



**FCT**  
Fundação para a Ciência e a Tecnologia  
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR



ESTeSC  
**COIMBRA**  
HEALTH SCHOOL

# Nursing Care in Peripheral Intravenous Catheter: Impact on Microbiological Profile

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JOÃO MANUEL GRAVETO, PHD, MSN, RN  
DANIELA VIDAL SANTOS, MSN, RN  
ANABELA DE SOUSA SALGUEIRO OLIVEIRA, PHD, MSN, RN  
NÁDIA OSÓRIO, PHD

<b>Faculty Name</b>	<b><u>João Graveto, RN, MS, PhD</u></b>
Conflicts of interesse	None
Employer	Nursing School of Coimbra
Sponsorship/Commercial Support	None

<b>Faculty Name</b>	<b><u>Daniela Santos, RN</u></b>
Conflicts of interesse	None
Employer	Nursing School of Coimbra
Sponsorship/Commercial Support	None

<b>Faculty Name</b>	<b><u>Anabela Oliveira, RN, MS, PhD</u></b>
Conflicts of interesse	None
Employer	Nursing School of Coimbra
Sponsorship/Commercial Support	None

<b>Faculty Name</b>	<b><u>Anabela Oliveira, RN, MS, PhD</u></b>
Conflicts of interesse	None
Employer	Nursing School of Coimbra
Sponsorship/Commercial Support	None

