抗菌縫線與手術病患安全

衛福部 疾病管制署
中區傳染病防治醫療網
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Outline

- **The global definition of SSI & TW current status**
- Risk factors of SSI
- HE Clinical evidence of SSI prevention

US CDC Report

- In the US, at least 780,000 SSIs occur each year[1]
- SSIs account for about 37% of all hospital-acquired infections for surgical patients[1]
- SSIs occur in up to 5% of surgical patients[2]
- SSIs are the 2nd most common nosocomial HAI (hospital-associated infection).[3]

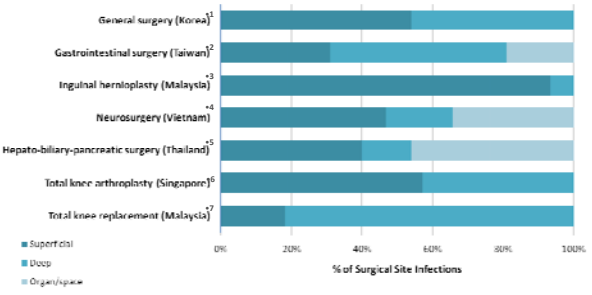
1. *WHO Guidelines for Safe Surgery 2009.*
2. Cheadle WG. Risk factors for surgical site infection. *Surg Infect.* 2006;7: s7-s11.
3. Mangram A, et al, CDC guideline for prevention of surgical site infection. Infection Control & Hospital Epideminology, 1999;20(4):247-280

Taiwan CDC report

- In Taiwan, SSIs account for approximately 4 - 15% of all HAIs.[1-3]
- Overall incidence of SSI between 1 – 15%.[2,4-6]
- Rate of SSI vary substantially according to:
  - Surgical procedure
  - Surveillance period (pre- and/or post-discharge)
  - Wound classification
  - Risk

•1. National Nosocomial Infections Surveillance System Report, 2008. CDC (Taiwan)
• 2. Sheng WH et al. J Hosp Infect 2005;59(3):205-214.
•3. Sheng WH et al. J Formos Med Assoc 2007;106(2):110-118.
•4. Chen YY et al. Infect Control Hosp Epidemiol 2009;30(1):39-46.
•5. Maa SH et al. Infect Control Hosp Epidemiol 2008;29(8):767-770.
•6. Su BH et al. Am J Infect Control 2007;35(3):190-195.

AP region SSI by procedure



•1. Park C et al. Transplantation 2009;87(7):1031-1036.
•3. Praveen S et al. Asian J Surg 2009;32(1):59-63.
•5. Kchachindawat P et al. J Med Assoc Thai 2007;90(7):1356-1362
•7. Syahrizal AB et al. Med J Malay 2001;56 Suppl D:5-8.
2. Shan YS et al. Br J Surg 2003;90(10):1215-1219.
4. Thu LTA et al. Infect Control Hosp Epidemiol 2006;27(8):855-862.
6. Yang K et al. J Arthroplasty 2001;16(1):102-106.

Incidence of SSI in CVS & GS

- **Cardiothoracic and vascular surgery: 2.9 – 7.1%**
- **Gastrointestinal tract surgery: 1.4 – 48.3%**

Source	Surgical procedure	Surveillance period	Incidence (%)
Cardiothoracic and vascular			
Wu 2006[1]	CABG	Pre-discharge	3.3% (106/3227)
		30 days post-discharge	5.6% (179/3227)
Pan 2000[2]	Open heart surgery	At least 4 weeks post-operation	2.9% (43/1491)
Ku 2005[3]	Cardiac surgery (sternal SSI)	30 days post-operation	5.1% (74/471)
	CABG (leg SSI)	Not reported	7.1% (23/323)
Gastrointestinal tract			
Chuang 2004[4]	Open Cholecystectomy	30 days post-operation	14.4% (18/125)
	Laparoscopic cholecystectomy		1.4% (6/420)
Liu 2007[5]	Appendectomy for perforated appendicitis	Not reported	27.3% (33/121)
Shan 2003[6]	Gastric surgery	Pre-discharge	48.3% (70/145)

•1. Wu SC et al. Infect Control Hosp Epidemiol 2006;27(3):308-311.
•3. Ku CH et al. Am J Epidemiol 2005;161(7):661-671.
•5. Liu SA et al. Laryngoscope 2007;117(1):166-171.
2. Pan SC et al. Formosan J Surg 2000;33(6):281-286.
4. Chuang SC et al. J Formos Med Assoc 2004;103(8):607-612.
6. Shan YS et al. Br J Surg 2003;90(10):1215-1219.

