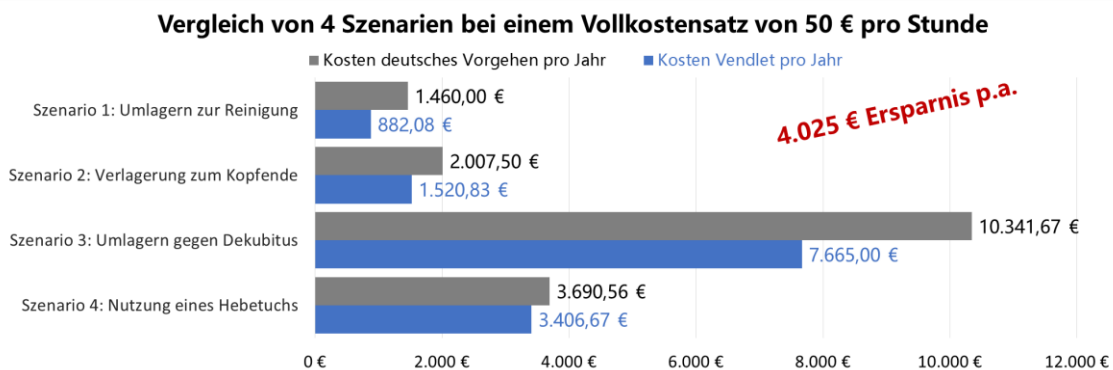

Figure 1: Comparison of German practice with VENDLET V5

The usual practice in Great Britain leads to even higher savings. It is about £7,012 per patient per year at a full cost of £20/hr for an expert nursing attendant. This means that VENDLET V5 is already amortised with 4 scenarios in approx. half a year.
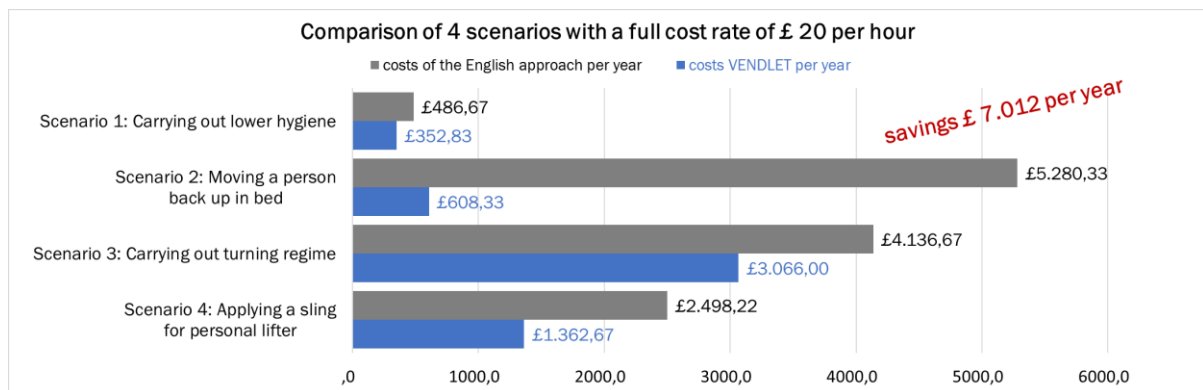

Figure 2: Comparison of British practice with VENDLET V5

In Denmark the moving processes are only carried out by one nursing attendant. There, the estimated saving is about 63,556 DKK per patient per year with a full cost of 225 DKK/hr for an expert nursing attendant. This means that VENDLET V5 is already amortised with 4 scenarios in approx. half a year.