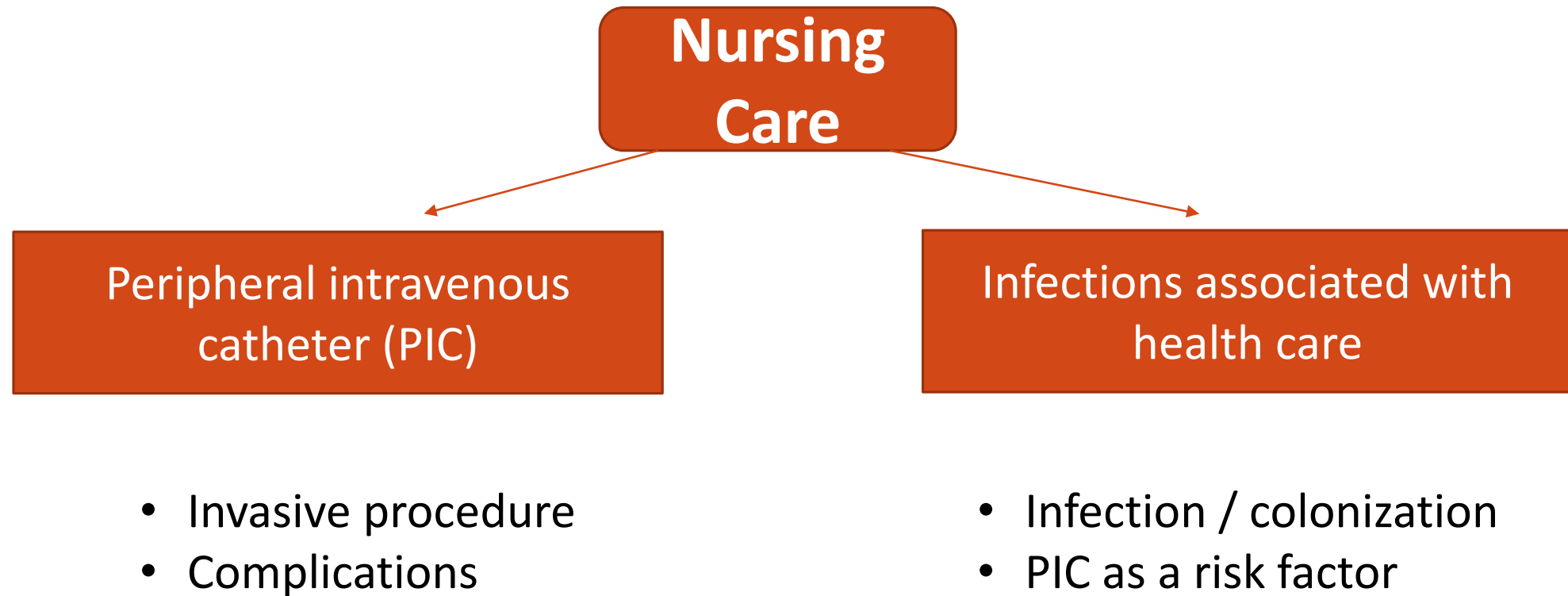
# Goals

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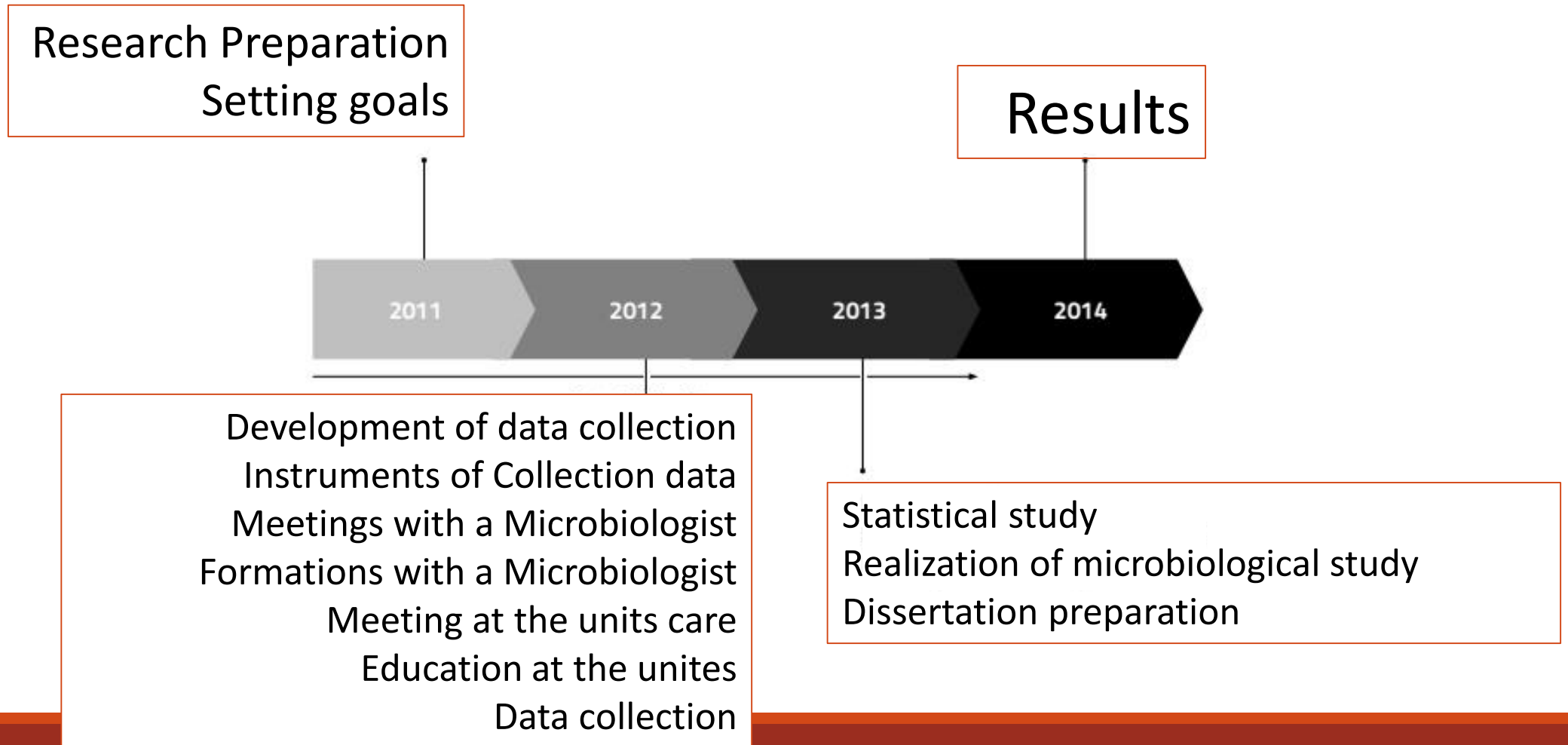
- To describe the nursing care during the peripheral venous catheterization process
- To Identify factors related to nursing care, which can interfere with bacterial colonization of Peripheral Intravenous Catheteres (PICs)
- To determine the prevalence of bacterial colonization of PICs, removed on adults patients, and the microbiological analysis exudate on the skin at the puncture local

# Background

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# Chronogram



# Methodological framework

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## Research

Descriptive, correlational and cross-sectional study

## Questions

What are the impact of nursing care procedures in the microbiological profile of the PICs?

Are the nursing care to patients with PICs sufficiently effective in controlling colonization?

# POPULATION / SAMPLE

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Surgical wards from a Central Hospital at Portugal

Patients hospitalized between September 17<sup>th</sup> and December 21<sup>st</sup>, 2012

The sample size:

335 patients with PICs

335 sample from PICs and patient skin

1080 data collection grids (description of the Nursing - insert, maintain and remove PICs)

## Inclusion criteria

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- collected PICs after a minimum period of maintenance ( $\geq 24$  hours);
- PICs handled in the units care (insert, maintain and remove) according to the protocol of the institution
- Patients  $\geq 18$  years

## Exclusion criteria

- Patients with Central Venous Catheter
- Catheters inserted at other units
- Catheters with less than 24 hours of maintenance , except if signs / symptoms of complications appears



# Variables

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## Dependents:

- Colonization PICs
- Colonization of the skin exudate

## Independent, grouped in the following categories:

- User profile
- Nursing Care
- Materials used
- Drugs
- Kind and number of Manipulations

# Documents

**CUBAOS DE ENTREGA NA MANIPULAÇÃO DE CATETERES VENOSOS PERIFÉRICOS**

Investigadora: Profª Daniela Vidal Santos  
E-mail: dvidal@fct.edu.br

Assessoria: Profª Drª Mariana de Sá  
E-mail: mds@fct.edu.br

CVP - Cateter Venoso Periférico  
Des: CVP utilizado no acesso venoso a um meio de SGA de permeabilidade.