Incidence of SSI in Orthopaedic surgery

- **Orthopaedic surgery: 1.8 – 4.9%**
- **Other surgical procedures: 4.7 – 24.5%**

Source	Surgical procedure	Surveillance period	Incidence (%)
Orthopaedic surgery			
Chang 2010[1]	Total hip or knee replacement	Pre-discharge or re-admitted within 30 days post-operation	1.8% (56/3081)
Liu PC 2008[2]	Open reduction and internal fixation	At least 6 months post-operation	4.9% (7/142)
Kuo 2004[3]	Spinal surgery	At least 4 weeks post-operation	2.2% (72/3230)
Other surgical procedures			
Liu SA 2006[4]	Head and neck surgery	Pre-discharge	19.8% (197/997)
Liu SA 2008[5]	Head and neck surgery	30 days post-operation	24.5% (13/53)
Wu 1996[6]	Lung surgery	3 months post-operation	4.7% (5/107)

•1. Chang CC et al. Anesthesiol 2010:113:279-284.
•3. Kuo CH et al. J Chin Med Assoc 2004:67:398-402.
•5. Liu SA et al. J Laryngol Otol 2008:122:403-408.
2. Liu PC et al. Kaohsiung J Med Sci 2008:24:45-49.
4. Liu SA et al. Laryngoscope 2006:117:166-171.
6. Wu MH et al. Respirol 1996:1:283-289.

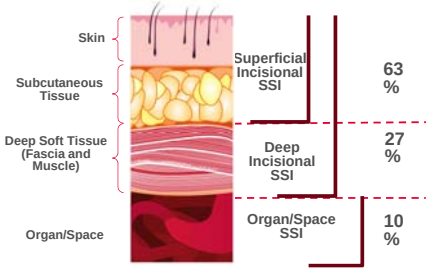
Definition Surgical Site Infection

- The US Centre for Disease Control (CDC) defines surgical site infection (SSI) as:
  - An infection that occurs at an incision site, or any part of the anatomy that was opened or manipulated during the procedure.
  - An infection that occurs within 30 days after surgery, or within 1 year in the presence of an implant.

Classification of Surgical Site Infections

SSI can be classified into two main types

- **Superficial**
- **Deep**
- **Organ/space**

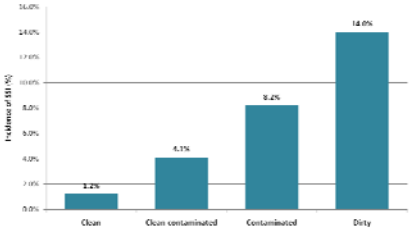


The majority of SSIs occur in the superficial Layers – 63%

•Source: Centre for Disease Control (www.cdc.gov)

Incidence of SSI by wound classification

- None of the studies identified in Taiwan reported wound classification.
- However, one study in Japan showed that the incidence of SSI increased as wound conditions worsened.



•Source: Togo S et al. Yokohama Igaku 2008;59:55-59.

Mortality risk to patients with SSIs

- A patient with an SSI is:
  - 5x more likely to be readmitted after discharge[1]
  - 2x more likely to spend time in intensive care[1]
  - 2x more likely to die after surgery[1]
- The mortality risk is higher when SSI is due to MRSA
  - A patient with MRSA is 12x more likely to die after surgery[2]

•1. WHO Guidelines for Safe Surgery 2009.
2. Engemann JJ et al. Clin Infect Dis. 2003;36:592-598.

•6

SSIs Financial burden on the healthcare system in US

- The average cost of treating one SSI is between $11,000 and $35,000[1]
- The average cost of treating one MRSA-related SSI is more than $60,000[2]
- In total, SSIs have been estimated to cost the US healthcare system up to $10 billion/yr[1]

1. Scott RD. *Centers for Disease Control and Prevention*. March 2009.
2. Anderson DJ et al. PLoS One. 2009 Dec 15;4(12):e8305.

