

# Cost of wound treatment to increase significantly in Denmark over the next decade

- **Objective:** To demonstrate that changes in demography, life expectancy and incidence of background diseases (including type 2 diabetes mellitus) during the period 2009–2020 will significantly increase the costs of wound care in Denmark.
- **Method:** A simple activity-based equation, which was applied to Danish national statistics on medical conditions and key financial figures from previously published surveys.
- **Results:** Currently, DKK 735m (€99m) is spent each year on municipal wound care. Denmark's population is 5.4 million and about 18,000 wounds can be expected annually in the municipal sector, requiring more than three million dressing changes. These figures are expected to rise significantly up until 2020. The percentage of senior citizens will rise by 22% during this time and the number of patients with type 2 diabetes mellitus will increase by 22–24,000 per year. Improved treatments and longer life expectancies will increase the elderly population by 40,000. These changes will cause a gradual rise in wound care costs of up to 30%, corresponding to DKK 224m (€30m) in 2020. However, by adopting a national strategy based on best practice guidelines, it may be possible to intercept this increase in costs. A national strategy in Denmark seems to have the potential to reduce costs by a matching 30%. If Denmark fails to adopt a national strategy, an accumulated loss of DKK 1.5 billion (€206m) can be expected over the next decade.
- **Conclusion:** Wound therapy will pose a major economic challenge to Denmark in future if no intervention is carried out. This study presents an empirical model calculating the economic consequences of future challenges such as demography, lifestyle and type 2 diabetes mellitus. It is suggested that a national strategy for wound therapy may convert a future deficit to zero-balance. Similar challenges are expected in other western European countries.
- **Declaration of interest:** None.

wound management; cost-effectiveness; costs development; health-care systems

**D**anish municipalities are currently facing financial problems due to a government-enforced stop on new extra taxes, together with increasing public expenses. This has resulted in tight public budget constraints in recent years.<sup>1</sup> Furthermore, severe financial problems are expected to emerge within the wound care sector in the near future.

Denmark has 98 municipalities; they all lack the effective organisation of wound management within the municipal home-care system. The Danish health-care system is divided into public and private systems, the private only covering approximately 5% of inpatient beds. The quality of health care performed in the two sectors is similar, although waiting times are shorter in the private sector. The current public system is based on a socialist system, where all services are free. In the secondary sector, including hospitals and non-private clinics, all health-care investigations, procedures, drugs and devices are gratis. In the primary sector health care

investigations and procedures are free, while different reimbursement policies exist regarding drugs and devices. The degree of reimbursement varies, depending on the politics of a specific municipality. No national consensus has yet been achieved.

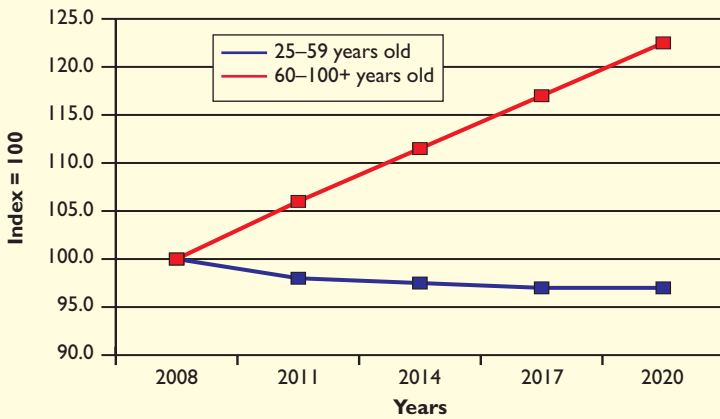
The municipalities, therefore, are vulnerable to new financial challenges. Indeed, these are already apparent in the wound care sector. At present, the municipalities spend DKK 735m (€99m) per year on wound care (where €1 = DKK 7.45). The reasons for this increase in cost are three-fold:

- A growing number of elderly citizens,
- Improved life expectancy
- An increase in chronic lifestyle diseases, such as type 2 diabetes mellitus.