**DADOS DO USUÁRIO**  
Nome: \_\_\_\_\_ Sexo: ☐ M ☐ F Data de nascimento: \_\_\_\_/\_\_\_\_/2012  
Vigilância: ☐ Diária ☐ Semanal ☐ Mensal  
Assessoria: ☐ Diária ☐ Semanal ☐ Mensal

**COORDENAÇÃO**  
Data de coleta: \_\_\_\_/\_\_\_\_/2012 Hora: \_\_\_\_:\_\_\_\_  
Tipo de CVP: ☐ 18G ☐ 20G ☐ 22G ☐ 24G ☐ 26G ☐ 28G ☐ 30G ☐ 32G ☐ 34G ☐ 36G ☐ 38G ☐ 40G ☐ 42G ☐ 44G ☐ 46G ☐ 48G ☐ 50G ☐ 52G ☐ 54G ☐ 56G ☐ 58G ☐ 60G ☐ 62G ☐ 64G ☐ 66G ☐ 68G ☐ 70G ☐ 72G ☐ 74G ☐ 76G ☐ 78G ☐ 80G ☐ 82G ☐ 84G ☐ 86G ☐ 88G ☐ 90G ☐ 92G ☐ 94G ☐ 96G ☐ 98G ☐ 100G ☐ 102G ☐ 104G ☐ 106G ☐ 108G ☐ 110G ☐ 112G ☐ 114G ☐ 116G ☐ 118G ☐ 120G ☐ 122G ☐ 124G ☐ 126G ☐ 128G ☐ 130G ☐ 132G ☐ 134G ☐ 136G ☐ 138G ☐ 140G ☐ 142G ☐ 144G ☐ 146G ☐ 148G ☐ 150G ☐ 152G ☐ 154G ☐ 156G ☐ 158G ☐ 160G ☐ 162G ☐ 164G ☐ 166G ☐ 168G ☐ 170G ☐ 172G ☐ 174G ☐ 176G ☐ 178G ☐ 180G ☐ 182G ☐ 184G ☐ 186G ☐ 188G ☐ 190G ☐ 192G ☐ 194G ☐ 196G ☐ 198G ☐ 200G ☐ 202G ☐ 204G ☐ 206G ☐ 208G ☐ 210G ☐ 212G ☐ 214G ☐ 216G ☐ 218G ☐ 220G ☐ 222G ☐ 224G ☐ 226G ☐ 228G ☐ 230G ☐ 232G ☐ 234G ☐ 236G ☐ 238G ☐ 240G ☐ 242G ☐ 244G ☐ 246G ☐ 248G ☐ 250G ☐ 252G ☐ 254G ☐ 256G ☐ 258G ☐ 260G ☐ 262G ☐ 264G ☐ 266G ☐ 268G ☐ 270G ☐ 272G ☐ 274G ☐ 276G ☐ 278G ☐ 280G ☐ 282G ☐ 284G ☐ 286G ☐ 288G ☐ 290G ☐ 292G ☐ 294G ☐ 296G ☐ 298G ☐ 300G ☐ 302G ☐ 304G ☐ 306G ☐ 308G ☐ 310G 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☐ 598G ☐ 600G ☐ 602G ☐ 604G ☐ 606G ☐ 608G ☐ 610G ☐ 612G ☐ 614G ☐ 616G ☐ 618G ☐ 620G ☐ 622G ☐ 624G ☐ 626G ☐ 628G ☐ 630G ☐ 632G ☐ 634G ☐ 636G ☐ 638G ☐ 640G ☐ 642G ☐ 644G ☐ 646G ☐ 648G ☐ 650G ☐ 652G ☐ 654G ☐ 656G ☐ 658G ☐ 660G ☐ 662G ☐ 664G ☐ 666G ☐ 668G ☐ 670G ☐ 672G ☐ 674G ☐ 676G ☐ 678G ☐ 680G ☐ 682G ☐ 684G ☐ 686G ☐ 688G ☐ 690G ☐ 692G ☐ 694G ☐ 696G ☐ 698G ☐ 700G ☐ 702G ☐ 704G ☐ 706G ☐ 708G ☐ 710G ☐ 712G ☐ 714G ☐ 716G ☐ 718G ☐ 720G ☐ 722G ☐ 724G ☐ 726G ☐ 728G ☐ 730G ☐ 732G ☐ 734G ☐ 736G ☐ 738G ☐ 740G ☐ 742G ☐ 744G ☐ 746G ☐ 748G ☐ 750G ☐ 752G ☐ 754G ☐ 756G ☐ 758G ☐ 760G ☐ 762G ☐ 764G ☐ 766G ☐ 768G ☐ 770G ☐ 772G ☐ 774G ☐ 776G ☐ 778G ☐ 780G ☐ 782G ☐ 784G ☐ 786G ☐ 788G ☐ 790G ☐ 792G ☐ 794G ☐ 796G ☐ 798G ☐ 800G ☐ 802G ☐ 804G ☐ 806G ☐ 808G ☐ 810G ☐ 812G ☐ 814G ☐ 816G ☐ 818G ☐ 820G ☐ 822G ☐ 824G ☐ 826G ☐ 828G ☐ 830G ☐ 