•7

SSIs Financial burden on the healthcare system in Taiwan

TKR	SSI Type	Incidence Rate	Avg Medical cost Per Patient	Avg. Length of Hospital stay	readmitted Rate	Mortality Rate
73,475pt	No SSI		NT$135,802	9 days		
	Superfical SSI	2.33% (2.14%~2.65%)	NT$137,413 (+ NT$1,611)	Not reported	3.29% (2.95%~3.68%)	Not reported
	Deep SSI	1.32% (0.84%~1.64%)	NT$173,249 (+ NT$37,447)	27 days		0.01%
THR	**SSI Type**	**Incidence Rate**	**Avg Medical cost Per Patient**	**Avg. Length of Hospital stay**	**readmitted Rate**	**Mortality Rate**
75,547 pt	No SSI		NT$108,886	11 days		
	Superfical SSI	2.92% (2.88%~2.95%)	NT$128,029 (+ NT$ 19,143)	Not reported	8.22% (7.62%~8.56%)	Not reported
	Deep SSI	2.18% (1.48%~2.74%)	NT$186,069 (+ NT$77,182)	29 days		0.04%

** medical cost is excluded patient self-pay items

- 2010 CDC DATA
- Web date :http://www.nhi.gov.tw/ [illegible]

Economic burden of SSI in Taiwan

- **Extended hospital stay associated with SSI**
  - **Hospital stay: Additional 14 days**
  - **ICU stay: 1 – 10 additional days**

Source	Surgery type	Type of stay	Mean length of stay (days)		
			No SSI	SSI	Difference
Ku 2005[1]	Cardiac surgery - sternotomy	ICU	53.9 hours ± 38.1	78.3 hours ± 48.4	~24 hours *
	Cardiac surgery- saphenous vein graft	ICU	53.9 hours ± 38.1	79.1 hours ± 76.4	~25 hours *
Sheng 2005[2]	All inpatients (medical centre)	ICU & Ward	Not reported		14.4 days ± 25.8
	All inpatients (community hospital)	ICU & Ward	Not reported		14.4 days ± 9.6
Wang 2000[3]	CABG (deep sternal wound infections)	ICU	4.9 days ± 5.85	14.9 days ±14.09	~10 days *

•* p<0.001

•1. Ku CH et al. Am J Epidemiol 2005;161(7):661-671. 2. Sheng WH et al. J Hosp Infect 2005;59(3):205-214.
•3. Wang FD et al. J Cardio Surg 2000:41:709-713.

Outline

- The global definition of SSI & TW current status
- **Risk factors of SSI**
- HE Clinical evidence of Antibacterial suture

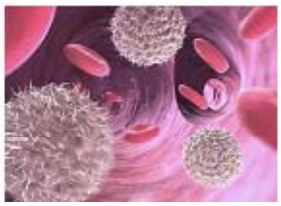
Factors in Bacterial Colonization Leading to SSIs

Patient-related

Procedure/Techniques

Wound classification

Implants



•Hebert CK et al. *Clin Orthop*. 1996;331:140-145.
•Fletcher N et al. *J Bone Joint Surg Am*. 2007;89:1605-1618.
•Mangram AJ et al. *Am J Infect Control*. 1999;27:97-134.
•Fry DE. *Medscape Surgery*. 2003.

Who is at Risk of a SSI? Patient Characteristics

- **Age**
- **Diabetes**
  - **HbA1C and SSI**
  - **Glucose > 200 mg/dL postoperative period (<48 hrs)**
- **Nicotine use**
  - **delays primary wound healing**
- **Steroid use:**
  - **Controversial**
- **Malnutrition:**
  - **no epidemiological association**
- **Obesity:**
  - **20% over ideal body weight**
- **Prolonged preoperative stay:**
  - surrogate of the severity of illness and comorbid conditions
- **Preoperative nares colonization with *Staphylococcus aureus*:**
  - **significant association**
- **Perioperative transfusion:**
  - **controversial**
- **Coexistent infections at a remote body site**
- **Altered immune response**

1. Mangram et al. Infect Control Hosp Epidemiol. 1999;20:247-277.

Who is at Risk of a SSI? Operative Factors

- **Duration of surgical scrub**
- **Maintain body temp**
- **Skin antisepsis**
- **Preoperative shaving**
- **Duration of operation**
- **Antimicrobial prophylaxis**
- **Operating room ventilation**
- **Inadequate sterilization of instruments**
- **Foreign material at surgical site**
- **Surgical drains**
- **Surgical technique**
  - **Poor hemostasis**
  - **Failure to obliterate dead space**
  - **Tissue trauma**

1. *Mangram et al. Infect Control Hosp Epidemiol. 1999;20:247-277.*

Who is at Risk of a SSI?
Wound classification

Wounds are generally classified into four categories:[1]

- **Class 1 = Clean**
- **Class 2 = Clean contaminated**
- **Class 3 = Contaminated**
- **Class 4 = Dirty infected**

NNIS project found that there are three independent variables associated with SSI risk[2]

- **Contaminated or dirty/infected wound classification**
- **ASA > 2**
- **Length of operation > 75th percentile of the specific operation being performed**