Vergleich von 4 Szenarien bei einem Vollkostensatz von 225 DKK pro Stunde

■ Kosten dänisches Vorgehen pro Jahr   ■ Kosten VENDLET pro Jahr

Scenario	Kosten dänisches Vorgehen pro Jahr	Kosten VENDLET pro Jahr
Szenario 1: Umlagern zur Reinigung	28.333 DKK	3.969 DKK
Szenario 2: Verlagerung zum Kopfende	2.874 DKK	6.844 DKK
Szenario 3: Umlagern gegen Dekubitus	46.264 DKK	34.493 DKK
Szenario 4: Nutzung eines Hebetuchs	46.720 DKK	15.330 DKK

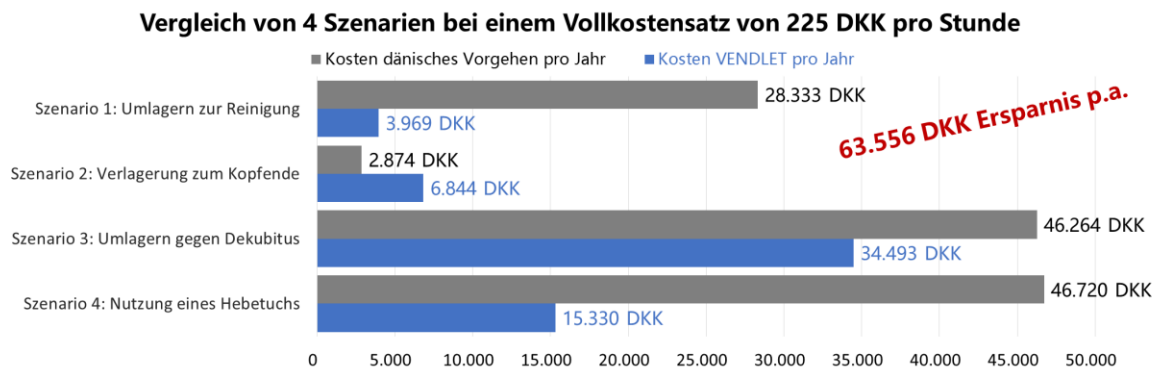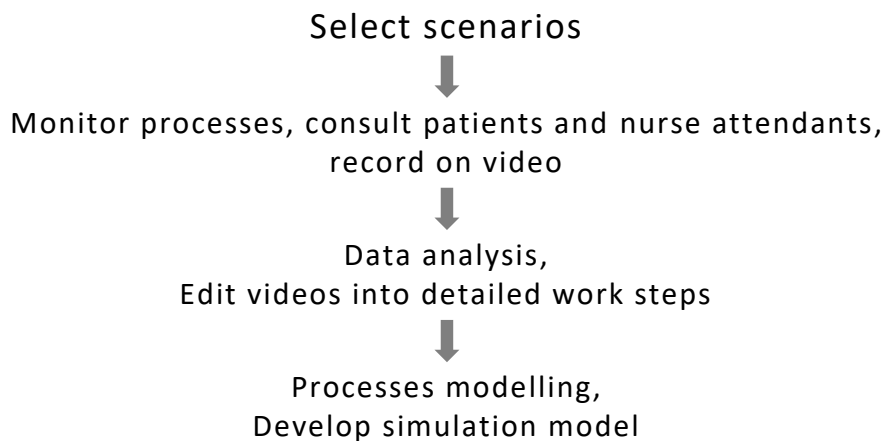*63.556 DKK Ersparnis p.a.*

Figure 3: Comparison of Danish practice with VENDLET V5

The economic benefits significantly increase in all countries if the loss of nursing attendants through disorders of the spine - e.g. due to severe slipped disks - can be reduced by using VENDLET V5. This also reduces the likelihood that nursing attendants will move away to other occupations as a result of several slipped disks.

1   The realisation of the study

Vendlet ApS is selling the electromechanical system VENDLET V5 worldwide with increasing success. With VENDLET V5, patients are moved by moving the bed sheet. The nursing attendant controls this process via a remote control and, in doing so, touches the patient only softly to give him a feeling of security. Moving takes place without the application of force. With the help of the study and the simulation developed for this, the improvements should become visible, learnable and measurable in everyday practice so as to be able to convey the benefits with lasting effect. This study forms the basis for an international comparison.