832G ☐ 834G ☐ 836G ☐ 838G ☐ 840G ☐ 842G ☐ 844G ☐ 846G ☐ 848G ☐ 850G ☐ 852G ☐ 854G ☐ 856G ☐ 858G ☐ 860G ☐ 862G ☐ 864G ☐ 866G ☐ 868G ☐ 870G ☐ 872G ☐ 874G ☐ 876G ☐ 878G ☐ 880G ☐ 882G 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1398G ☐ 1400G ☐ 1402G ☐ 1404G ☐ 1406G ☐ 1408G ☐ 1410G ☐ 1412G ☐ 1414G ☐ 1416G ☐ 1418G ☐ 1420G ☐ 1422G ☐ 1424G ☐ 1426G ☐ 1428G ☐ 1430G ☐ 1432G ☐ 1434G ☐ 1436G ☐ 1438G ☐ 1440G ☐ 1442G ☐ 1444G ☐ 1446G ☐ 1448G ☐ 1450G ☐ 1452G ☐ 1454G ☐ 1456G ☐ 1458G ☐ 1460G ☐ 1462G ☐ 1464G ☐ 1466G ☐ 1468G ☐ 1470G ☐ 1472G ☐ 1474G ☐ 1476G ☐ 1478G ☐ 1480G ☐ 1482G ☐ 1484G ☐ 1486G ☐ 1488G ☐ 1490G ☐ 1492G ☐ 1494G ☐ 1496G ☐ 1498G ☐ 1500G ☐ 1502G ☐ 1504G ☐ 1506G ☐ 1508G ☐ 1510G ☐ 1512G ☐ 1514G ☐ 1516G ☐ 1518G ☐ 1520G ☐ 1522G ☐ 1524G ☐ 1526G ☐ 1528G ☐ 1530G ☐ 1532G ☐ 1534G ☐ 1536G ☐ 1538G ☐ 1540G ☐ 1542G ☐ 1544G ☐ 1546G ☐ 1548G ☐ 1550G ☐ 1552G ☐ 1554G ☐ 1556G ☐ 1558G ☐ 1560G ☐ 1562G ☐ 1564G ☐ 1566G ☐ 1568G ☐ 1570G ☐ 1572G ☐ 1574G ☐ 1576G ☐ 1578G ☐ 1580G ☐ 1582G ☐ 1584G ☐ 1586G ☐ 1588G ☐ 1590G ☐ 1592G ☐ 1594G ☐ 1596G ☐ 1598G ☐ 1600G ☐ 1602G ☐ 1604G ☐ 1606G ☐ 1608G ☐ 1610G ☐ 1612G ☐ 1614G ☐ 1616G ☐ 1618G ☐ 1620G ☐ 1622G ☐ 1624G ☐ 1626G ☐ 1628G ☐ 1630G ☐ 1632G ☐ 1634G ☐ 1636G ☐ 1638G ☐ 1640G ☐ 1642G ☐ 1644G ☐ 1646G ☐ 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1898G ☐ 1900G ☐ 1902G ☐ 1904G ☐ 1906G ☐ 1908G ☐ 1910G ☐ 1912G ☐ 1914G ☐ 1916G ☐ 1918G ☐ 1920G ☐ 1922G ☐ 1924G ☐ 1926G ☐ 1928G ☐ 1930G ☐ 1932G ☐ 1934G ☐ 1936G ☐ 1938G ☐ 1940G ☐ 1942G ☐ 1944G ☐ 1946G ☐ 1948G ☐ 1950G ☐ 1952G ☐ 1954G ☐ 1956G ☐ 1958G ☐ 1960G ☐ 1962G ☐ 1964G ☐ 1966G ☐ 1968G ☐ 1970G ☐ 1972G ☐ 1974G ☐ 1976G ☐ 1978G ☐ 1980G ☐ 1982G ☐ 1984G ☐ 1986G ☐ 1988G ☐ 1990G ☐ 1992G ☐ 1994G ☐ 1996G ☐ 1998G ☐ 2000G ☐ 2002G ☐ 2004G ☐ 2006G ☐ 2008G ☐ 2010G ☐ 2012G ☐ 2014G ☐ 2016G ☐ 2018G ☐ 2020G ☐ 2022G ☐ 2024G ☐ 2026G ☐ 2028G ☐ 2030G ☐ 2032G ☐ 2034G ☐ 2036G ☐ 2038G ☐ 2040G ☐ 2042G ☐ 2044G ☐ 2046G ☐ 2048G ☐ 2050G ☐ 2052G ☐ 2054G ☐ 2056G ☐ 2058G ☐ 2060G ☐ 2062G ☐ 2064G ☐ 2066G ☐ 2068G ☐ 2070G ☐ 2072G ☐ 2074G ☐ 2076G ☐ 2078G ☐ 2080G ☐ 2082G ☐ 2084G ☐ 2086G ☐ 2088G ☐ 2090G ☐ 2092G ☐ 2094G ☐ 2096G ☐ 2098G ☐ 2100G ☐ 2102G ☐ 2104G ☐ 2106G ☐ 2108G ☐ 2110G

