Original

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Reduction in diabetic amputations over 15 years in a defined Spain population. Benefits of a critical pathway approach and multidisciplinary team work

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ABSTRACT

Objective. To assess changes in diabetic lower-extremity amputations (LEA) rates in a defined population over a 15-year period, following a multidisciplinary approach including a critical pathway in an inpatient setting with standardized preoperative and postoperative care, as well as in an outpatient setting through the establishment of a diabetic foot clinic.

Methods. This is a study of the incidence and types of LEAs performed in patients with diabetic foot disease complicated admitted to Morales Meseguer Hospital (Murcia, Spain), a large district general hospital, before (1998-2000) and after (2001-2012) of the introduction of better organized diabetes foot care. Hospital and clinic characteristics to the success of the programme are described. All cases of LEA in diabetic patients (1998-2012) within the area were identified by ICD-9-Clinical modification (CM) diagnostic codes. A chi square test was used to compare the frequency and level of amputations.

Results. Over all inpatients with diabetes admitted with foot infections and gangrene, there was a significant decrease in the proportion of total major amputations (47%) and elective major amputations (66%) (p<0.001). The incidence of total major amputations rates per 100.000 of the general population fell with statistical significance (p=0.009). The biggest improvement in LEA incidence was seen in the reduction of major elective amputation with fell 60%, from 7.6 to 3.1 per 100,000 (p<0.001).

Conclusions. Significant reductions in total and major amputations rates occurred over the 15-year period following improvements in foot care services included multidisciplinary teamwork (critical pathway and diabetic foot clinic).

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Disminución de las amputaciones en pacientes diabéticos en un área de salud a lo largo de 15 años. Resultados de la implantación de una vía clínica intrahospitalaria y una consulta externa del pie diabético

RESUMEN

Introducción. El objetivo ha sido valorar los cambios en las tasas de amputaciones en pacientes diabéticos, durante un periodo de 15 años, al introducir una aproximación multidisciplinar en equipo, incluyendo una vía clínica intrahospitalaria, con estandarización de los cuidados pre y postoperatorios y posteriormente, la puesta en funcionamiento de una Clínica del Pie Diabético enfocada al paciente ambulatorio.

Métodos. Se monitorizaron la incidencia y tipos de amputaciones realizadas en pacientes con pie diabético complicado, ingresados en el Hospital JM Morales Meseguer (Murcia, España), antes (1998-2000) y después (2001-2012) de la introducción de las modificaciones multidisciplinares destinadas a mejorar el proceso asistencial de los pacientes con pie diabético complicado. Se identificaron todos los casos de amputaciones en pacientes diabéticos mediante los códigos diagnósticos ICD-9-CM. Para el estudio estadístico se usó el test de la "chi cuadrado" para comparar la frecuencia y el nivel de las amputaciones.

Resultados. Hubo una disminución significativa en la proporción de amputaciones mayores totales (incluyendo las amputaciones urgentes) (47%) y en las amputaciones mayores electivas (66%), siendo para ambas p<0,001, al considerar la totalidad de pacientes ingresados con infección del pie diabético y/ó gangrena. Al considerar la incidencia de amputaciones mayores por 100.000 habitantes, se objetivó una disminución estadísticamente significativa (p=0,009), siendo aún mayor dicha disminución al considerar la tasa de amputaciones mayores electivas con caída en torno al 60%, desde 7,6 a 3,1/100.000 (p<0,001).

Conclusiones. Se concluye que la organización del proceso asistencial del pie diabético complicado, tanto intrahospitalariamente en los casos que precisan ingreso (vía clínica del

Pie Diabético), como extra-hospitalariamente (Clínica del Pie Diabético) se asocia a reducciones significativas en las tasas de amputación mayor que se mantienen en el tiempo.

INTRODUCTION

The most of lower extremity (LEA) amputations is performed for diabetic individuals. Eighty-five percent of these amputations are preceded by a foot ulcer[1]. Foot ulceration due to neuropathy and repetitive trauma, often complicated by infection and ischemia, is the primary underlying pathway to amputation[2]. Despite major advances in understanding and management of diabetic foot, amputation rates in people with diabetic remain unchanged or even increased in many regions[3]. The evolution of the prevalence of diabetes in Spain over recent years, based on various cross-sectional studies, shows that previous estimates have been surpassed, with 10-15% of Spanish adults estimated to have diabetes[4] and this is expected to lead to an increase in the number of amputations[5]. In Murcia (Spain), the information available shows that the prevalence of diabetes is 11-12%[4,6].