The Danish Welfare Commission, formed by the Danish government in 2006, predicts that Denmark's age pyramid will change considerably up until 2020 (Fig 1).<sup>2</sup> The high birth cohort from 1946–1960 will form the elderly part of the population during this period. This group currently repre-

**A. Hjort**, MSc, MPP,  
Chief Financial Officer,  
Government of  
Greenland, Properties  
Agency INI, Sisimiut,  
Greenland;  
Email: astne@astne.dk  
**F. Gottrup**, MD, DMSc,  
Professor of Surgery,  
Copenhagen Wound  
Healing Center,  
Bispebjerg University  
Hospital, Copenhagen,  
Denmark;  
Email: fgottrup@post4.  
tele.dk

**Fig 1. Labour force and the no. of senior citizens in Denmark<sup>10</sup>**



Note: The year 2008 serves as a benchmark, set at index 100, to describe the relative development during the period 2008–2020.

sents 22% of the population, but is expected to rise to 26% by 2020. The majority of wounds are found in older people,<sup>3</sup> so it can be expected that the number of wounds will also increase. With an increase in life expectancy, we can expect more wounds requiring more wound-care resources in the municipalities.

In addition to this, an increase in both age-related and lifestyle diseases can be expected as the elderly population grows both in number and lifespan. These diseases will also become a financial burden for the municipalities' health budgets.<sup>1</sup> Furthermore, lifestyle diseases have started to affect the younger generations. One major problem is obesity, which can lead to an increase in the incidence of type 2 diabetes. Diabetic ulcers have been estimated to account for about 6% of the total number of ulcers.<sup>3</sup> This number may, however, be too low and furthermore, the number of diabetic patients in Denmark is expected to double in the next decade. It is estimated that 270,000 Danish citizens current-

ly have type 2 diabetes, and each year the number affected increases by 22-24,000.<sup>4</sup> In particular, those aged 45–59 are being affected.

Over the next decade, Danes are expected to live longer as treatments become steadily more advanced.

The aim of this study is to show that changes in demography, life expectancy and the incidence of type 2 diabetes will significantly increase the cost of wound care in Denmark. Estimating future costs is difficult but we will try to point out where costs are heading and the level of costs to be expected.

**Material and method**

In this study our calculations are solely based on costs incurred at municipality level, which includes nursing homes. If costs were to be calculated at community-level, then hospitalisation, bed-days, amputations and prostheses would also have to be accounted for. Our model would necessarily have to include further cost objects. In Denmark, the current estimated total cost at community level is roughly DKK 3 billion (€376m).<sup>5</sup>

To measure any financial consequences stemming from future changes in demography, life expectancy and the incidence of type 2 diabetes, we first calculated the current costs, establishing a benchmark. The method used was a simple activity-based cost model, consisting of two cost objects, three cost drivers and two cost rates. This model was applied to key empirical figures retrieved from two national and two international surveys.

The three cost drivers are:

- Number of citizens with wounds
- Frequency of dressing changes
- Time taken to change each dressing.

Average figures for these were retrieved from Danish surveys<sup>3,6</sup> in conjunction with representative UK surveys.<sup>7,8</sup> These surveys collected empirical data and reached results in a similar way. They are shown in Table 1.

**Table 1. Key figures from previous surveys of municipalities (2005–2007)**

	Population examined (no. of citizens)	No. of wounds per 1000 citizens (excluding hospitals)	Frequency of wound dressing change per week	Time consumption for one dressing change (minutes)
Funnel Jørgensen <sup>6</sup>	566,464	3.14	3.63	16.5
Drew <sup>7</sup>	590,000	3.07	2.96	20.0
Region of Copenhagen <sup>3</sup>	500,000	3.48	3.85	17.4
O'Keefe <sup>8</sup>	145,793	n/a	3.40	20.6
<b>Average</b>		<b>3.23</b>	<b>3.45</b>	<b>18.6</b>

