

# Building a circular economy for healthcare products

## Prof. Mahmood Bhutta

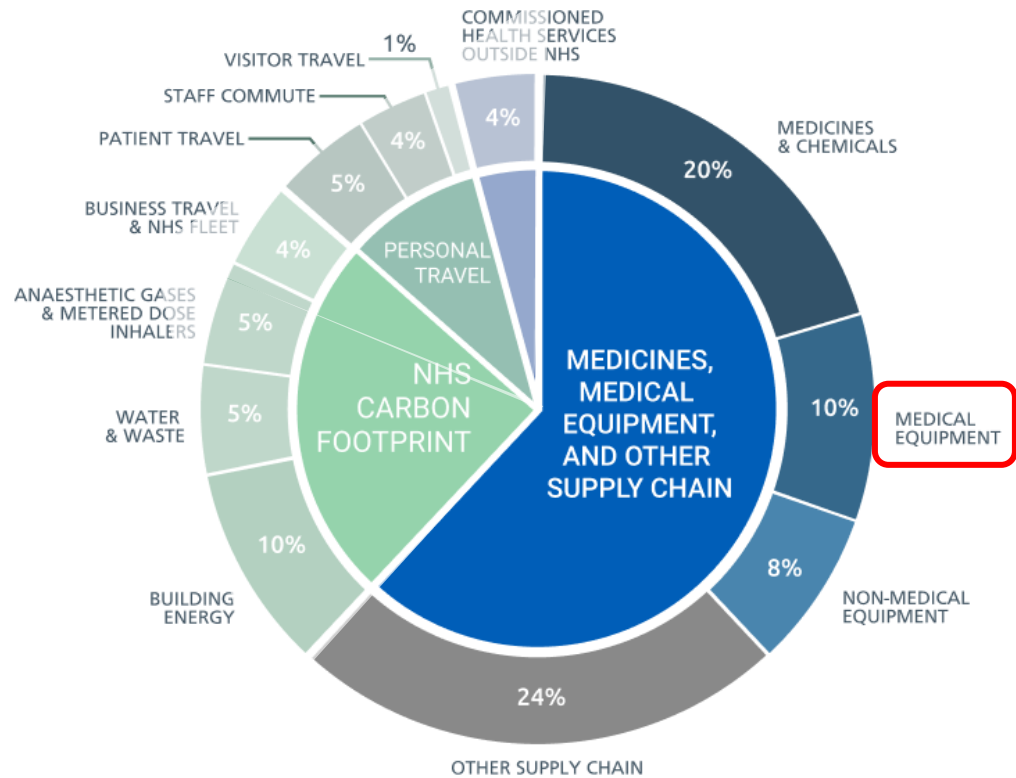
Chair in ENT Surgery & Sustainable Healthcare  
Brighton & Sussex Medical School

Consultant and Academic Lead in ENT  
Trust Clinical Green Lead  
University Hospitals Sussex

Founder  
BMA Medical Fair and Ethical Trade Group

THIS Institute Fellow





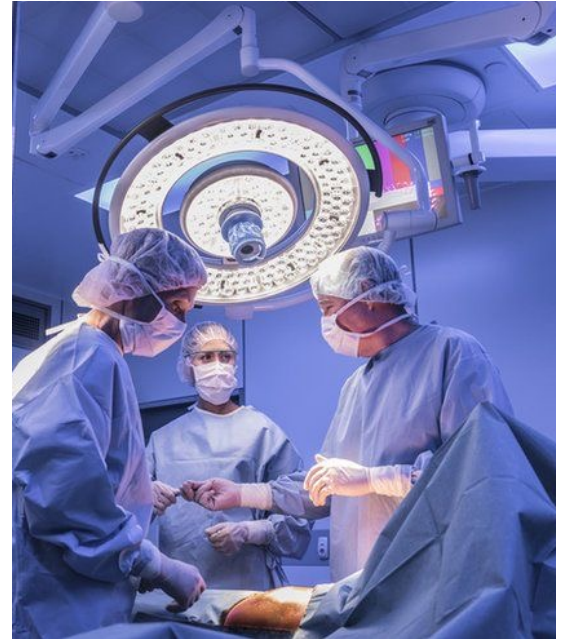
Scope 1 & 2 emissions

Scope 3 emissions

# Medical goods and the operating theatre

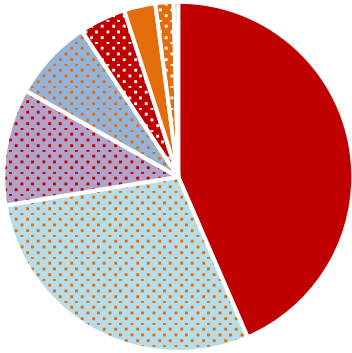
# The operating theatre

- Operating theatre most resource intensive area of hospital
  - 21-30% of total waste
  - 3-6 times higher energy consumption
- Typical operation is 150-170 kg CO<sub>2</sub>  
= driving from London to Edinburgh in a petrol car
- Hotspots (from our systematic review)
  - Energy use
  - Anaesthetic gases
  - **Consumable equipment**