1. Mangram et al. Infect Control Hosp Epidemiol. 1999;20:247-277.
2. NNIS. CDC. Am J Infect Control. 2001;29:404-421.

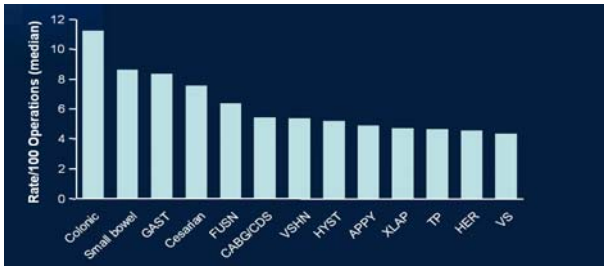
Patient-associated risk factors identified in Taiwan

Source	Risk variable	Surgical procedure specified	Risk estimate (95% CI)	P value
Diabetes/blood glucose level				
Chuang 2004[1]	Poorly controlled diabetes	Cholecystectomy	OR 4.7 (1.6, 13.5)	0.003
Wu 2006[2]	Diabetic	CABG	OR 2.02 (1.19, 3.42)	0.0099
Liu S-A 2006[3]	Diabetes mellitus	Head and neck surgery	OR2.51 (1.41, 4.48)	0.002
Age				
Ku 2005[4]	Age (years)	Saphenous vein harvest (leg)	OR 1.09 (1.01, 1.17)	0.029
Ku 2005[4]	Age (years)	Sternotomy	OR 1.14 (1.05, 1.23)	0.002
Shan 2003[5]	Age ≥60 years	Gastrointestinal	OR 3.15 (1.41, 6.92)	0.005

•1. Chuang SC et al. J Formos Med Assoc 2004;103(8):607-612.
•3. Liu SA et al. Laryngoscope 2007: 117:166-171.
•5. Shan YS et al. Br J Surg 2003;90(10):1215-1219
2. Wu SC et al. Infect Control Hosp Epidemiol 2006;27(3):308-311
4. Ku CH et al. Am J Epidemiol 2005;161(7):661-671.

SSI Risk according to Operative procedure:

NNIS, 1992 to 2004



NNIS = National Nosocomial Infection Surveillance; GAST=gastric; FUSN=spinal fusion; CABG=chest and donor site; VSHN=ventricular shunt; HYST=abdominal hysterectomy; APPY=appendectomy; XLAP=laparctomy; TP=organ transplant; HER=hemiorrhaphy; VS=vascular

1. NNIS System. National Nosocomial Infections Surveillance System Report, data summary from January 1992 through June 2004, issued October 2004. *Am J Infect Control.* 2004;32:470-485.

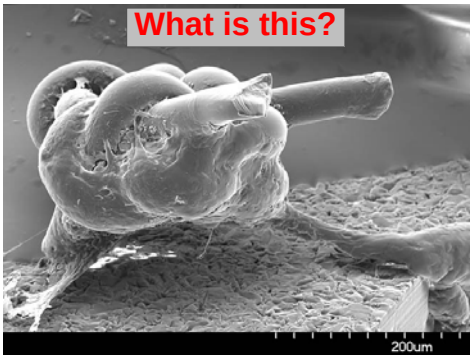
Who should receive prophylaxis?

- **Surgical procedures with a high rate of wound infection**
  - **Clean-contaminated, contaminated**
  - **Remember dirty cases receive therapeutic not empiric antibiotics**
- **Implantation of prosthetic materials**

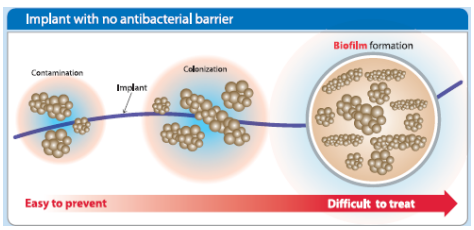
Surgical procedures where infection would have severe consequences

1. **Platt et al. *NEJM* 1990; 322:153-160.**

Uncontrollable Risk Factor?