**Table 2. Costs of wound therapy in Danish municipalities (2009)**

Text	Formula	Result
<b>Community nurse</b>		
No. of wounds	$3.23 \times 5,475.791$	(a) 17,687
No. of dressing changes	$(a) \times 3.45 \times 52$	(b) 3,173,013
No. of face-to-face hours	$(b) \times 18.6/60$	(c) 983,634
No. of performed hours	$(c) \times (100 / 45)$	(d) 2,185,853
Expense for community nursing (DKK)	$(d) \times 256.94$	(e) 561,633,070
No. of full-time jobs	$(d) / 1665 \times (1924 / 1665)$	(f) 1,517
<b>Materials</b>		
Expenditure, materials (DKK)	$(b) \times 54.68$	(g) 173,500,351
<b>Total costs (DKK)</b>	<b>(e) + (g)</b>	<b>735,133,420</b>

**Table 3. Frequency of wounds and baseline 2008<sup>3</sup>**

Age groups	Wounds Copenhagen study	h (x)	Wounds Denmark	%	Baseline 2008 (DKK)
0–10	5	0.00287	50.82	17.93	14,515.54 wounds (see Table 2)
11–20	19	0.01092	193.13		
21–30	30	0.01724	304.95		
31–40	43	0.02471	437.09		
41–50	65	0.03736	660.72		
51–60	150	0.08621	1,524.74		
61–70	271	0.15575	2754.70	82.07	
71–80	415	0.23851	4218.45		
81–90	577	0.33161	5865.17		
91–100	162	0.09310	1646.72		
100+	3	0.00172	30.49		
	<b>1740</b>	<b>1</b>	<b>17,687</b>	<b>100</b>	<b>564,951,311</b>

h (x) refers to frequency

Chosen cost objects are the:

- Consumption of community nurses' time
- Consumption of dressing materials.

Totals were generated using the two figures here, together with the applicable cost rates: an hourly wage rate and the price of wound dressing material

per change. All costs have been measured in DKK.

The hourly wage rate is not simply the community nurse's hourly pay rate, but the total cost paid by the employer for one hour of community nursing time within a municipal wound care organisation. This hourly wage rate is DKK 256.94, measured as the median for women in the age range 35+.<sup>9</sup> According to Local Government Denmark (a member organisation for all 98 municipalities), 45% of each hour (27 minutes) is the average time spent face-to-face with the patient. The remaining 55% (33 minutes) is used for other activities such as transport, recording in notes, coordination and lunch breaks.

Wound dressings have been set a mean price of DKK 55 (€7) per change. The calculation is based on a simple arithmetic average between the British and Danish surveys.

Using the 2009 population of 5m, the total cost of wound care to Danish municipalities can be set at DKK 735m (€99) (Table 2).

The empirical basis for our calculations is insufficient to establish a sound cost estimate. However, it is sufficient for a conservative calculation based on two cost objects.

Other cost objects, including pressure ulcer prevention strategies, risk scoring and biopsy could have been included, and may have reduced the overall costs. Indirect costs such as home care scoring and rehabilitation have not been included, but would certainly increase the number of working hours performed (e) and thus the total cost estimate if they had been.

## Results

### Financial effects of a changing demography

Projection of the Danish population from 2009–2020 reveals a significant increase in and a change in the composition of the older part of the population. The number of senior citizens will increase by an average 22,764 per year.<sup>10</sup> In 2005, the Copenhagen study illustrated that 82% of all wounds are in people aged 60 to 100+. Using the table of wound frequencies from this study (Table 3) and applying it to the projected 2020 population gives us a cost estimate. Indeed, a changing demography will have a huge impact on health budgets. The overall cost estimate is obtained using the formulae in Table 2, which generate a total cost for each year. 2009 serves as our baseline. In 2009, an additional cost of DKK 9m (€1m) will be incurred, due to changes in demography. The accumulating costs grow rapidly, and by 2020 an extra DKK 173m (€23m) is predicted.