The method in overview:

<div align="center">

Select scenarios

⬇

Monitor processes, consult patients and nurse attendants,
record on video

⬇

Data analysis,
Edit videos into detailed work steps

⬇

Processes modelling,
Develop simulation model

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1.1   Select scenarios

The study compares moving patients using VENDLET V5 and the usual procedures currently in practice in Germany, Great Britain and Denmark. Techniques according to the textbook or with special illnesses were not analysed. For this comparison, a bedridden patient type and the following four frequent scenarios were selected for time reasons and cost reasons from many possibilities:

1.   Moving for cleaning the buttocks
2.   Moving a person who has slipped towards the foot of the bed back to the head again
3.   Multiple moving into different positions for decubitus prophylaxis
4.   Laying a lift sheet/net for the patient lift

In doing this, VENDLET V5 was used for patients up to 200 kg; the version up to 400 kg was not used.

1.2   Observe processes, confer with patients and nursing attendants, record on video

Video sequences are the basis for the objective data collection in this study. These allow an analysis of times, actions, facial expressions and gestures that are repeatable at any time. The scenarios were filmed up to 3 times with VENDLET V5 and the German practice. For Great Britain, several videos were available, from which those comparable with the other ones were selected.

To receive a sufficiently large amount of data empirically, it would be statistically desirable to be able to consult more than one hundred patients and to film them several times. However, such an analysis could hardly be expected of the patients.

Hence, the following action was selected: for the comparison between the use of VENDLET V5 and the German practice, one patient in each case was initially observed and interviewed. Afterwards, the analysed moving processes were carried out with a test person and were recorded on video. Before the video recordings, the participants were briefed without influencing them about the contents. The goal was for the actors intuitively to show accustomed ways of acting. The comparison between the use of VENDLET V5 and the usual practice in Great Britain and Denmark were based on video recordings created by third parties, which were also analysed as follows.

1.3 Analysing data, editing videos into detailed work steps

The analysis of the video recordings is explained below with the help of the process "moving for cleaning the buttocks" (lower hygiene). For the analysis, coherent movement patterns were summarised into sections related to the contents, for example "turn patient" (turn patient), "centre patient" (centre patient). These sections correspond to so-called activities in the process models and include start, end and designation. They were defined as marks and then transferred into a spreadsheet. The following indicators were also determined from the video, which have an influence on the load on the nurse and the patient: the number of touches per patient, the deflection angle of the back of the nurses, the application of force during flexion and the associated duration.

Figure 4: Management of the scenarios in Adobe Premiere CC

The analysis of the moving of the actual patients served as a reference for the activities with the test person. In doing this, the times for individual actions, flexion angles of the back and the effects of the forces were compared.

1.4   Modelling the processes, developing the simulation model

It is necessary for the required simulation to transfer the observed scenarios into a model. The processes while moving a patient are complicated and require different methods of modelling, which must be united into a uniform overall model. With the help of the simulation tool AnyLogic, a simulation environment was created especially for Vendlet ApS, in order to be able to compare the scenarios with VENDLET V5 and the scenarios in different countries very objectively.

The activities were mapped using the discrete event-oriented Process Modelling Library. The components nursing attendant, patient, VENDLET V5, pillow and net are agents with their own state models (State Chart Models). Thus, each simulated patient and nurse can assume different states in a scenario.

After modelling the individual process steps in the simulation model, incl. movements, bending and touches, these were filled with the specific figures that were recorded in the analysis of the videos. The times of the individual activities were mapped in normal distribution; in this, the averages are the times measured in the videos. Thus, the simulation can occur and the individual steps can run successively according to the observed times within the statistical distributions.

The computer-aided simulation of the scenarios makes it possible to observe them repeatedly and to carry out different analyses with changed parameters. In this, the results vary because the times within the activities are assigned random values and are distributed normally around the average; i.e. the repetition of the simulation with the same parameters can lead to different results.