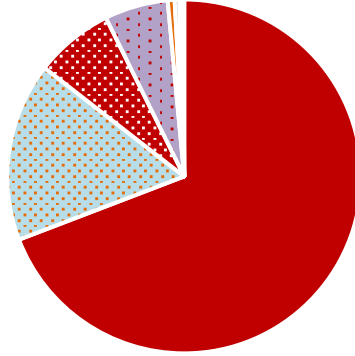


# Proportional contribution to CO<sub>2</sub>

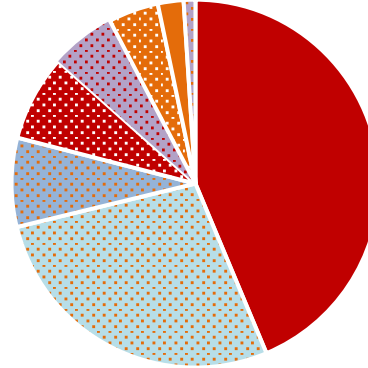
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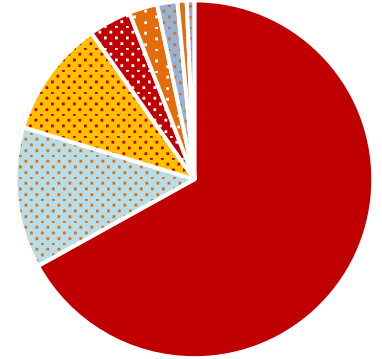
Tonsillectomy



Knee arthroplasty



Laparoscopic cholecystectomy



Carpal tunnel decompression

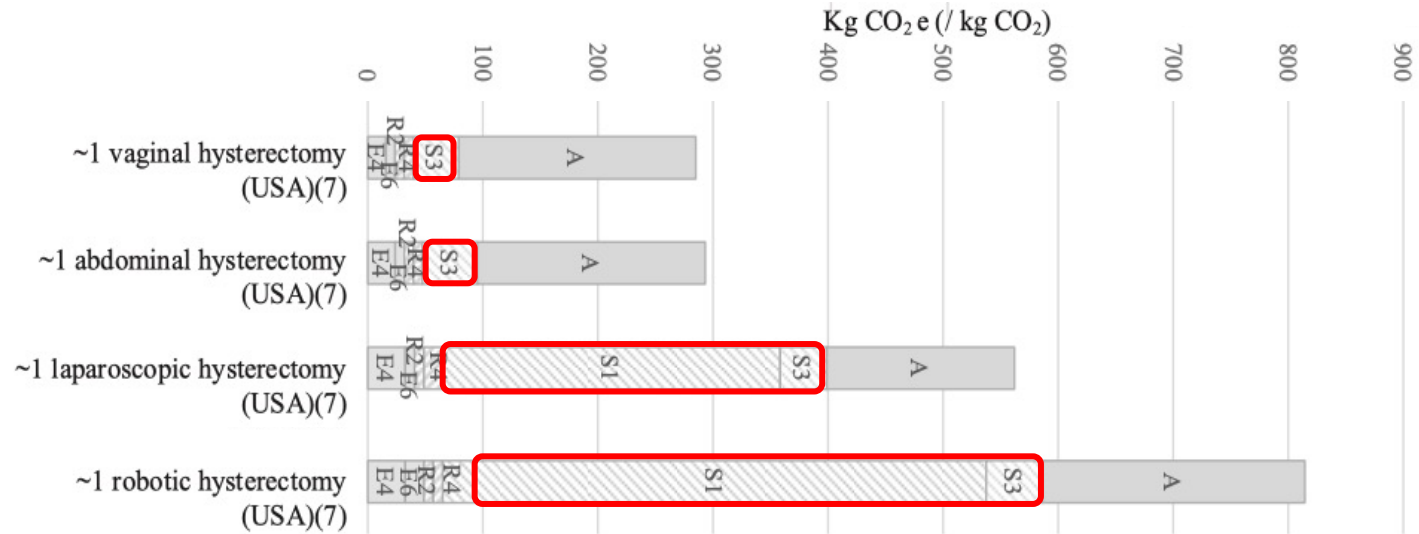
Production single-use equipment

Decontamination

Waste

68% of carbon of products used is due to single use products

# Carbon footprint of different approaches to hysterectomy



# Carbon footprint of cataract in different settings

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Cataract operation  
in UK = **182 kg CO<sub>2</sub>**