Obviously, this calculation does not cover all of the extra costs. Attention must also be paid to consequential costs: for instance, as the older part of the population grows, so too will the prevalence of problematic, non-healing wounds.

**Table 4. Life expectancy for a 65-year-old person 2006–2020**

		OECD								Average growth rate	R <sup>2</sup>
		2006	2008	2010	2012	2014	2016	2018	2020		
Denmark	Men	16.2	16.4	16.6	16.7	16.9	17.1	17.3	17.5	0.1825	0.9849
	Women	19.2	19.3	19.5	19.6	19.7	19.8	20.0	20.1		
Sweden, Norway and Finland	Men	17.4	17.8	18.2	18.6	19.0	19.4	19.7	20.1	0.1950	0.9773
	Women	21.0	21.3	21.6	21.9	22.2	22.5	22.8	23.1		
Difference	Men	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2	-2.4	-2.7	0.3123	0.3171
	Women	-1.8	-1.9	-2.1	-2.3	-2.5	-2.7	-2.9	-3.0		
Government scenario	Men	16.2	17.0	17.0	17.6	18.3	18.9	19.5	20.1	0.3123	0.3171
	Women	19.2	20.0	20.0	20.6	21.2	21.9	22.5	23.1		
Difference	Men	-1.2	-0.8	-1.2	-0.9	-0.7	-0.5	-0.2	0.0	0.3123	0.3171
	Women	-1.8	-1.3	-1.6	-1.3	-1.0	-0.6	-0.3	0.0		

Source: OECD and own calculations.

**Fig 2. Formulae to calculate the extra lifetime produced**

$$(I) \quad A=Y ((\phi_{60} \dots \phi_{100+}) \times \begin{pmatrix} l_{60}^{2008} & \dots & l_{60}^{2020} \\ \vdots & \ddots & \vdots \\ l_{100+}^{2008} & \dots & l_{100+}^{2020} \end{pmatrix} )$$

$$(II) \quad B= Y \begin{pmatrix} \chi^2 \\ \vdots \\ \chi^{12} \end{pmatrix} \times ((\phi_{60} \dots \phi_{100+}) \times \begin{pmatrix} l_{60}^{2008} & \dots & l_{60}^{2008} \\ \vdots & \ddots & \vdots \\ l_{100+}^{2008} & \dots & l_{100+}^{2020} \end{pmatrix} )$$

$\phi$  = life-time expectancy in 2007 for age 60–100+ <sup>10</sup>  
<sup>10</sup> = projected population in 2007 for age 60–100+ for 2008-2020 <sup>10</sup>  
 $\chi = (1 + j)$ ,  $j$  = growth rate of improved life-time expectancy, male:  $j = 0.3123$ , female:  $j = 0.3171$

**Financial effects of improved life expectancy**

For years, OECD statistics have shown that Danes have a significantly shorter lifespan when compared with the citizens of other Nordic countries.<sup>11</sup> In 2008, the Danish Government pledged to improve its citizens’ life expectancy by at least three years over the course of the next decade.<sup>12</sup> In 2009, a government commission developed an action plan, primarily based on improved treatments and healthier lifestyles. The government has predicted that Danish life expectancy will be at the same level as in other Nordic countries by 2020.

The financial impact of this scenario is dependent on the number of extra years of life that the 60–100+

group is able to collect during the period 2009–2020.

The Nordic countries of Sweden, Norway and Finland have been chosen as our benchmark. All are expected to experience a steady upwards drift in life expectancy, which must be accounted for.

Two calculation steps have been followed:

- Step 1: a simple linear regression model is constructed, using OECD data pooled from 1995 to 2006.
- Step 2: this model is then used to project the development in life expectancy, both for Denmark and the other Nordic countries for 2009–2020.

As seen in Table 4, the other Nordic countries are performing much better than Denmark, and the gap appears to be widening. For example, in 2006 life expectancy for a 65-year-old Danish man was only 1.2 years lower. However, this age gap is expected to more than double by 2020, to 2.7 years. A lower growth rate in the improvement of life expectancy is predicted for both men and women.