The challenge for all health care systems is to manage lower extremity disease of diabetics in a clinically and cost-effective manner: reducing the frequency of major amputations and lowering overall costs. The complex nature of diabetic foot pathology is best treated with a team approach. An aggressive multidisciplinary approach to pedal complications of diabetes appears to increase limb salvage.

Integrated Care Pathways (ICPs) increase communication between the various specialties and expedite decision making: similar patients are treated with the highest standard of care in the most cost-effective manner, moreover increase the use of clinical guidelines and reduce variability in clinical practice in order to improve health care quality[7,8]. The use of a critical pathway approach improves inpatient outcomes and significant decrease in mayor amputations[9].

However, limb preservation services are frequently consulted very late in the disease process, after significant pathology has progressed. Edmonds established a diabetic foot clinic at King´s College Hospital in 1981, it was able prevent nearly all major amputations in neuropathic feet[10]. History has taught us that optimal management of diabetic foot complications is best provided in a hospital-based diabetic foot clinic[11].

The objective of this study was to assess trends in non-traumatic LEAs among people with diabetes after to integrate critical pathway for inpatient setting and diabetic foot clinic for outpatient setting.

METHODS

The study populations comprised the health care districts area 6 of Murcia in southeast Spain with 170,240-240,284 inhabitants (1998-2012) and the diabetic population rose from 15,300 in 1998 to 22,366 in 2012[6].

The data were collected retrospectively. All patients who underwent an LEA between 1 January 1998 and 31 December 2012 were identified through operating theatre records; surgery department and hospital discharge records were used as secondary sources, based on ICD-9 (International Classification of Diseases, 9th revision) and OPC S4 (Operating and coding Procedures, 4th revision). All patients admitted with the applicable diagnostic codes: ICD-9 CIDES 250.xx (Diabetes Mellitus) and its complications 707.1 (chronic ulcer, foot) and/or 785.4 (gangrene) were included in this study. All amputations diabetes-related in the area 6 were performed at the Department of Surgery, Morales Meseguer University Hospital. An LEA was defined as loss in the transverse anatomical plane of any part of the limb and a major amputation as any above the ankle, including below knee (BKA) and above knee (AKA) (ICD-9-CM codes 84.13-84.17). A minor amputation was defined as any LES distal to the ankle joint. The lowest level of amputation included was through the distal interphalangeal joint of a toe. Traumatic and tumor-related amputations were excluded (ICD-9-CM codes 84.10-84.12)

Incidences of amputations were expressed per 100,000 of the general population, per 10,000 people with diabetes and percentages over total inpatients with diabetic foot complicated. The use of the total population is more representative when the prevalence of diabetes is not well documented in all years of study.

Prior to 2001, diabetic patients with foot lesions were treated they first attended, most commonly in Primary Health Care or Departments of Infections Diseases, Vascular Surgery, General Surgery, Orthopaedic or Internal Medicine. No common strategy existed. The 1998-2000 group was defined as the conventional methodology group (Group A).

At the year 2000, the Critical Pathway Committee designs and implements the organization, coordination and procedural elements for a success foot critical pathway approach to emergency room patients admitted with diabetic pedal infections and ischemic gangrene. The teamwork of Critical Pathway Committee included several disciplines: diabetology, emergency medicine, anaesthesiology, surgery, infectious diseases, radiology, pharmacy, physical medicine and rehabilitation, psychiatry, medical quality, family physician, nursery and social worker. Critical pathways describe the clinical work of each professional discipline and department as it relates to patients and familiars measurable outcomes of care[12]. The pathway was initiated in the Emergency Department utilising committee-approved standing physician´s orders and clinical progress records to facilitate transitions between departments (tables 1 y 2).

From 2001 to 2012 was defined as the Multidisciplinary teamwork group. Strict amputation criteria and yearly analysis of performance based on the audit data were applied. The first five years (2001-2005) was defined as the Critical Pathway Group (Group B).