In a test phase, the simulation was shown to nurses and other experts from the health service and was checked for validity and found to be correct.
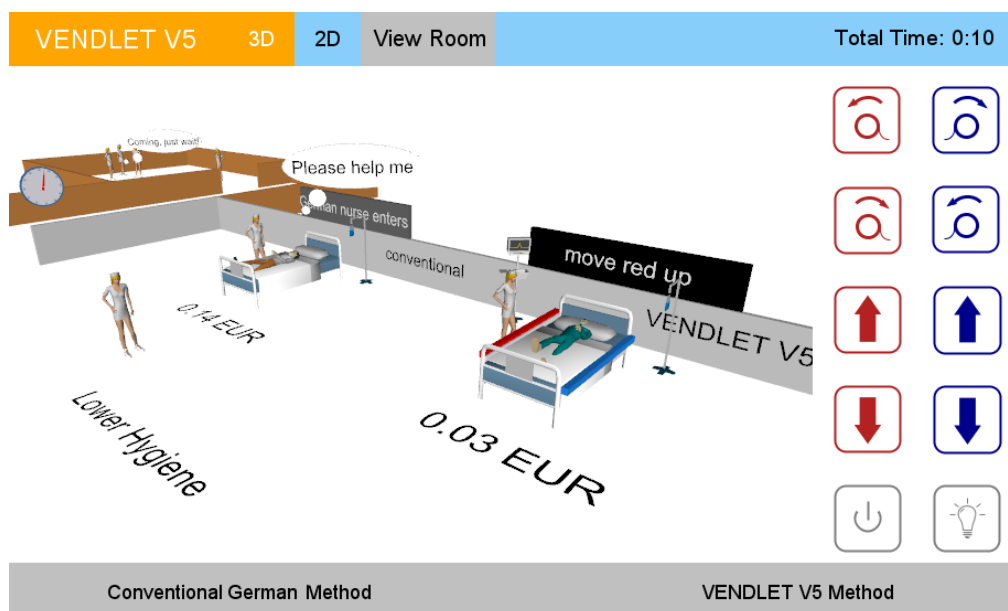

Figure 5: The VENDLET V5 Simulation window

The simulator for VENDLET V5 is an independent program that can be used to act out different scenarios. In this case, the following parameters can be defined for the simulation:

- the respective repetitions per day,
- the delay until the second nurse starts to support the first nurse in the German and British scenarios (in Denmark the processes are carried out by only one nursing attendant),

- and the hourly rate on a full cost basis.

2 The results in the simulator

The results of the simulation are explained as an example in the process "moving for cleaning the buttocks". In the simulation window, the values are mapped on the left for the German process and on the right for the process with VENDLET V5. Before the start of the simulation, the parameters are set for this process as follows: 6 repetitions per day, full costs of € 50 per hour and no waiting period for the second nursing attendant (0 seconds); these are indicated in the bottom row (Figure 6: Measured data "Moving for cleaning the buttocks" ①).
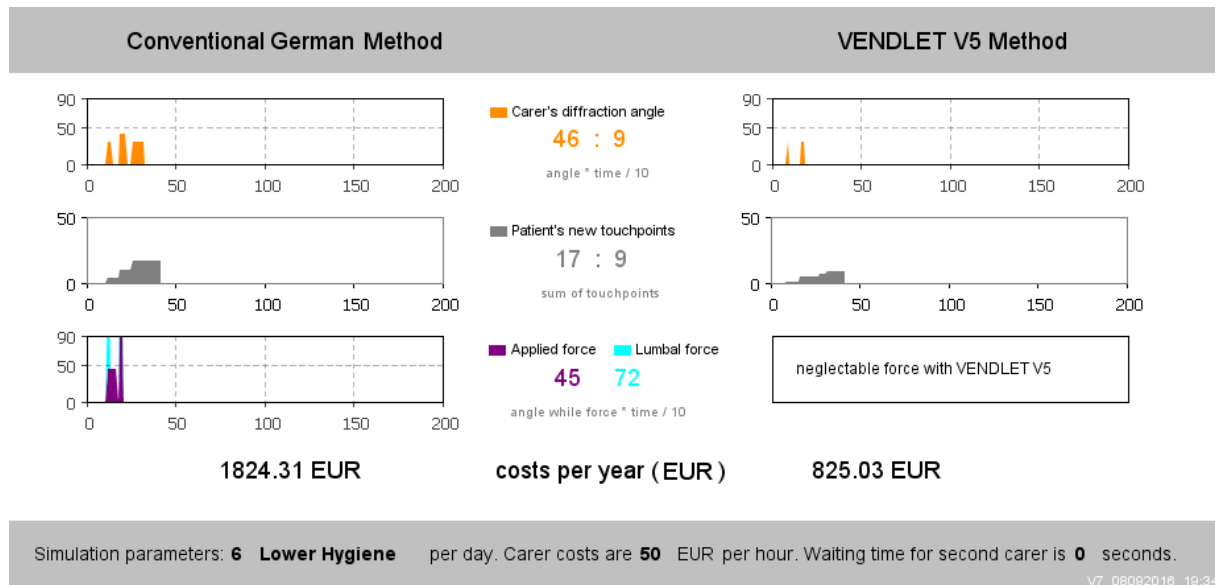