Cataract operation  
in India = **6 kg CO<sub>2</sub>**



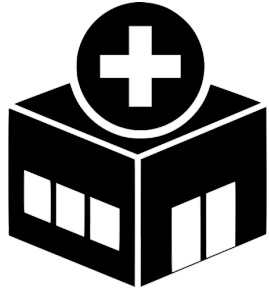
Highly efficient systems

Reuse of equipment

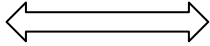
Lower rates of infective  
endophthalmitis

# Market dynamics of medical goods

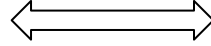




payer

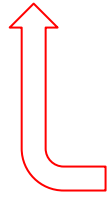


user



consumer

Low  
cost/complexity  
products  
(high volume)



supplier



High  
cost/complexity  
products

\$300bn industry

## High cost products

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- Complex and multicomponent
  - High embedded carbon
  - Recycling difficult or impossible, **and of low priority**
- Restricted or limited number of uses
  - Regulatory restrictions on reuse / infection
  - Economic drivers

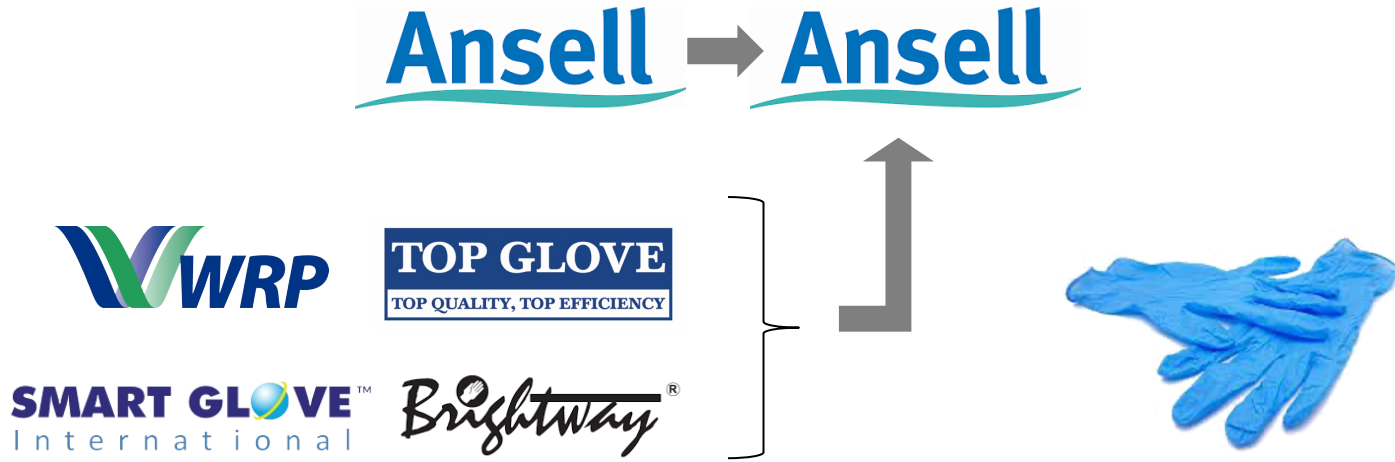
# Low cost: free market economics

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# Low cost: free market economics

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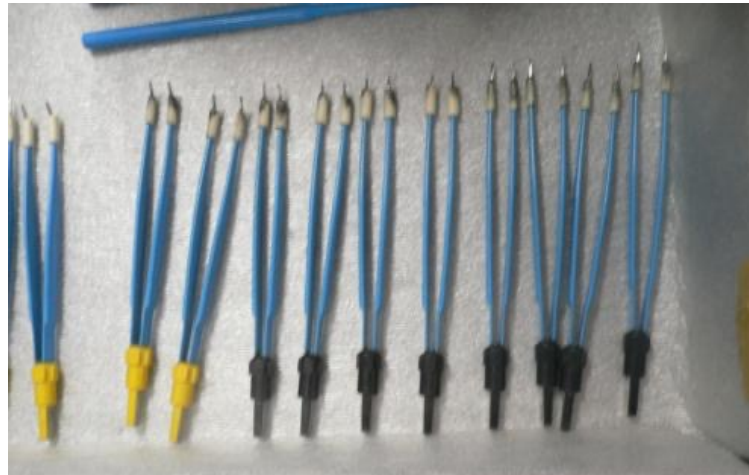
# Low cost: outsource production