The year 2006 we established a diabetic foot clinic in the hospital. The multidisciplinary foot care team consisting

Table 1 **Clinical pathway of diabetic foot. Patient with or without minor amputations**

Activities Date and place	Emergency room	WARD 1st Day and Critic phase	WARD Improving phase	WARD DISCHARGE
Medical treatment	-Inclusion in the clinical pathway -Anamnesis and physical examination -Request previous clinical history. -Request for test. -Location of the patient in emergency romm	-Anamnesis. Physical examination. Consulting to endocrinology and rehabilitation. -Doing and asking for test. -Evaluation of ischemia and osteomyelitis. -Evaluation of needing to surgical clearing or/and debridament.	- Anamnesis. Physical examination. Consulting to endocrinology and rehabilitation. -Coordination with byopsychosocial counceling.	- Anamnesis. Physical examination. - Reminder of discharge
Test	-Blood test. -X-ray of thorax and affected site. -Electrocardiogram. -microbiological test. -Optionals: venouse gasometry, urine test, Eco-doppler.	-Blood testl (H,B,C), Hg glicosilada, P. Lipidic. -US-Doppler. Ankle/arm index. -Finger transdermic oxymetry -Optional: CT, MR, Angiography, isotopic tecnics, angio-MR.	- Blood test (H,B,C), Hg glicosilada, P. Lipidic. -Determination of plantar pressures	
Nursing care	-Reception -Checking for: temperatura, blood pressure, cardiac rate and glucaemia). -Hepariniced venose. -Request for test. -Surgical nursing care and debridement of the wound -Begin antibiotic treatment -Health education	-Reception protocolo and inicial evaluation of familiar support. -CF/BP/T[a] each 8h and diuresis daily. -Local care of the wounds with crape on saline fluid each 8 h. -Blood glucose levels /6 h. and Insulin treatment.	- CF/BP/T[a] each 8h and diuresis daily. - Local care of the wounds. - Blood glucose levels /6 h. and Insulin treatment. -Check for personal toilet.	-Health education: WATCHING FOR THE FOOT. -BP control. Avoid smoking. -1500 calories diet. -Personal toilet. -Informing to byopsychosocial counceling. -Checking for the need of translation.
Treatment	-Antibiotherapy (Anexo VI). -glucaemia control.	-Antibiotherapy. -Insulinotherapy. -Ranitidin orally. -Prophylactic Heparin subc. -Analgesics: NEAI, opioids. -Pentoxifilin.	- Oral antibiotics. - Reintroducing insulin NPH or oral antidiabetics treatment. - Subcutaneous heparina. - Ranitidin. - Analgesic: NEAI. - Hipolipemiants if hended; Pentoxifilin.	In discharge report: -Oral Antibiotics, analgesics and ranitidin. -Pentoxifilin. ASA, Insulina o oral antidiabetic . -Checking for BP and Hiperlypemics (if present. -Avoid smoking. -Cure in heath center or home.
Activity	REST IN A RAISED BED	REST IN A RAISED BED	Progressive walking avoiding pressure	ORTHOPEDICS SHOES
Diet	Diabetics 1,200, 1,500, 2,000 cals.	Diabetics 1,200, 1,500, 2,000 cals. 4 eatings	Diabetics 1,200, 1,500, 2,000 cals. 6 eatings	1,200, 1,500, 2,000 CALS.
Information and support	-First information (arrival). -Information (discharge). -Information formo f the clinical pathway.	-Dayly information previous to surgery if needed. -Implementation of the description of lessions form. -If hended, consultin to byopsychosocial counceling.	- Dayly information. - Health education form. - Self controlling blood glucosa levels and administration of insulin.	-DISCHARGE REPORT. -DIET -STANDARDIZED NURSE REPORT. -"DIABETIC FOOT REPORT". -HAND OUT SATISFACTION SURVEY (collect later)