Figure 6: Measured data "Moving for cleaning the buttocks"

The simulation represents a real-time consideration. The second nursing attendant sets off directly in the selected case when the first nursing attendant steps near the bed. About 6 seconds pass until the arrival of the second nursing attendant, i.e. altogether 12 seconds (precisely 12.567 seconds from the simulation) until both nursing attendants can begin with moving. The two nursing attendants then need 24 seconds respectively for this, so that the German practice lasts a total of 61 seconds. These costs are rounded to €0.84 per process. With the use of VENDLET V5, a nursing attendant needs 26 seconds for moving, which corresponds to a cost of €0.40; this is less than half of the personnel cost in the comparison. The values are multiplied by the number of executions per day and 365. This results in costs of €1842.26 per year for the German practice and of €882.08 for the use of Vendlet②. The duration of the cleaning is independent of the procedure for moving and therefore does not enter into the calculation.

In addition to the financial aspects, the overview of results shows the evaluation of qualitative criteria as indicators of the loads on the nursing attendants and the patients. The Y axis shows the angles or the number of touches and the X axis shows the time sequence. As a result, the intensity and duration of the loads can be read.

The deflection angle of the back of the nursing attendants without the effect of the force (carer's diffraction angle) is an indicator of the load on the spine and thus the probability of pain in this part of the body③. It shows how strongly the back is bent and for how long work goes on with this deflection. During the conversion into a numerical representation, the angle of the body deflection is multiplied

by the duration of the trunk deflection: angle * time. This corresponds to the indicator of the area. To make the results clearer, this value was divided by ten. Then the ratio of the deflection angle of the back amounts to 46:9. I.e. when using VENDLET V5 the back is significantly less deflected; the load amounts to 20 percent.

The touches per patient (patient's new touchpoints) correspond to external mechanical impulses which must be processed sensitively, cognitively and affectively by the patient④. Each processing means energy that the patient must use for it. The higher the pain sensitivity, the more annoying the effect of the touches. In the case of the number of touches per patient, each event is added to the occurring time. The graph thus shows the cumulative touches per patient. The nursing attendants touch the patient together almost twice as much according to the German practice. The ratio is 17:9.

The force applied by the nurse with back deflection (applied force) is another indicator of its load⑤. The effect of the forces increases with increasing deflection angle. The more frequently loads occur in this area, the higher the risk of damage and possible incapacity for work. The beginning and the end of the application of force can be determined by the observation of the muscle tone in the arms of the nurse. No value can be determined for VENDLET V5, since there is no force applied during turning. Only the hands are used for guidance or a reassuring touch.

In addition, loads from shear forces in the lumbar spine (lumbal force)⑥, occurring when pulling and from loads when deflecting, are shown. No value can be determined for VENDLET V5, since there is no force applied.

3   The summary of the results for the four scenarios in the individual countries

An objective of the study is to determine whether the use of VENDLET V5 makes it possible to increase the economic use of nursing staff. Therefore, the time needed and the resulting costs of the procedures in the individual countries will be compared with the time needed for the use of VENDLET V5 for each of the four scenarios (moving to clean the buttocks, moving a person who has slipped towards the foot of the bed back to the head again, multiple moving into different positions for decubitus prophylaxis, laying a lift sheet/net for the patient lift).

For this evaluation, the following assumptions were made about the frequency of the procedures on a patient per day: each patient is cleaned on the buttocks 6 times daily, is moved 6 times up from the end of the bed, is rearranged 12 times for decubitus prophylaxis and is moved 4 times with the lift.