Implants and SSI



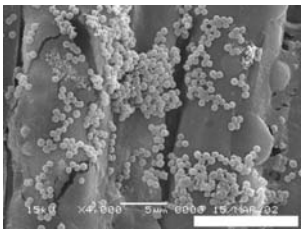
The result of an implant becoming contaminated

1. **Implants provide nidus for attachment of the organisms[2]**
2. **The infection is harder to treat because of biofilm formation[3]**
3. **takes only 10^2 staphylococci per gram of tissue for an SSI to develop[1]**

1.Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection. Infect Control Hosp Epidemiol, 1999, 27:97-134
2.Ward KH et al. Mechanism of persistent infection associated with peritoneal implants. J. Med. Microbiol., vol. 36 (1992), p. 406-413
3.Nucci C et al. A microbiological and confocal microscopy study documenting a slime-producing Staphylococcus epidermidis isolated from a nylon corneal suture of a patient with antibiotic-resistant endophthalmitis. Graefe's Arch Clin Exp Ophthalmol, 2005, 243:951-954

Suture is the most common medical implant in most operations

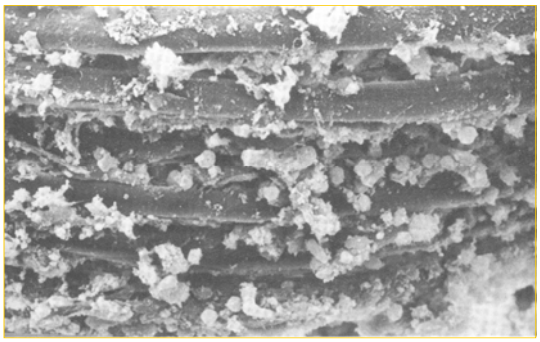
Staphylococcus Epidermidis Incisional Wound Infection



- Knot as a central repository, **bigger knots**![1]
- **More than 66% of SSIs occur at the incision site**[2]
- **Even in operations classified as "clean," there is still a risk of SSI**[3]

1.Surgical Microbiology Research Laboratory, Milwaukee – 2005
2.Mangram AJ et al. *Am J Infect Control Hosp Epidemiol*, 1999; 27:97-134
3.Barber GR, et. al. *Arch Surg*. 1995; 130(10):1042-1047

Infected Silk Suture at 70 Days



Outline

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- Risk factors of SSI
- **HE Clinical evidence of Antibacterial suture**

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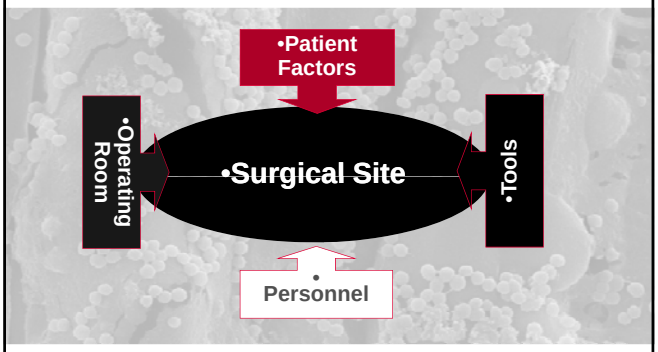
Objective: Control Microbiologic Risk



Innovative technologies to address risk factors for SSIs

FDA-approved or cleared antibacterial devices

Antiseptic cloth	–	2% chlorhexidine gluconate (CHG) impregnated
Urologic devices	–	Foley catheters—hydrogel/silver
	–	Ureteral stents—triclosan eluting
	–	Implantable prostheses—antibiotic
Central venous catheters	–	CHG-impregnated disk (dressing)
	–	Silver alone
	–	Silver sulfadiazine (SS)
	–	SS/CHG
	–	Minocycline/rifampin
Peritoneal catheters	–	Silver-coated
Vascular catheters	–	Silver/antibiotic-coated
Orthopedic devices	–	External fixation pins—silver
	–	Antibiotic-impregnated polymethylmethacrylate (PMM)
Critical care	–	Endotracheal tube
Surgical sutures	–	Braided and monofilament with triclosan
Topical Skin Adhesives	–	Wound Closure device / with proven microbial barrier claim

* http://www.fda.gov/

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Innovative Technology: Plus Antibacterial Sutures

Plus Antibacterial Sutures can address a risk factor often associated with SSIs

- Only antibacterial sutures cleared by the FDA
- >8 years of clinical use
- >135 million strands of Plus Sutures have been implanted worldwide
- >300 publications (both preclinical and clinical data)

MONOCRYL® Plus Antibacterial (Poliglecaprone 25) Suture

Coated VICRYL® Plus Antibacterial (Polyglactin 910) Suture

PDS® Plus Antibacterial (Polydioxanone) Suture

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Plus Antibacterial Sutures: Protection against bacterial colonization

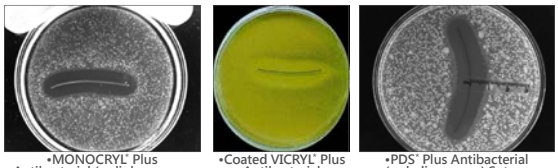
Plus SUTURES are designed to reduce a risk factor for SSIs by preventing bacterial colonization of the suture[1,2]