Table 2 **Clinical pathway of diabetic foot. Patient with major amputation**

Activities Date and place	WARD PREOPERATIVE PERIOD	WARD POSTOPERATIVE 1	WARD POSTOPERATIVE 2	WARD POSTOPERATIVE 3	WARD POSTOPERATIVE 4	WARD POSTOPERATIVE 5-6	WARD POSTOPERATIVE-DISCHARGE
Medical treatment	Requiring to: REHABILITATION, ANESTHESIA, PSICHYATRIST. -Decissión of level of amputation. -Assessmento of functional prognosis. -Informed consentment.	-Assessment:Pain control, aedema. -Physical examination - Psychiatric evaluation	-Assessment: Pain control, Rehabilitation Pshyquiatrics Byopsychosocial councelin after discharge - Physical examination	-Rehabilitation -Psyquiatrist. -Physical examination and anamnesis by surgeon	-Rehabilitation. Prostetic iniciation. -Anamnesis and physical examination by surgeon. -Surgical wound assessment	-Rehabilitation. Self-walking. -Surgery: check for wound healing and health status - Plan for discharge.	Check: - Healed wound -Urinary and bowel function -Correct nutritional and phsyc status.
Test	-Preoperative assess. -Tc Po2, US-Doppler, Unkle/arm index optional to determine level of amputation	-CBC, serum parameters					
Nurse care	-Vital signs. -Glucaemia/6h. -Wound care. -Toilet and preoperative care. -Byopsychosocial counceling	Check: - Vital signs - capillary glucaemia - diuresis - Wound bleeding Assess: - emotional distress - pain - avoiding decubitus (mattress antiulcer)	- Avoiding decubitus - Vital signs /8h - Capilary glucaemia /6h. - Soft dressing fixed with a mesh daily.	- Avoiding decubitus - Vital signs/8h. - Change dressing - Capillary glucaemia /6-8h	-Change dressing - Remove Foley tube - Assist to go the Toilet - Vital signs - Capillary glucaemia /6-8 h	- Change dressing - Vital signs	- Change dressing - Vital signs - Standardized nurse report
Treatment	- Intravenous antibiotics - Insulin /6h. - Pain killer, Ranitidin, - Subcutaneous LWMH - Ansiolytic	- Antibiotics 24 hours alter surgery - Analgesics: opioids and NSAIDs intravenous - Intravenous ranitidine - DVT and PE prophylaxis - Insulin each 6 h.	- Intravenous analgesic: opioids - Oral antidiabetic or NPH insulin - Oral ranitidin - DVT and PE prophylaxis - Hypolipemiant if neccessary	- Analgesic (intravenous or orally each 8h.) - Oral antidiabetic or NPH insulin - Oral ranitidin - DVT and PE prophylaxis - Hipolipemiant if neccessary	- Oral pain killer. - Oral antidiabetic or NPH insulin - Oral ranitidin - DVT and PE prophylaxis - Hipolipemiant if neccessary	- Oral pain killer. - Oral antidiabetic or NPH insulin - Oral ranitidin - DVT and PE prophylaxis - Hipolipemiant if neccessary	-NSAIDs. If pain, add, Cod-Efferalgan 1 mes -- Oral antidiabetic or NPH insulin - Oral ranitidin - Pentoxifilina, ASA - Hipolipemiants if neccessary. - Avoid smoking - HTA control

Table 2 **Clinical pathway of diabetic foot. Patient with major amputation (cont.)**

Activities Date and place	WARD PREOPERATIVE PERIOD	WARD POSTOPERATIVE 1	WARD POSTOPERATIVE 2	WARD POSTOPERATIVE 3	WARD POSTOPERATIVE 4	WARD POSTOPERATIVE 5-6	WARD POSTOPERATIVE-DISCHARGE
Activity Physiotherapy	- Physiotheraphy - Monopodal standing - Respiratory physiotherapy - Psycological support to motivate.	- Rest in bed - Training exercise	- Rest in bed - The same that the firs day	- Postural self-changing. - Idem days 1 and 2.	- Cinesitherapy with the amputated leg. - Potenciation arms	- Cinesitherapy with the amputated leg (abdominal muscles, gluteus, cuadriceps). - Deambulation with sticks - Potenciation arms - Visit the amputated unit.	- Practice motility - Show exercises
Diet	1,200, 1,500 or 2,000 cals. Absolut diet alter midnight	- intravonous fluidotherapy - oral fluids - Diet 1,200, 1,500, 2,000 cals. 4 times	1,200, 1,500, 2,000 cals. 6 times.	1,200, 1,500, 2,000 cals.	1,200, 1,500 or 2,000 cals.	1,200, 1,500 or 2,000 cals.	1,200, 1,500 or 2,000 cals.
Information And Support	- Informated consentiment (surgery and anestesia) - Information preventive care of the other foot. -Acceptance to incineration leg		- Discusión with relatives plans. - To give information "hygienic and postural cares"	- Review-learning care the other leg - Training change pads to relatives. - Training control glucaemia and diabetic dieta	- Complete instructions previous discharge. - Prepare wheels chair if neccessary. Coordination with Byopsychosocial counceling .	- Book outpatient clinic to Rehabilitation after discharge	- Discharge report - Book outpatient clinic surgery, rehabilitation, endocrin and/or psychiatry - Nurse discharge report foot care. - Diabetic diet report. - Amputated recommendations