In order to reach an equal level by 2020, Denmark must not only overcome its lower dynamic growth rate, but it must also achieve a high enough growth rate to catch up with the other Nordic countries. Table 4 shows that the compound growth rate must be 0.31 for men and 0.32 for women.

Based on these two growth rates, the number of extra years of life can be calculated using formulae (I) and (II) in Fig 2.

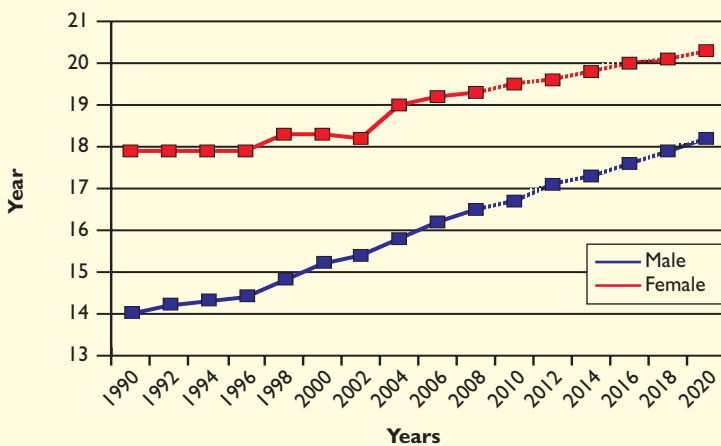
From these calculations, we can expect 40,060 (18,795 + 21,265) more elderly people by 2020 (Table 5). This is equivalent to 163,889 people, as the demography composition factor is 4.0911. In terms of financial impact, this corresponds to DKK 22.0m (€3.0m) (Table 2). Thus, on average, the

**Table 5. Results of extra lifetime produced**

2009–2020	Living years produced	
	Male	Female
Formula A =	100,128,767	137,869,548
Formula B =	118,637,227	159,612,540
Extra years (B – A)	18,508,460	21,742,992
Average life years per year	1,542,372	1,811,916
Average life expectancy (new born) (years)	82.065	85.205
Average extra population	18,795	21,265

NB: In the final result 2008 is deducted from the sum of formula A and formula B.

**Fig 3. Remaining life expectancy for a 65-year-old Dane**



Source: OECD Health Data, version June 2008 and own calculations

increased cost will be DKK 1.8m per year (€0.2m). This result seems insignificant in terms of financial challenges to the municipalities, but nevertheless it is important that we include it.

**Financial effects of type 2 diabetes**

Lifestyle diseases such as obesity and type 2 diabetes are significant players in Denmark, as in many other western countries.<sup>13</sup> At present, about 230,000 Danes have type 2 diabetes. If the trend continues, we can expect about 625,000 Danes to have the diagnosis by 2025.<sup>4</sup> This is an increase of more than 70% within one generation, as forecast by the Juvenile Diabetes Research Foundation in Denmark (JDRF). According to JDRF, 8–15% of these patients will suffer wounds at some point during their lives. Unless these developments change, 23,235 more citizens will be diagnosed with type 2 diabetes each year. By 2020, the accumulated number will be 278,820. Clearly, type 2 diabetes will have an impact on pub-

lic health budgets. Our calculation of the financial effects rests on the following assumptions:

- As many as 97% of all complications of type 2 diabetes relate to older patients: >31% 40–65 years, >66% 60–100+ years<sup>14</sup>
- As a representative, our 'typical' person with type 2 diabetes is a 65-year-old woman living in 2014, with a life expectancy of 19.75 years (Fig 3)
- A lifetime-incidence rate of 8% is used, since no trustworthy point prevalence rate was found
- Purely arbitrarily, we have estimated that there are 1,859 wounds (8% of 23,235) and that these are distributed equally over the 19.75 years, giving an incidence of 94.2 wounds per year. However, this incidence rate has been replicated 12 times, due to the number of years in the period. All in all, type 2 diabetes mellitus yields 1,129 wounds (94.2 x 12).