- Plus Sutures contain IRGACARE® MP (the purest form of triclosan)
- IRGACARE® MP actively inhibits colonization of the suture by pathogens commonly associated with SSIs, including:[1,3,4]
  - *Staphylococcus aureus*
  - *Staphylococcus epidermidis*
  - MRSA
  - MRSE
  - *Escherichia coli*
  - *Klebsiella pneumoniae*

1. Rothenburger et al. Surg Infect. 2002;3:79-87.
2. Mangram AJ et al. Infect Control Hosp Epidemiol.1999;27:97-134.
3. Ming X, Nichols M, Rothenburger S. Surg Infect. 2007;8:209-213.
4. Ming X, Rothenburger S, Nichols MM. Surg Infect.2008;9:451-457.

Plus Antibacterial Sutures: Protection against bacterial colonization

Plus SUTURES have been proven *in vitro* to create a zone of inhibition against the most common surgical site pathogens:[1-3]



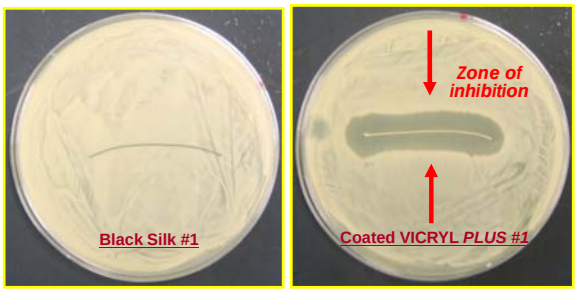
•MONOCRYL® Plus Antibacterial (poliglecaprone 25) Suture

•Coated VICRYL® Plus Antibacterial (polyglactin 910) Suture

•PDS® Plus Antibacterial (polydioxanone) Suture

1. Storch ML, Rothenburger SJ, Jacinto G. Experimental efficacy study of coated VICRYL plus antibacterial suture in guinea pigs challenged with Staphylococcus aureus. *Surg Infect.* 2004;5:281-288
2. Ming X, et. al. In vivo antibacterial efficacy of MONOCRYL plus antibacterial suture (poliglecaprone 25 with triclosan). *Surg Infect.* 2007;8:209-213
3. Ming X, et. al. In vivo and in vitro antibacterial efficacy of PDS® plus (polidioxanone 25 with triclosan) suture. *Surg infect.* 2008;9:451-457

Efficacy test of Coated VICRYL PLUS in MRSA



Tested and Photo Taken by Korea University Graduate School of Life Sciences Lab September 2007

Characteristics of Silk

1) Braided

- Bacteria is likely to adhere.

2) Extremely Hydrophilic

- To provide an easy-to-live environment for bacteria, where bacteria rapidly multiply. (Bacteria need water to grow)
- However Synthetic Absorbable have low hydrophilic, bacteria are unlikely to grow.

3) Natural Animal Protein

For bacteria...

Silk sutures, natural animal protein, are the source of nutrition for bacteria and thus bacteria multiply.

For Self-cells...

Since silk sutures are natural animal protein, the living body recognizes them as apparent enemies and starts attacking them.

(Since a virus is also a foreign protein, autoimmune cells attacks the virus)

4) Permanent Foreign Body in the Body

- Silk sutures remaining in the body are permanently recognized as foreign bodies at cellular level. (Foreign body reactions)
- However Synthetic Absorbable sutures do not remain in the body as foreign body.

HE Clinical Evidence

Impact of using triclosan-antibacterial sutures on incidence of surgical site infection

Ibrahim Galal, M.D.[a,*], Khaled El-Hindawy, M.D.[b]

- Publication: The American Journal of Surgery (2011) 202,133-138
- Method : prospective, randomized, double-blinded ,controlled multiple center study

Background

Study design:

- **Study Group : 230 patients triclosan-coated polyglactin 910 antimicrobial sutures (Vicryl Plus) were used in all surgical steps except in some cases polypropylene was used for laparotomy closure and vascular suture**

- **Controlled Group : 220 patients conventional polyglactin 910 sutures (Vicryl) were used in all surgical steps except in some cases polypropylene was used for laparotomy closure and vascular suture, and Poliglecaprone 25 was used in skin closure.**