of a general surgeon and a rehabilitation physician assisted by a diabetes nurse, a physiotherapist, an orthotists and shoemakers and working in close cooperation with the Department of Endocrinology, Orthopaedic surgery, Vascular surgery and Interventional radiology. A direct communication system with primary health care units was established, where the team is available throughout the week, acted as a referral unit for severe diabetes-related complications, including ulcers, infection, ischemia, osteoarthropathy and neuropathy. Treatment of complicated diabetic foot ulcers included aggressive management of infections, diagnosis of ischemia and evaluation for possible revascularization, improvement of the wound bed preparation with relief of pressure and debridement weekly. Strict amputation criteria were applied. The patients were followed by the same teamwork as in-and out patients and throughout the process a high degree of continuity and accessibility was maintained. After healing with or without amputation, the patients were followed by the team at least twice yearly.

The last seven years (2006-2012) included the effects of both aspects, critical pathway and diabetic foot clinical, was defined as Group C.

Statistical Analysis: The quantitative variables were expressed as means ± standard deviation and the qualitative variables as percentages Categorical variables were compared by the chi square test for trends. In those cases the where w were comparing means of continuous variables for 3 groups, we used the ANOVA test. All data were processed and analyzed using the Statistical Package for the Social Sciences (SPSS) software package for Windows (SPSS Inc. v15.0, Chicago, USA).

RESULTS

A considerable male predominance was observed in patients admitted with pedal complications of diabetes (p=0.002). The overall median age was 65 ± 17 in 1998-2000 (Group A) and being higher during the multidisciplinary periods 2001-2005 (Group B): 67±18 and 2006-2012 (Group C): 68 ±17 (p=0.258). There was a significant decrease in the proportion of total major amputations (BKA or AKA) over all patients with diabetes admitted with foot infections and gangrene in Group B (18%) and Group C (13%) compared to patients treated with methodology conventional, Group A (24.7%) (p<0.001), this decrease was very significantly in elective major

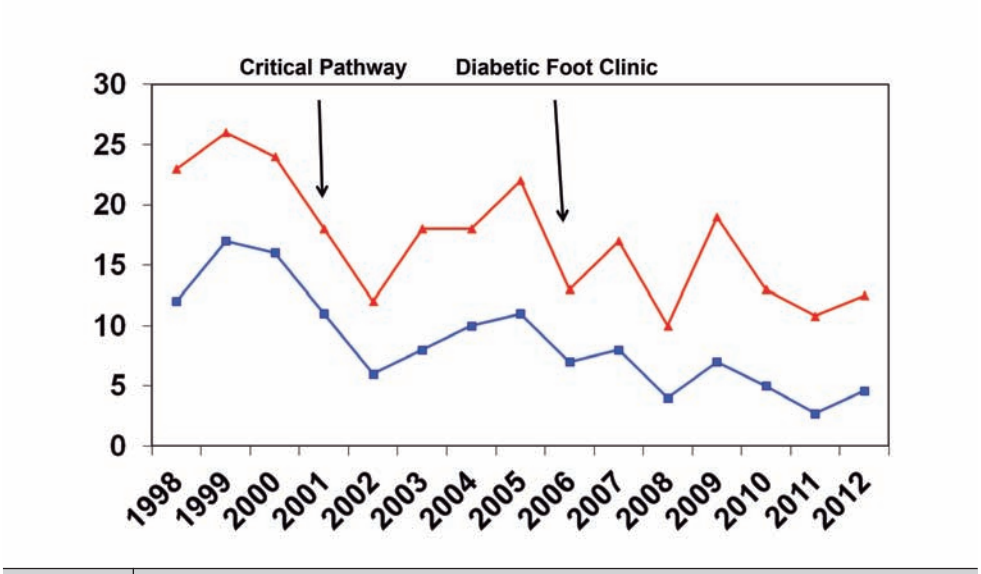

Figure 1 **Changes in proportion in total major amputations (▲) and elective major amputations (■) over all patientes admitted with pedal complications of diabetes.**

amputations with fall from 15.9% to 5.4% (p<0.001), without changes in urgent major amputations (p=0.897). The proportion of minor amputations also decreased, although without significantly changes (p=0.079). The proportion of total LEAs fell from 60.8% (Group A) to 42.8% (Group C) (p<0.001). Figure 1 illustrates year to year the changes in proportion in total and elective major amputations and the table 3 the comparison of inpatient populations. There was not a significant difference in length hospital stay between these periods (p=0.115). The unadjusted overall in hospital mortality rate (%) decreased although without significant variations (p=0.065).