# Collection data

- Inserted PICs
- Collection - samples (PICs and swab)
- Transportation - for ESEnfC laboratories - Sowing and counts (24h and 48h)
- Storage - petri dishes in the refrigerator
- Weekly confirmation - meeting with Microbiologists

**Samples whose PICs plate submit more than 15 Colony Forming Units (CFU) and with positive swab, were studied (subject to various identification tests, PCR and sensitivity tests), the remaining were wasted.**

# Ethical Procedures

## Authorizations

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- Board of the Hospital
- Board of Control and Prevention of infections from the Hospital
- Head Nurses of the Units
- Nurses
- Patients and/or families

# RESULTS / DISCUSSION

Table 1 – Biographical characterization of the patients with PIC

Variabel		n	%
Sex			
	Male	158	38,6
	Female	250	61,4
	Total	408	100,0
	Missing	3	
Age			
	18-29 Years	13	3,2
	30-44 Years	75	18,3
	45-64 Years	135	33,0
	65-79 Years	121	29,6
	80 ou + Years	65	15,9
	Total	409	100,0
	Missing	2	
Min. 18		Máx. 98 Years	

Completed 1080 data collection grids →  
335 samples taken for analysis (PICs +  
skin)

Changes from aging impair the  
placement of PICs

(Micozzi et al., 2012)

# RESULTS / DISCUSSION

Table 2 – Number of PICs inserted

Variable		n	%
Number of PICs inserted per patient			
	1 PIC	197	47,9
	2 PICs	84	20,4
	3 PICs	36	8,8
	4 PICs	37	9,0
	5 > PICs	57	13,9
	Total	412	100,
			0

The patients have **more phlebitis** when they had a **more number of PICs**

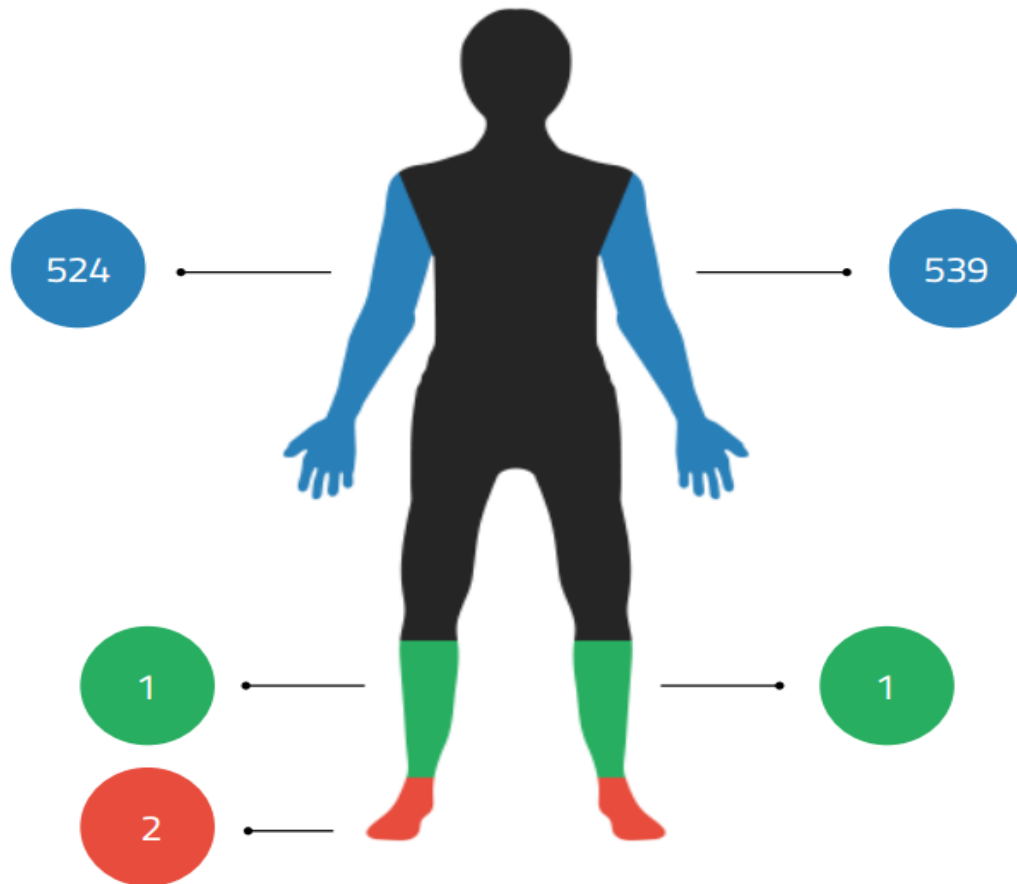
(Ferreira et al., 2007)