Basic parameters

	Study group	Control group	All cases	P
Number of patients	230	220	450	
Age group				
21–30 y	42	40	82	.5670
31–40 y	75	85	160	
41–50 y	90	75	165	
51–60 y	23	20	43	
Sex				
Male	148	127	275	.1499
Female	82	93	175	
Hypertension				
Hypertensive	50	50	100	.8010
Normotensive	180	170	350	
Diabetes				
Diabetic	32	42	74	.1386
Nondiabetic	198	178	376	
Smoking				
Smoker	105	107	212	.5261
Nonsmoker	125	113	238	
Traditional wound classification				
Clean	117	119	236	.9039
Clean-contaminated	71	72	143	
Contaminated	35	36	71	
Number of risk factors of surgical site infection*				
0	149	133	282	.8676
1	55	73	128	
2	26	14	40	

*National Nosocomial Infections Surveillance risk factor.

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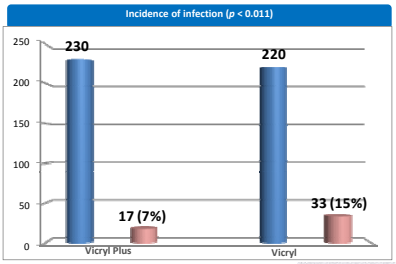
Incidence of Surgical site infection



Number of risk factors of surgical site infection*	All	Study group	Control group
0	5%	3%	7%
1	17%	15%	19%
2	35%	19%	64%
Overall	11%	7%	15%

*National Nosocomial Infections Surveillance risk factor.

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Results

Table 7 Total cost per patient with or without surgical site infection

	Surgical site infection	No surgical site infection
Number of patients	50	400
Mean length of hospital stay	7.10	3.39
Daily cost	LE 180 ($33) in first 3.39 days and LE 500 ($91) in the extended period	LE 180 ($33)
Total cost per patient	LE 2,465 ($448)	LE 610 ($112)

- Surgical site infections occurred in 17 of 230 patients (7%) in the study group versus 33 of 220 (15%) in the control group
- The mean extended stay in this study was 3.71 days.
- Per patient total cost is USD 448 in SSI group vs USD 112 in non-SSI group
- The impact on health care resources by the extra occupation of hospital beds could reach 16,695 bed-days annually.
- If these bed-days could be saved, this could increase the capacity by 4,925 surgical cases per year

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Plus Suture Clinical Data: Sternotomy

Triclosan-Coated Sutures for the Reduction of Sternal Wound Infections: Economic Considerations

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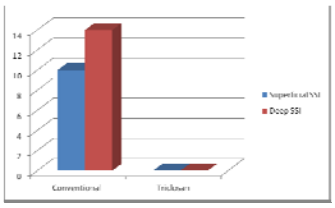
➢ **METHODS: From May to December 2005, a total of 479 patients underwent a cardiac surgical procedure. From those, 103 patients were closed with triclosan-coated suture material (cost per patient $30 [in United States dollars]), whereas the remaining 376 patients had their incision closed with noncoated sutures (cost per patient $21).**

Ann Thorac Surg. 2007 Jul;84(1):232-6.

Results

➢ **RESULTS: During the study period, 24 patients had superficial (n = 10) or deep (n = 14) sternal wound infections (cost per patient $11,200). All those patients were closed with conventional suture material. In the triclosan group, no wound infection or dehiscence was observed during hospital stay and follow-up visits.**



- **SSI Medical Extra Cost USD 11,200 / PATIENT**
- **Antibacterial Suture Extra cost Only USD $ 9/PATIENT**

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Conclusions

➢: **Triclosan-coated sutures might be valuable in the reduction of sternal wound infections and avoid the suture being a risk factor for surgical site infections.**

The increased cost of the coated suture material has to be weighed against the enormous cost of sternal wound infections caused directly by the cost of care as well as indirectly through the loss of economic productivity.

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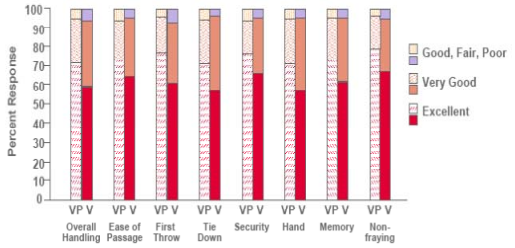
Plus Antibacterial Sutures: Intraoperative Handling Characteristics

Clinicians noted no significant difference in handling Plus SUTURES compared with the equivalent non-Plus suture



1. Ford et al. *Surg Infect* (Larchmt). 2005;6:313-321.

The 3 indisputable facts of PLUS Sutures

1. *Implants are a potential source of infection*[1]
2. *Bacteria may colonize at the suture line*[1]
3. *Plus sutures create the "Zone of Inhibition" to prevent bacterial colonization*[2-4]