Table 4 illustrates the changes in amputation incidence rates between the three groups expressed per 100,000 inhabitants. Figure 2 illustrates year to year the changes in foot major amputation rates expressed per 100,000 of the general population. Since yearly amputation rates fluctuate, baseline and find rates were calculated by averaging years 1998 to 2000 (Conventional Methodology group, Group A), 2001 to 2005 (Critical Pathway Group, Group B), 2006-2012 (Critical Pathway and Diabetes Foot Clinical, Group C). After the first 5-year period, total and major amputations per the 100,000 general population fall 15.5% (27.1 to 22.9) and 24.8% (11 to 8.2) respectively, with a small decrease (8.7%) in minor amputations (16.1 to 14.7). Over most recent 7 years (2006-2012), total and major amputations per 100.000 general population fall 32.1% (22.9 to 18.2) and 17.1% (8.2 to 5.9, respectively, with a reduction of 17% in minor amputations.

Between the first period (Group A) and he last period (Group C) the total amputations fall 32.8% (p=0.003), major amputations fall 46.4% (p<0.001), electives major amputations fall 57.7% (p<0.001) and minor amputations fall 13.3% (p=0.199). There was an incidence of 17.5/100,000 for the total amputations (decrease by 37%), of 5.5/100,000 for the major amputations (decreased by 50%) and of 12.3/100,000 for the minor amputations (decreased 24%). The incidence of major, minor and total amputations per 10.000 people with diabetes in these years, fell 40.1% (12.2 to 7.3), 15.2% (17.8 to 15.1) and 25.3% (30 to 22.4), respectively (table 5).

Preservation of the knee joint rates in major amputations (BKA) increased from 5% in the baseline period (1998-2000) up to 26.5% on average, in the following years (2001-2012), and 44% in the two last years (2011-2012) (p<0.001) (figure 3).

CONCLUSIONS

As far as we are aware, this is the longest prospective study of LEA in people with diabetes undertaken in Spain. The observations indicate a measurable reduction in the incidence of amputations in the diabetic population between 1998 and 2012. The incidence of the major amputation among our diabetic population has decreased 32% from the baseline period (10.9/100,000) to the last 5-years (7.4/100,000). In the present study, the decrease of the amputations rates was not only achieved but also sustained. A prolonged observation time is of great importance thus in come studies the decrease did not appear until the system had been in operation for 5 years, by which time the majority of the patients undergoing amputation had been involved in programme prior to amputation[13].

Large falls in amputations would be expected with modest improvements in care when baseline rates are high[14]. As with most medical phenomena a combination of factors may have contributed, however there dates support the hypothesis that a multidisciplinary team approach playing a major role through the utilization of a inpatient critical pathway and a hospital-based diabetic foot clinic. In England, found no evidence that the diabetes-related amputation incidence has significantly decreased over the last 5 years (2004-200), despite there have been substantial improvements in U.K. primary care during the last decade. Your overall amputation incidence rates per 10,000 people with diabetes of major and total, 11 and 26 respectively, did not significant change over time[3]. In the nation-wide analysis of the incidence of diabetes-related LEAs in Spain recently published[15], an upward trend was observed in type 2 diabetes-related minor and major LEAs, between 2001-

Table 3 **Comparison of inpatient populations (Group A, B and C).**

	1998-2000 (n: 227)	2001-2005 (n: 438)	2006-2012 (n: 795)	p	% Decrease
Male, n (%)	132 (58)	250 (57)	527 (66)	0.002	
Age, average ± DE	65±17	67±18	67±16	0.258	
Major amputations, n (%)					
Total	56 (24.7)	79 (18)	107 (13)	<0.001	47%
Urgent	20 (8.8)	38 (8.7)	64 (8.1)	0.897	
Elective	36 (15.9)	41 (9.3)	43 (5.4)	<0.001	66%
Minor amputations, n (%)	82 (36.1)	141 (32.2)	228 (28.7)	0.079	
Total amputations, n (%)	138 (60.8)	220 (50.2)	340 (42.8)	<0.001	30%
Length hospital stay (LOS), average (DE)	11.2±4.1	11.4±4.4	10.1±4.3	0.115	
Death rate, n (%)	11 (4.8)	13 (2.9)	16 (2)	0.065	

Dates are presented as average (range). N: number of patients. (% on total inpatients with pedal complications of diabetes)

2008, however the absolute increase was small: the incidence of total LEAs diabetes-related increased from 17.82 (2001) to 19.02 (2008) and the incidence of major amputations did not change, 7.71 (2001) and 7.69 (2008). The achieved major amputation rate in the last five years of 7.4 per 100,000 of the general population compares well with this. The lowest published major amputation rates per 100,000 of the general population are 2.2 from Madrid[16] and 2.8 from Ipswich[14], following improvements in foot care through multidisciplinary teamwork.