Average 2,63 catheters; standard deviation 2,89; Median 2,00 catheters

Mín. 1 catheter Máx. 32 catheters

# CHARACTERIZATION OF PUNCTURE (PICs placed) - RELATION WITH THE LOCATION

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If PICs are placed in the lower limbs  
should be replaced on the upper limbs

(O'Grady et al., 2011)

# Anatomical PUNCTURE IN THE ARMS

Flexure zones (with highly mobile) > traumatic phlebitis

(Uslusoy & Mete, 2008)

The insertion site should not interfere with the mobility

(Martins et al., 2008)

Arm

29

Forearm

334

146

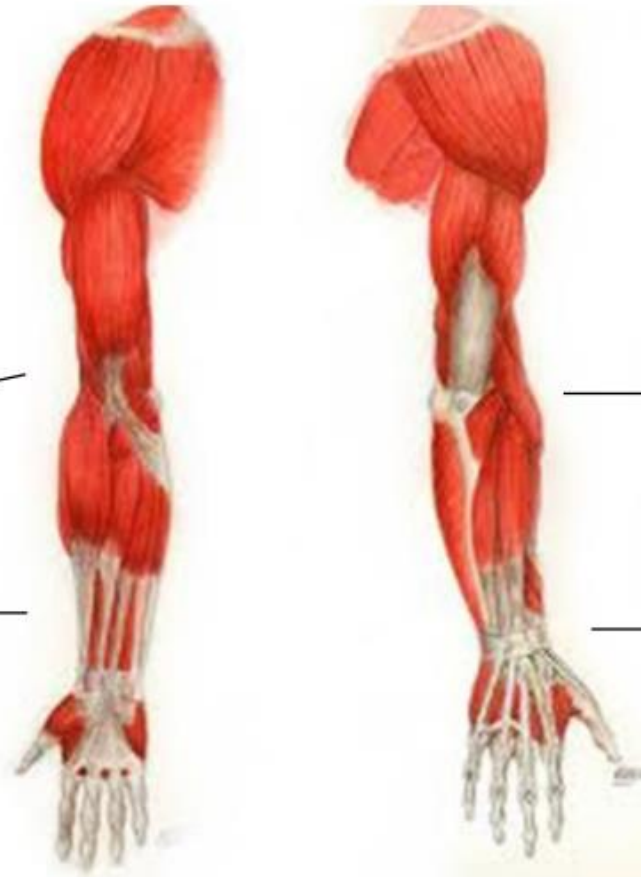
Antecubital fossa

196

Pulse

335

Hand





# CHARACTERIZATION OF THE PUNCHES

**Table 3** – Characterization of the Punches

Variable		n	%
Gauge catheter			
	16G	4	0,4
	18G	87	8,2
	<b>20G</b>	<b>733</b>	<b>69,5</b>
	22G	216	20,5
	24G	15	1,4
	Total	1055	100,0
	Missing	25	
PIC with Obturator			
	Sim	1014	95,4
	Não	49	4,6
	Total	1063	100,0
	Missing	17	

**Catheters with smaller size should be used to prevent complications**

(O'Grady et al., 2011)

The **larger caliber** is one of the **risk factors** for complications

(Vendramim, Silva & Martinez, 2009)

A wound caused by a cut-puncturing object (PIC) and foreign to the body is uncomfortable and painful to the patient. The risk rises if we connected a serum system, a protractor, a shutter, ...