Using the formulae in Table 2, we estimate that the costs of wound care will increase by an extra DKK 47m per year (€6m). The total extra cost over the period 2009–2020 will be DKK 563m (€76m). This is a rather conservative calculation.

**Discussion**

Over the next 10 years, the financial challenges to wound care and management can be summarised thus:

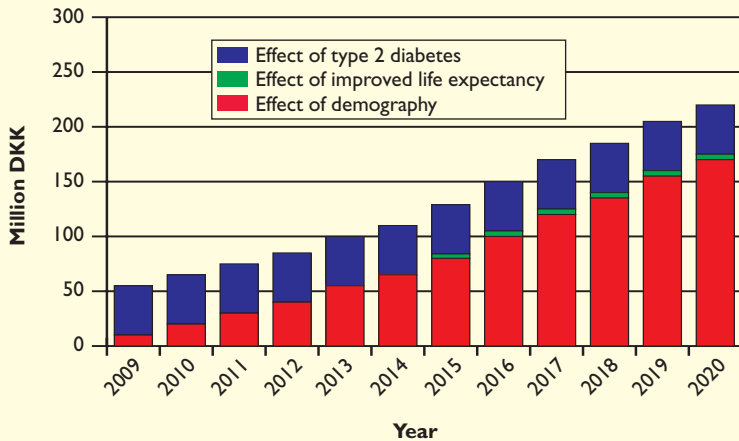
- The rapidly changing demography will increase costs by an accumulated DKK 173m (€23m)
- An improvement in life expectancy will increase costs by an accumulated DKK 22m (€3m)
- Lifestyle diseases such as type 2 diabetes mellitus will increase costs by a total of DKK 563m (€76m).

The main cost object in wound management and care is nursing time. The only way to minimise time consumption is to control the cost-drivers. This will only be possible by optimising prevention, diagnosis and treatment of wounds, reducing both the number of citizens with wounds and the number of wounds per patient. Optimal management condi-

**Table 6. A simple scenario to show the financial impact of a national strategy**

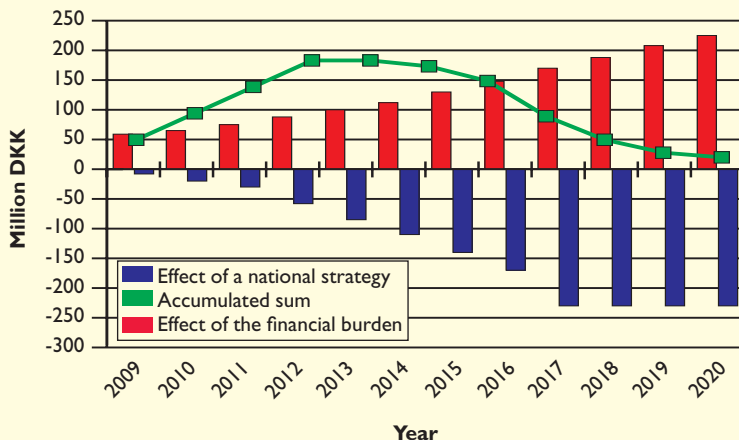
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Future financial burden	56.4	65.0	75.7	86.5	99.3	113.6	130.3	148.3	168.0	187.3	206.2	223.7
I. Effect of demography	9.2	17.5	27.9	38.5	51.0	65.1	81.4	99.2	118.5	137.5	156.1	173.3
II. Effect of improved life expectancy	0.3	0.5	0.8	1.1	1.4	1.7	2.0	2.2	2.6	2.9	3.2	3.5
III. Effect of type 2 diabetes	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9	46.9
National strategy	-6.8	-18.2	-28.5	-57.0	-85.5	-113.9	-142.4	-170.9	-227.9	-227.9	-227.9	-227.9
Net effect	50	47	47	30	14	0	-12	-23	-60	-41	-22	-4
Rate of implementation x 227.1	0.03	0.08	0.13	0.25	0.38	0.50	0.63	0.75	100.00	100.00	100.00	100.00

**Fig 4. The financial burden divided into different sources**



Source: own calculations

**Fig 5. The financial potential of a national wound strategy**



Source: own calculations

tions are dependent on a national plan for wound management.