On the other hand, in Leverkusen (Germany), no change in incidence rates over time could be detected between 1990 and 1998[17]. An interdisciplinary ward for inpatient treatment, including preoperative and postoperative care, was opened in 2001. When patients are discharged, they continue to be treated by the now established outpatient network. Over 15 years, an estimated reduction of amputations above toe level by 37.1% results[18]. In our study, the overall incidence of major amputations over the last 7 years (2005-2012), per 10,000 people with diabetes fell 35.6% (from 11.8 to 7.6). Several studies in Spain showed geographic variation in rates of total LEAs per 10,000 people with diabetes (Madrid area 7, Malaga, Madrid area 3 and Gran Canaria report 4.6, 13.6, 19.1 and 31.97, respectively)[16,19-21]. Comparison between series is difficult due to attitudes, skills and methodological differences driven to diabetic foot care.

The Guideline Development Group (GDG) of NICE clinical guideline (2010), review evidence over the key components and organisations of hospital care to ensure optimal management of people with diabetic foot problems[22], five studies were included[9,13,23-25]. Limited evidence showed that organised care or multidisciplinary care improved patient outcomes. The GDG identifies as key priority for implementation in each hospital a care pathway, managed by a multidisciplinary foot care team, for inpatients with diabetic foot problems.

Table 4 **Changes in amputation incidence rates among the three groups expresssed per 100,000 inhabitants.**

	1998-2000 A	2001-2005 B	2006-2012 C	Comparison between Group A and B		Comparison between Group B and C		Comparison between Group A and C	
				p value	variation %	p value	variation%	p value	variation %
Major amputations									
Total	10.9	8.2	7.4	0.122	-24.8%	0.530	-9.7%	0.022	-24.8%
Urgent	3.9	3.9	4.4	0.928	0	0.649	+11.4%	0.710	+12.8%
Elective	7.1	4.3	3	0.036	-39.4%	0.122	-30.2%	<0.001	-57.7%
Minor amputations	16.1	14.7	15.7	0.554	-8.7%	0.559	+6.4%	0.966	-13.3%
Total amputations	27.1	22.9	23.5	0.149	-15.5%	0.781	+2.5%	0.199	-32.8%

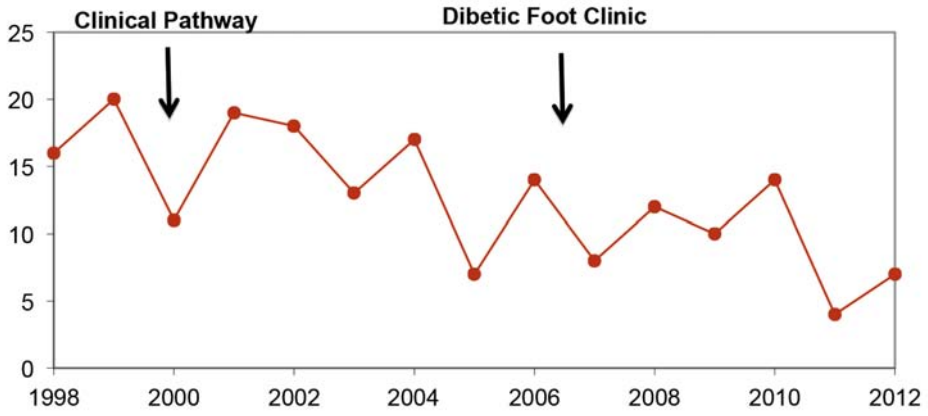

Figure 2 | **Changes in foot major amputation rates expressed per 100,000 of the general population.**
1998-2000 Conventional Methodology Group.
2001-2012 Multidisciplinary team Work Group: critical pathway and diabetic foot clinic (2206-2012)

The objective of the critical pathway approach is to create an atmosphere where similar patients are treated consistently with the highest standard of care, increasing communication between the various specialties and expedite decision waking. The integrated care pathway is the tool that helps us to effective implement a process management approach in hospital "patient-focused care"[9].