(Santos, Graveto & Abreu, 2013)

PIC with 3-wat tap				
	yes	81	7,6	
	No	982	92,4	
	Total	1063	100,0	
	Missing	17		
With extended sistem				
	Sim	89	8,4	
	Não	974	91,6	
	Total	1063	100,0	
	Missing	17		
Use of infusion machine				
	Sim	90	8,5	
	Não	973	91,5	
	Total	1063	100,0	
	Missing	17		
Infusion rate				
<u>Avarage 62,95</u> ; standart deviation 31,38; Median 61,40; Mín. 2 Máx. 127,5				

**Table 3** – Characterization of the Punches(Cont.)

The phlebitis rate with use of protractors is 1.67% and 11.04% if this device is not used

(Oliveira and Parreira, 2010)

**The infusion machines – increase highly the rate of phlebitis**

(Oliveira and Parreira, 2010)

When infusion **rate > 90ml /hr** the **risk of phlebitis increases**

(Martinho and Rodrigues, 2008)

# The Phlebitis degrees and remaining time of the PICs

**Table 4** – Frequency of the phlebitis degree

Variable		n		%
The Phlebitis degrees				
	Degree 0	713		79,3
	Degree 1	58		6,4
	Degree 2	94		10,5
	Degree 3	32		3,6
	Degree 4	2		0,2
	Degree 5	0		0
	<b>Total</b>	<b>899</b>		<b>100,0</b>
	Missing	181		

## The Phlebitis Scale - Jackson (1998)

in this research :

phlebitis occurrence rate = 20.7%

Research from Nakimi and Fujita (2008):  
The **phlebitis rate** = 7.2%

**Prolonged catheterization** - major risk factor for the occurrence of infections in PICs (Amadei and Damasceno, 2008; Martins et al, 2008)

**Table 5** – Remaining time of the PICs

Variable
The remaining time of the PICs
Avarage 64h23m; Standart deviation 65h55m; Median46h22m;
Mín. 1h30m <u>Máx. 773h</u>

**It is not necessary to replace the PIC at shorter intervals to 72-96h** to reduce the risk of infection and phlebitis in adults patients (O'Grady et all, 2011)

# Reasons for placing and removing the PICs

**Table 6** – Reasons for placing and removing the PICs

Variável		n	%
Reasons for placing PICs			
	Therapy (drugs)	1014	99,4
	Other reasons	7	0,6
	Total	1021	100,0
	Missing	59	
Reasons for removing the PICs			
	Suspended intravenous medication	45	4,9
	Not permeable	235	25,6
	Signs of phlebitis	184	20,1
	Hightclinical	203	22,1
	Infiltration infusion	22	2,4
	Decease	9	1,0
	Removed in the Operating Room	14	1,5
	<b>Accidental removal</b>	<b>192</b>	<b>21,0</b>
	Extravasation	13	1,4
	Total	917	100,0
	Missing	163	

The PICs should be removed when occur  
**1 - signs of phlebitis (warmth, tenderness, erythema or palpable venous cord)**  
**2 - infection**  
**3 - catheter nonfunctioning / windproof**  
**4 - Each 72-96 h**

(O'Grady et al., 2011)

# PIC manipulation

Table 7 – Antimicrobial administration in the PICs

Variable		n	%
Antimicrobial administration			
	yes	584	69,1
	No	261	30,9
	Total	845	100,0
	Missing	235	
Number of antimicrobial “infusion” for each catheter			
	Zero	261	30,9
	One	459	54,3
	Two	116	13,7
	Three or more	9	1,1
	Total	845	100,0

Table 8 – Infusion of blood components or blood products

Variable		n	%
Parental Nutrition			
	Yes	43	4,0
	No	1035	96,0
	Total	1078	100,0
	Missing	2	
Infusion of blood components or blood products			
	Yes	16	1,5
	No	1062	98,5
	Total	1078	100,0
	Missing	2	

**Drugs (infusions)** with low or high **Ph (ace/base)**, differences in the **osmolarity increase the risk** of **phlebitis** (eg. potassium chloride, hypertonic glucose, intravenous nutrition, ...) (O’Grady et al., 2011)

**Increased vascular sensitivity or pain** at the site of insertion (PH differences) (Arreguy-Sena and Carvalho, 2009)

# Nursing Care

**Table 9 – Nursing Care**

Variable		n	%
<b>Handwashing</b>			
	Yes	1024	96,3
	No	39	3,7
	Total	1063	100,0
	Missing	17	
<b>Gloves</b>			
	Yes	267	25,1
	<b>No</b>	<b>797</b>	<b>74,9</b>
	Total	1064	100,0
	Missing	16	
<b>Antiseptic solution</b>			
	Alcool	954	99,4
	Clorohexidine	6	0,6
	Other	0	-
	Total	960	100,0

In the venipuncture technique: Hand washing with water and antiseptic soap or use alcohol gel (...), use of gloves and skin disinfecting the area to be punctured (...)  
(Martinho and Rodrigues et al ., 2008)

The **use of protective gloves** - shown in the pic insertion and handling of the PICs  
(Martins et al., 2008)