•1. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection., Infect Control Hosp Epidemiol, 1999, 27:97-134

•2. Rothenburger S, Spangler D, Bhende S, Burkely D. In vitro antibacterial evaluation of coated VICRYL* Plus antibacterial suture, (coated polyglactin 910 with triclosan) using zone of inhibition assays. Surg Infect (Larchmt), 2002, 3:79-87

•3. Ming X, Nichols M, Rothenburger S. In vivo antibacterial efficacy of MONOCRYL* Plus Antibacterial Suture, (poliglecaprone 25 with triclosan). Surg Infect (Larchmt), 2007, 8:209-213

•4. Ming X, Rothenburger S, Nichols MM. In vivo and in vitro antibacterial efficacy of PDS* Plus (polidioxanone 25 with triclosan) Suture., Surg Infect (Larchmt), 2008, 9:451-457

Plus Antibacterial Sutures

Proven *in vitro* to create a zone of inhibition around the suture against the most common surgical site pathogens

	Spectrum of efficacy	VICRYL* Plus[1]	MONOCRYL* Plus[2]	PDS* Plus[3]
Gram positive bacteria	Staphylococcus aureus	+	+	+
	Staphylococcus epidermidis	+	+	+
	MRSA-methicillin resistant Staphylococcus aureus	+	+	+
	MRSE-methicillin resistant Staphylococcus epidermidis	+	+	+
Gram negative bacteria	Escherichia coli		+	+
	Klebsiella pneumoniae		+	+

Rothenburger S, Spangler D, Bhende S, Burkely D. In vitro antibacterial evaluation of coated VICRYL* Plus antibacterial suture, (coated polyglactin 910 with triclosan) using zone of inhibition assays. Surg Infect (Larchmt), 2002, 379-87

Ming X, Nichols M, Rothenburger S. In vivo antibacterial efficacy of MONOCRYL* Plus Antibacterial Suture, (poliglecaprone 25 with triclosan). Surg Infect (Larchmt), 2007, 8:209-213

Ming X, Rothenburger S, Nichols MM. In vivo and in vitro antibacterial efficacy of PDS* Plus (polidioxanone 25 with triclosan) Suture., Surg Infect (Larchmt), 2008, 9:451-457

The things you are doing in the OR to prevent SSI – prevention is better than cure.

A Family of Antibacterial Sutures

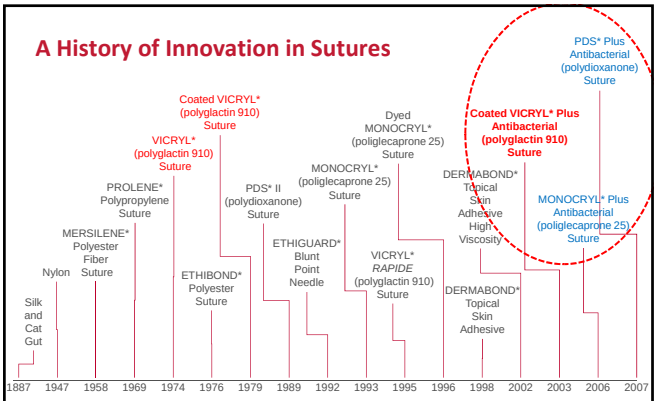
ETHICON Plus SUTURES: leading the fight against surgical site infection.

BECAUSE ONE INFECTION IS ONE TOO MANY

GI tract dedicated Suture recommendation

Procedure	Recommeded Suture	FAB
Gastrojejunostomy	4-0 Aantibaterial PDS Suture	Inhibit MRSA, MRSE,SA,SE,E.Coli & K.P. 180 days aborption
	3-0 Antibaterial MONOCRYL Suture	Inhibit MRSA, MRSE,SA,SE,E.Coli & K.P.
Hepaticojejunostomy	5-0 Antibaterial PDS Suture with DBLE ARMED	Inhibit MRSA, MRSE,SA,SE,E.Coli & K.P. Easy to handle
	5-0 PROLENE Suture with DBLE ARMED CC needle	decidecated for anastomosis pro cedure
Colon anastomosis	Outer Layer 3-0 Antibaterial VICRYL Suture C/R	MRSA, MRSE,SA,SE time saving
	Inner Layer 4-0 Antibaterial PDS Suture	MRSA, MRSE,SA,SE,E.Coli & K.P.

A History of Innovation in Sutures



ETHICON began manufacturing high quality suture products in 1887(more than 120 years).