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International  
Labour  
Organization

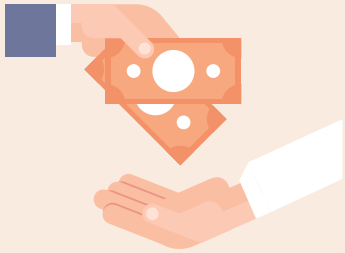


**TOP GLOVE**

**TOP QUALITY, TOP EFFICIENCY**



Brightway®



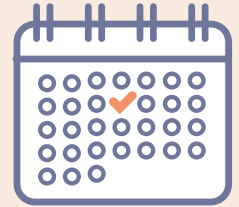
**43%** workers took out a loan to pay recruitment fees, averaging over \$2,000, which took 11.7 months on average to repay



**47%** felt unable to leave their employment due to contractual or other restrictions



Workers worked an average of **12 hours a day**



**10%** reported receiving no days off on average in the last three months, **31%** had just one day off per month



**SUPERMAX**  
Healthcare Limited



Central Medicare



ssn medical products

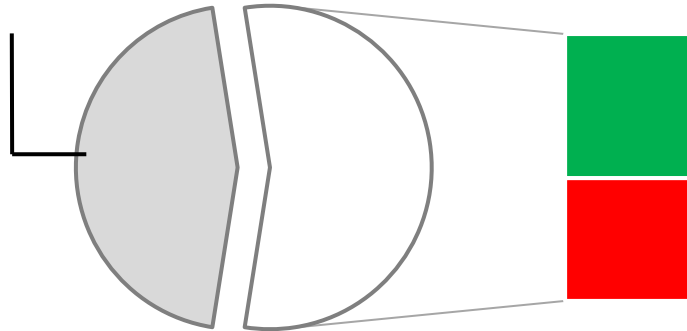


**SMART GLOVE**™  
International



# Country of origin ITUC ranking $\geq 4$

45% data  
unavailable



42%

5+	No guarantee of rights due to the breakdown of the law
5	No guarantee of rights
4	Systematic violations of rights
3	Regular violations of rights
2	Repeated violations of rights
1	Sporadic violations of rights



All health contracts SE Norway: 2015-16  
(>29,000 items)



Reuse

# Reuse has lower financial and carbon costs

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- Example
  - Single use scissors: 835g CO<sub>2</sub>e/use, £4.26/use
  - Reusable scissors: 64g CO<sub>2</sub>e/use, £1.43/use
- Systematic Review: **22 studies** of single use versus reusable surgical or anaesthetic equipment, **all but 2 favour reuse**
- Experience suggests in almost all cases reuse **saves money**



# Why is everything disposable?

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- At the point of use
  - Perceived or uncertain risk of infection
  - Convenience / lack of relevant infrastructure
- System challenges
  - Regulatory challenges
  - Financial structures that support a linear economy
  - Lack of guidance on infection risk

Infection risk: precipitating circumstances

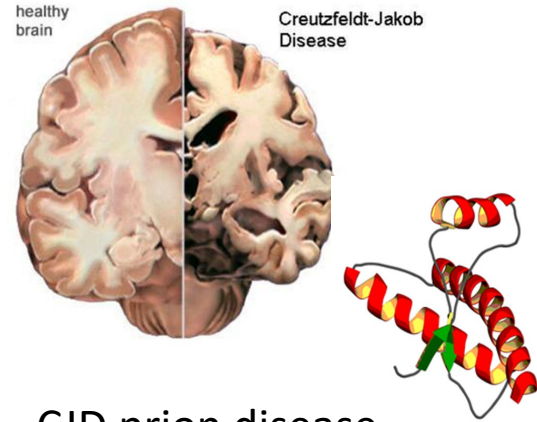
# Precipitating circumstances: surgical instruments