The preparation of the PIC insertion site with 70% alcohol, tincture of iodine or alcoholic solution containing 2% chlorhexidine  
(O'Grady et al., 2011) (CDC, 2012)

# MICROBIOLOGICAL RESULTS

**Table 10** – Microbiological Results (PICs and swabs of skin near the punch)

	0 CFUs	CFUs<15	≥15 CFUs
<u>Swabs</u>			
Negative	80	54	12
Positive	45	65	<b>79</b>
Total partial	<b>125</b>	119	<b>91</b>
		Total	<b>335</b>

CFU: Colony Forming Unit

**79 samples simultaneously with positive results in the PICs and in the skin Swabs**

From the total sample (335 samples) **only 125 were negative** in the PICs and in the skin swabs

# BACTERIAL IDENTIFICATION

**Table 18** – bacterial Identification (strains)

Strains	n	%
Staphylococcus epidermidis	34	34,0
Staphylococcus haemolyticus	14	14,0
Staphylococcus hominis	9	9,0
Staphylococcus aureus	<b>14</b>	<b>14,0</b>
Staphylococcus capitis	3	3,0
Acinetobacter calcoaceticus	2	2,0
Pseudomonas aeruginosa	1	1,0
Enterococcus faecalis	3	3,0
Pseudomonas putida	1	1,0
Proteus vulgaris	1	1,0
Escherichia coli	1	1,0
Staphylococcus chromogenes	2	2,0
Staphylococcus saprophyticus	1	1,0
Staphylococcus capitis ss urealyticus	1	1,0
Staphylococcus equorum	1	1,0
Sem interesse clínico	9	9,0
Não identificadas	3	3,0
<b>Total</b>	<b>100</b>	<b>100,0</b>

**Staphylococcus** - commensal skin and mucous

**Staphylococcus aureus** - 5 were MRSA (Methicillin-resistant Staphylococcus aureus **(principal responsible for nosocomial infections)**)

**Pseudomonas** - water, soil, sewage, plants and clinical specimens. Opportunist.

**Enterococcus** - gastrointestinal tract

**Staphylococcus saprophyticus** - urinary infections



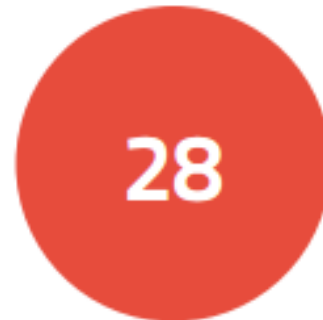
# Biofilms

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The greater the **ability to form biofilm** ( $\bar{X} \geq 0.15$ ), the greater chance of microorganisms colonize catheters and form Biofilm the action of disinfectants go smaller.



Less  
easily



Easily

# RELATIONSHIP BETWEEN VARIABLES

**Tabela 19 - Comparison between the colonization of PICs at risk of infection and the PIC length of stay**

	Colonization with risk of infection	N	X	S	t	p
length of stay of the PIC	Yes	88	93,87	81,64	-3,763	0,000
	No	231	59,34	44,21		

## Colonization at risk of infection

it has been found that the residence time of the PICs (length of stay) affects colonization and the risk of infection

**All the PICs over 94H of residence presented microorganisms with number of colonies indicative of infection risk.**

All the PICs with residence **time less than or 59h** were not colonized or were colonized **without risk of infection**

Namiki and Fujita (2008) - research on PICs replacement – developed in patients of surgical area. The results suggest that the residence time can be increased safely up to 120h

**37.5% of phlebitis occur in the first 3 days of permanence of the PIC. After 4 days the phlebitis rate is 62.5% (Ferreira et al., 2007)**

# Conclusions

## Needs

- Decrease the clinical variability;
- Increase rigor in adopting simple procedures;
- Recognition of peripheral intravenous catheterization as a complex procedure;
- Recognition PIC as an extrinsic risk factor of nosocomial infections;
- Recognition, knowledge and unequivocal adoption of evidence-based practices;
- Health teams: Creation of regular and formal moments for presentation / discussion of the recommendations and results investigations;
- Strengthen the interest in nurses in the prevention and Control Infections;

# Conclusions (cont.)

## Fragilities

- Lack of knowledge of the source of users;
- Lack of knowledge of how many PICs each user submitted throughout the hospital.

## Suggestions

- Replication of the research;
- Collection of sociodemographic information of users;
- Other researchs related to this subject.

## In the future

- Getting risk profiles;

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# Nursing Care in Peripheral Intravenous Catheter: Impact on Microbiological Profile

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JOÃO MANUEL GRAVETO, PHD, MSN, RN  
DANIELA VIDAL SANTOS, MSN, RN  
ANABELA DE SOUSA SALGUEIRO OLIVEIRA, PHD, MSN, RN  
NÁDIA OSÓRIO, PHD