As far as we are aware, the only report published about results of a critical pathway approach to treat diabetic foot complications is of Crane y Weber[9]. The authors noted a significant decrease in the proportion of major amputations for patients treated with the pathways model (7%) compared to patients who were not treated with this approach (29%). In our study, there were falls from a high baseline of 25% to 13% ($p<0.001$) there were dramatic falls in the proportion of the elective major amputations (66%) from 15.9% of the inpatient setting with pedal complications of diabetes, to 5.4%.

Patients with BKA have a greater likelihood of independent ambulation with a prosthesis than those with AKA. Preservation of the knee joint and a significant length of the tibia permit the use of lightweight prostheses and enables older or more frail patients to walk independently.

The quality-of-life benefits derived from these improved patients outcomes are significant. In major LEAs impairment scores in quality of life were significantly different with more functionally impaired than patients with minor LEAs or control subjects[26].

In conclusion, an aggressive multidisciplinary approach to pedal complications of diabetes, including an Integrated Care Pathway and a Diabetic Foot Clinic, appears to increase limb salvage. In most cases, few additional resources are needed to implement this type of team approach. The main obstacles are organizations and political. Despite these data indicated that efforts to delay and reduce the incidence of LEAs in people

Table 5 | **Changes in amputations incidence rates among the three groups expressed per 10,000 people with diabetes.**

	1998-2000	2001-2005	2006-2012	Comparison between		Comparison between		Comparison between	
	A	B	C	Group A and B		Group B and C		Group A and C	
				p value	variation %	p value	variation%	p value	variation %
Major amputations									
Total	11.8	9.1	7.6	0.150	-22.9%	0.274	--16.5%	0.009	-35.6%
Urgent	4.2	4.4	4.6	0.981	+4.5%	0.907	+4.3%	0.863	+8.6%
Elective	7.6	4.7	3.1	0.045	-38.1%	0.062	-34.1%	<0.001	-59.2%
Minor amputations	17.4	16.2	16.3	0.673	-6.9%	0.986	+6.1%	0.664	-6.3%
Total amputations	29.3	25.4	24.3	0.203	-13.3%	0.664	-4.3%	0.074	-17.1%

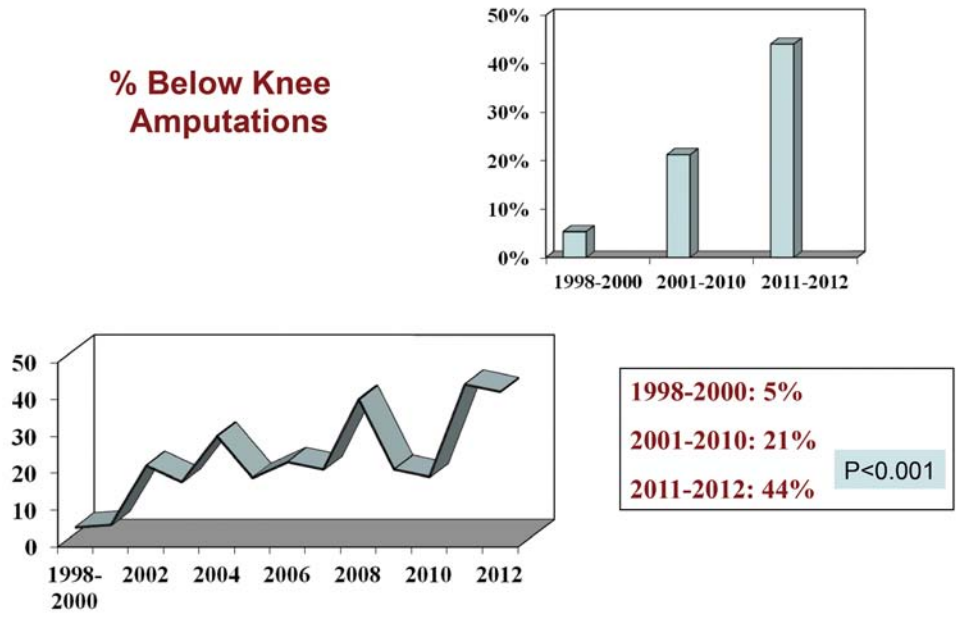

Figure 3 | **Evolution in below knee amputation (percentage) over total major amputations along the 15 years studied.**

with diabetes succeeded, the incidence remains high, suggesting that diabetic foot care remains suboptimal in Murcia. A more substantial reduction in LEAs in diabetics should be achieved with foot protection programs for people at increased risk of developing lower limb complications and an earlier diagnosis and management provided by a multidisciplinary foot care team.

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