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1990s



Inconsistent or inadequate  
sterilisation



CJD prion disease

J Hosp Infect, 2001; 48; 180, Quintessence Int 1998 29:231, Inf Control Hosp Epidem 2010; 31: 107  
J Clin Neurosci 2013;20:1207; J Hosp Infect, 2014: 88; 127

# Precipitating circumstances : surgical instruments

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2020s



Robust decontamination &  
sterilisation

HTM 0101



Standards and quality  
assurance

# Precipitating circumstances: surgical textiles

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“Drapes and gowns must be made of impervious materials. **Thin cotton drapes and gowns** have no place in orthopaedic surgery”



British  
Orthopaedic  
Association

2014 Consultant Advisory Book

- Knee arthroplasty (>80,000 per annum)
  - 11 drapes/gowns, 14.5kg CO<sub>2</sub> = driving around 72 miles in an average UK car
- Carpal tunnel (>45,000 per annum)
  - 3 drapes/gowns, 5.8kg CO<sub>2</sub> = driving around 21 miles in an average UK car

## Precipitating circumstances: surgical textiles

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- Single use: typically non-woven petrochemicals (plastic) made overseas
- Reusable: typically woven high-density petrochemicals, reused 75 times
- **cotton is obsolete**
- Re-useable textiles have typically less than **one-third** carbon of disposable



# Precipitating circumstances: surgical textiles

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- All health textiles must meet EN13795 standards **throughout the lifecycle**



Liquid penetration



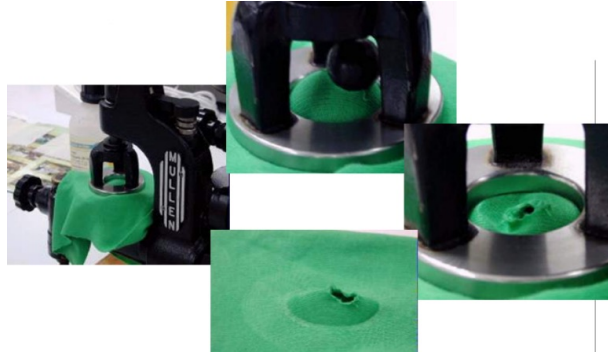
Microbial penetration

# Precipitating circumstances: surgical textiles

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Tensile strength  
4x higher with reusable  
10x higher if wet



Burst  
10x lower with reusable



Linting (particle release)  
8x lower with reusable

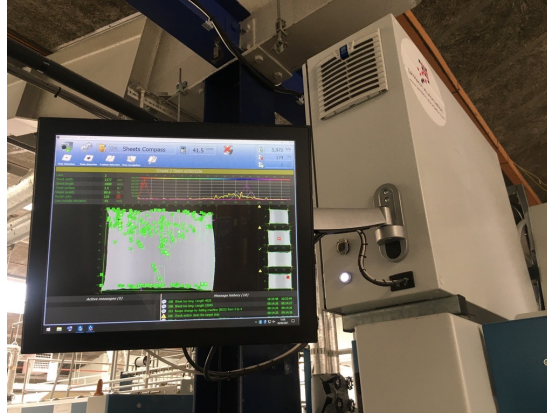


# Precipitating circumstances: surgical textiles

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Robust decontamination & sterilisation



HTM 0104



Standards and quality assurance

Infection risk: Perpetuating factors

# Gloves: personal misconception

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- Glove volumes
  - >1.7 billion/annum in NHS prior to the pandemic, single-use plastic
  - If placed end to end would almost stretch to the moon
- Most glove use (2/3rds) is inappropriate
  - Only required when expected contact with potentially infected bodily fluids or broken skin
  - Inappropriate use may be perpetuated by individuals, hospitals, or even government