3.1   Germany

Firstly, the average times and the time savings are determined for each moving process. Here, it should be taken into account that for the cost comparison in the German procedure, it was assumed that two people were standing ready by the bed and so there was no waiting period for a second nursing attendant. The process cost overviews therefore include the pure treatment times and no travel times. In practice, this means that the longer the first nursing attendant must wait for the arrival of the second nursing attendant, the higher the saving using VENDLET V5.

	Zeitersparnis VENDLET V5 je Vorgang in Sek	Häufigkeit am Tag	Zeitersparnis VENDLET V5 am Tag in Min:Sek	Kosten- ersparnis VENDLET V5 am Tag in €	Zeitersparnis VENDLET V5 im Jahr in Std:Min	Kostenersparnis VENDLET V5 im Jahr in €
Umlagern zum Reinigen des Gesäßes	19	6	0:01:54	1,58 €	11:33	577,92 €
Eine im Bett an das Fußende gerutschte Person wieder ans Kopfende verlagern	16	6	0:01:36	1,33 €	09:44	486,67 €
Umlagern zur Dekubitusprophylaxe	44	12	0:08:48	7,33 €	53:32	2.676,67 €
Anlegen und Abnehmen eines Hebetuchs / Netzes für den Patientenlifter	14	4	0:00:56	0,78 €	05:40	283,89 €
Summe			**0:13:14**	**11,03 €**	**80:30**	**4.025,14 €**

Figure 7: Overview of process costs in Germany

It can be concluded from the times to the costs that the above-mentioned assumptions about the frequency of carrying this out on one patient per day were met. To determine the costs, an hourly rate of €50 was assumed for the full costs per nursing attendant. In Germany estimated savings are about €4,025 per patient per year[1]. This means that VENDLET V5 is already amortised with 4 scenarios in approx. one year.
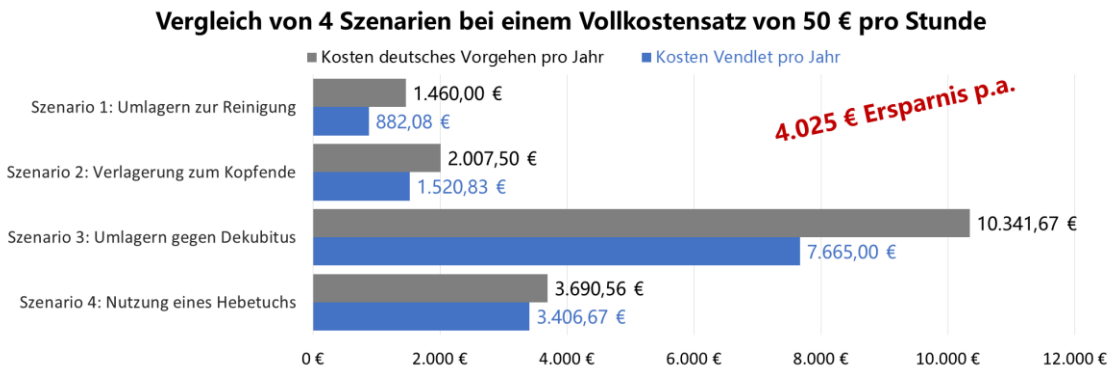

Figure 8: Comparison of the 4 scenarios in Germany

3.2 Great Britain

In Great Britain, the moving processes are also carried out by two nursing attendants. Here, for the cost comparison it was also assumed that two nursing attendants were standing ready by the bed and so there was no waiting period for the second nursing attendant. In Great Britain, the use of VENDLET V5 leads to an even higher saving compared to the usual practice.

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[1] The result for "moving to clean the buttocks" differs from the German practice in the explanation for the 'results in the simulator', because a delay of 6 seconds was set for visualisation there until the arrival of the second nursing attendant. This therefore results in higher costs.