If current treatment policies continue, the financial burden on the municipalities will increase from DKK 56m (€8m) in 2009, to DKK 224m (€30m) in 2020 (Fig 4). Health budgets are under pressure and some municipalities may not be able to overcome this challenge.

In 2008, a project conducted in the municipality of Aalborg NV documented that the implementation of best practice guidelines in wound therapy decreased the number of wounds by 31%.<sup>15</sup> Evidence-based guidelines are a cost-effective tool for gaining control over cost objects and the underlying cost drivers. A crucial point is, that these guidelines were implemented at both the tactical level and the operating level within the wound care organisation.

On a national scale, there is the potential for a financial gain of DKK 228m (€31m) each year in health-care expenses (31% of DKK 735m). If the municipalities continue on course, they can expect a total accumulated loss of DKK 1.5 billion (€206m) by 2020. In addition to financial losses, we must not overlook social losses, in terms of quality of life.

We believe that overcoming the financial threat posed by demographic factors, life expectancy and type 2 diabetes could be financed for almost nothing. All municipalities need to be united in a national strategy, sharing the same wound management principles. Such a strategy is not yet in place.

A simple scenario illustrates that if a national wound management strategy had been implemented in 2009, and was gradually and conservatively enforced over a seven-year period, a financial gain of DKK 228m (€31m) would be achieved by 2016. This scenario is replicated in Table 6 and a graphical representation is presented in Fig 5. From 2014 a

surplus starts to build-up, accumulating DKK 4m (€0.5m) in 2020.

Adopting individual wound management strategies in the 98 municipalities may not be possible. Not every municipality has the capacity to develop and maintain a wound management initiative based on evidence and best practice. However, a national strategy is paramount if future financial burdens are to be overcome. Such a strategy will take time to enforce. Public reforms are not achieved overnight, but take years to successfully implement. In this scenario, a conservative figure of seven years has been chosen.

The call for a national strategy usually comes from either politicians or institutions but in the case of wound management, it might also come from patients and other citizens. Apart from the obvious pain and discomfort, wounds disable people's social lives and functionality.<sup>16,17</sup>

Municipalities will have to define and introduce a set of best practice guidelines, which must be acceptable to the population if they hope to gain the support of citizens. In the near future, we might expect a 'consumer attitude' among patients seeking the best treatment options. Municipalities must therefore be prepared to operate in a 'market setting', in which patients seek out the best quality institutions, regardless of whether they are public or private.

This market-orientation development has been ongoing for the last 15–20 years and is often referred to as new public management (NPM).<sup>18</sup> The NPM concept has dominated the Danish government's attempts to reform and modernise the public sector<sup>19</sup> and the Danish health-care sector has been sig-

nificantly affected. NPM is an economic paradigm directed towards the public sector focusing on efficiency and adaptation of principles of management from the private sector. It has been adopted in all western countries, although the same direction has not always been followed.<sup>20</sup>

In the future, a similar scenario is to be expected in other western European countries that face similar problems as Denmark. The Danish health-care system is special in some structural ways as earlier described, but the development of cost for treatment procedures and wound devices will probably be similar for all the countries in Europe.

## Conclusion

Major financial challenges in wound care will emerge in Denmark in the period 2009–2020. A similar scenario is to be expected in other western European countries. This study presents an empirical model that calculates the economic consequences of future challenges such as demography, lifestyle and type 2 diabetes. Our findings suggest that Danish municipalities will have to make a choice between either continuing their normal practice, which will most likely lead to further budgetary constraints, or changing direction and developing and implementing a national strategy for wound therapy. Our estimates show that the financial gain from such a strategy can almost offset the future financial burden.

The responsibility for developing a national strategy should be a priority for both municipalities and the national health authorities in Denmark and in other European countries. ■

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