# Ear microsuction: institutional misconception



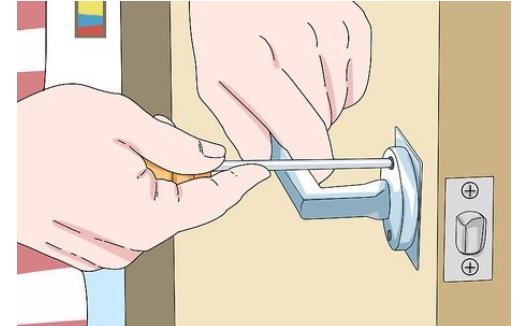
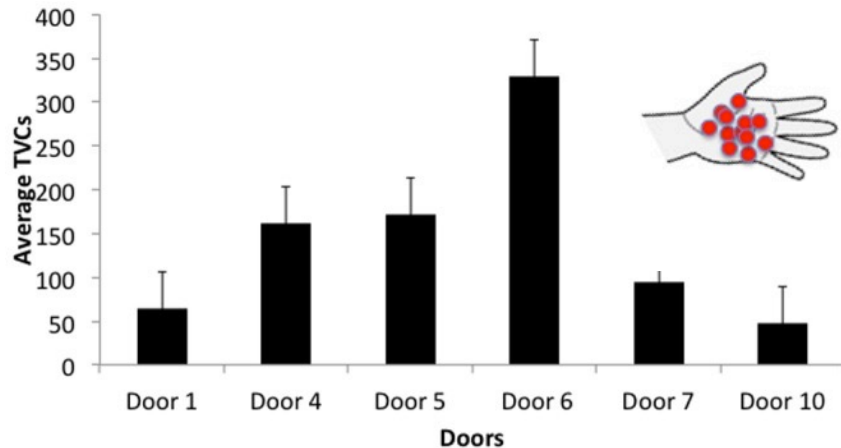
- >330,000 procedures performed in England per year (HES data)
- Large variation in practice in the equipment used

Equipment	Use routinely	Carbon footprint (g CO <sub>2e</sub> )
Single use sucker	100% (n=18)	3.6
Gloves	83% (n=15)	25
Apron	16% (n=3)	65
Gauze to clean sucker	66% (n=12)	2.1
Plastic tubing	28% (n=5)	130
Suction canister lining	6% (n=1)	78

85 fold  
increase  
in carbon

# Skin contact: institutional misconception

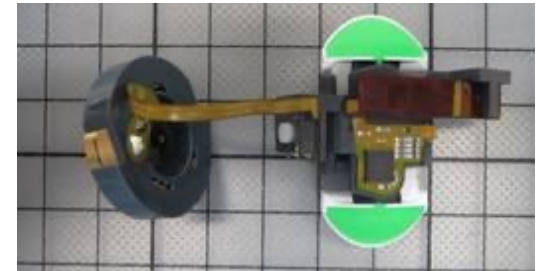
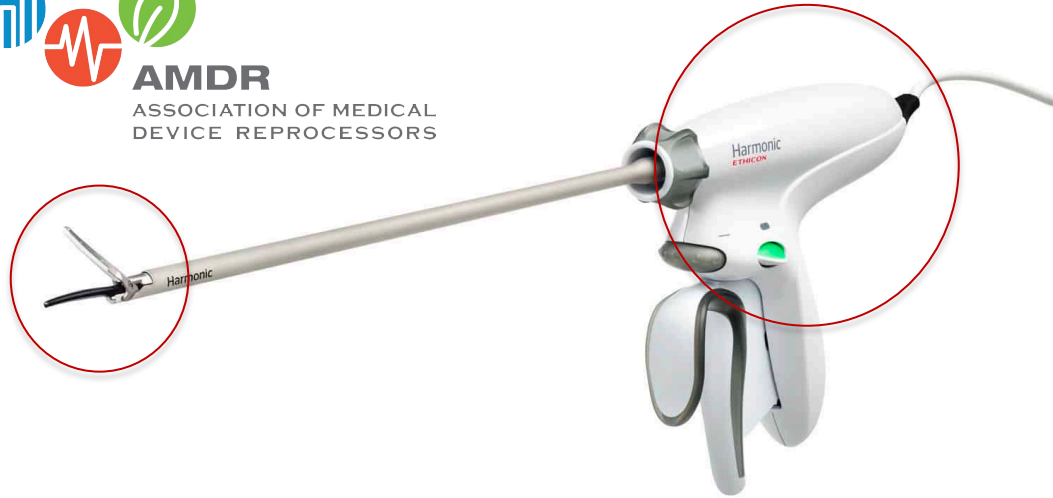
- Single use tourniquets, blood pressure cuffs
- Single use pulse oximeters (USA)
- Single use door handles







# Electrosurgical products: financial drivers?



Sterility is quality assured

Failure rates are less than those of new products

USA in 2020 >**31 million** devices were remanufactured



Questions

- **Healthcare staff attitudes and behaviours towards reuse**
  - Preliminary work started (MRC Grant)
- **Perceived infection risk**
  - Infection control guidance (Prof Jennie Wilson)
- **Infrastructure and architecture of healthcare**
  - Enabling infrastructure such as sterilisation and laundry
  - Cost including annualized budgets
- **Industry perspectives**
  - Regulatory restrictions
  - Economic models of purchase and supply (servitisation)