	Zeitersparnis VENDLET V5 je Vorgang in Sek	Häufigkeit am Tag	Zeitersparnis VENDLET V5 am Tag in Min:Sek	Kosten- ersparnis VENDLET V5 am Tag in £	Zeitersparnis VENDLET V5 im Jahr in Std:Min	Kostenersparnis VENDLET V5 im Jahr in £
Umlagern zum Reinigen des Gesäßes	11	6	0:01:06	£0,37	06:41	£133,83
Eine im Bett an das Fußende gerutschte Person wieder ans Kopfende verlagern	384	6	0:38:24	£12,80	233:36	£4.672,00
Umlagern zur Dekubitusprophylaxe	44	12	0:08:48	£2,93	53:32	£1.070,67
Anlegen und Ablegen eines Hebetuchs / Netzes für den Patientenlifter	140	4	0:09:20	£3,11	56:46	£1.135,56
Summe			**0:57:38**	**£19,21**	**350:36**	**£7.012,06**

Figure 9: Overview of process costs in Great Britain

It amounts to about £7,012 per patient per year at a full cost rate of £20/hr for an expert nursing attendant. This means that VENDLET V5 is already amortised with 4 scenarios in approx. half a year.
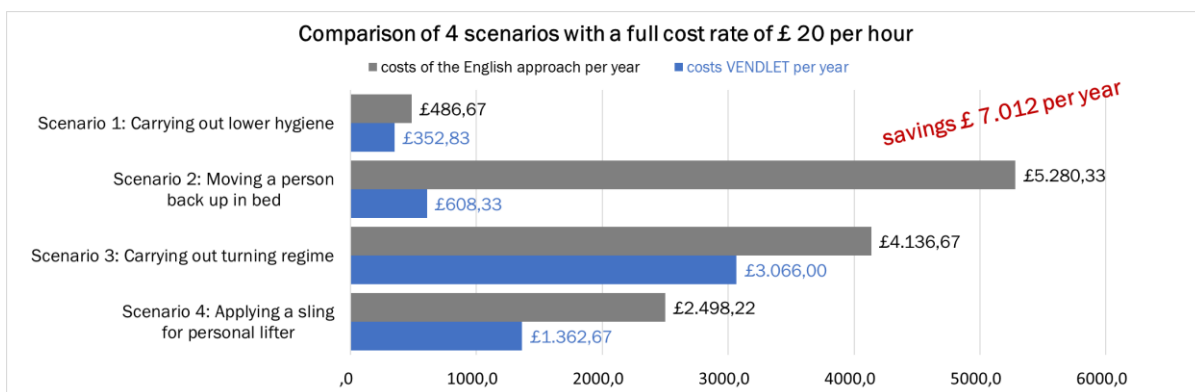

Figure 10: Comparison of the 4 scenarios in Great Britain

3.3 Denmark

In Denmark, the moving processes are carried out by only one nursing attendant. Here, the use of VENDLET V5 also leads to a much higher saving compared to the usual practice in Germany.

	Zeitersparnis VENDLET V5 je Vorgang in Sek	Häufigkeit am Tag	Zeitersparnis VENDLET V5 am Tag in Min:Sek	Kosten- ersparnis VENDLET V5 am Tag in DKK	Zeitersparnis VENDLET V5 im Jahr in Std:Min	Kostenersparnis VENDLET V5 im Jahr in DKK
Umlagern zum Reinigen des Gesäßes	178	6	0:17:48	14,83 DKK	108:17	24.363,75 DKK
Eine im Bett an das Fußende gerutschte Person wieder ans Kopfende verlagern	-29	6	-0:02:54	-2,42 DKK	-17:38	-3.969,38 DKK
Umlagern zur Dekubitusprophylaxe	43	12	0:08:36	7,17 DKK	52:19	11.771,25 DKK
Anlegen und Abnehmen eines Hebetuchs / Netzes für den Patientenlifter	344	4	0:22:56	19,11 DKK	139:30	31.390,00 DKK
Summe			**0:46:26**	**38,69 DKK**	**282:28**	**63.555,63 DKK**

Figure 11 : Overview of process costs in Denmark

In Denmark, the estimated savings resulting from the use of VENDLET V5 are about 63,556 DKK per patient per year with a full cost rate of 225 DKK/hr for an expert nursing attendant. This means that VENDLET V5 is already amortised with 4 scenarios in approx. half a year.
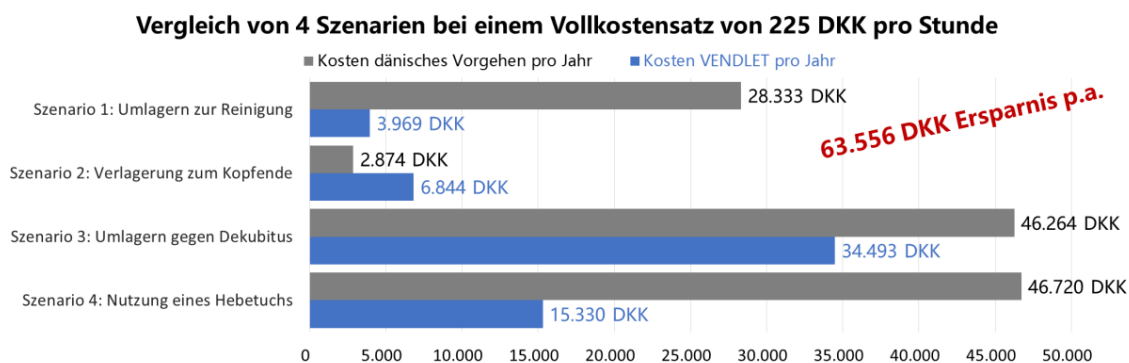
Vergleich von 4 Szenarien bei einem Vollkostensatz von 225 DKK pro Stunde

■ Kosten dänisches Vorgehen pro Jahr　■ Kosten VENDLET pro Jahr

Szenario 1: Umlagern zur Reinigung — 28.333 DKK / 3.969 DKK

Szenario 2: Verlagerung zum Kopfende — 2.874 DKK / 6.844 DKK

Szenario 3: Umlagern gegen Dekubitus — 46.264 DKK / 34.493 DKK

Szenario 4: Nutzung eines Hebetuchs — 46.720 DKK / 15.330 DKK

63.556 DKK Ersparnis p.a.

Figure 12 : Comparison of the 4 scenarios in Denmark

3.4   Germany, Great Britain, Denmark

The costs of losing individual nursing attendants through spine disorders depends on the nature and severity of the illness and its treatment. An average cost amount cannot be specified for this scientifically. It is nevertheless understandable that the economic benefits once again significantly increase in all countries if the loss of nursing attendants through spine disorders can be reduced by the use of VENDLET V5. Long-term illnesses of nursing attendants not only have a serious impact on the functioning and performance of a facility. They also cause nursing attendants to move away to other occupations as a result of several slipped disks. In this respect, the reduction of severe spine disorders has a strong impact on the costs and the increasing shortage of specialists.

4 The result

The manufacturer Vendlet ApS in Aabenraa, Denmark, had referred in the study to the following advantages of the use of VENDLET V5, which had to be checked:

1. Physical relief for the nursing attendants,
2. Improvement of comfort for patients and nursing attendants, as well as
3. Increased economic use of nursing attendants.

These three hypotheses could be confirmed. All measured data indicated lower physical loads. Fewer changing touches and force effects improved the comfort for patients and nursing attendants. Also, time savings can be ascertained which leads to a cost saving. For the 4 selected scenarios and the specified number of repetitions per day, as well as the specified full cost rates per working hour, there were annual savings in Germany of €4,025, in Great Britain of £7,012 and in Denmark of 63,556 DKK. It must be mentioned that the usage possibilities of VENDLET V5 go beyond the 4 scenarios selected for the sake of clarity in the study. I.e. the relief of the employees and the working time saved will even be significantly higher in the facilities.

Due to the different practices in the individual countries and the different full cost rates, the amortisation times for a VENDLET V5 vary greatly with the selected scenarios in the individual countries - from approx. one half up to one full year. However, a far higher human and also economic benefit lies in the avoidance of back injuries caused by overload. If only one loss of six weeks were to be avoided, VENDLET V5 would already have been worthwhile.

The study is a beginning in determining the comprehensive benefits of new health care tools like VENDLET V5.