FILTRATION AND HARM REDUCTION

Filtration consists in removing certain **undesirable elements** from the preparation to be injected with a view to reducing harms associated with injection drug use.

Today, the estimated number of people who inject drugs (PWID) is 15.6 million worldwide.
Various medical complications are associated with this practice and represent a significant source of morbidity and mortality among these people.

With a view of reducing harms associated to injection drug use, the filtration consists in removing certain undesirable elements from the preparation to be injected. A filter is placed at the tip of the needle or syringe, and the preparation goes through the filter while the syringe is filled up.

Filtering substances prior to their injection is a common practice among PWID, as it namely enables to:

- avoid the obstruction of the needle during the injection,
- limit the risk of vein damage,
- prevent the risk of occurrence of certain medical complications associated with the injection of insoluble particles.

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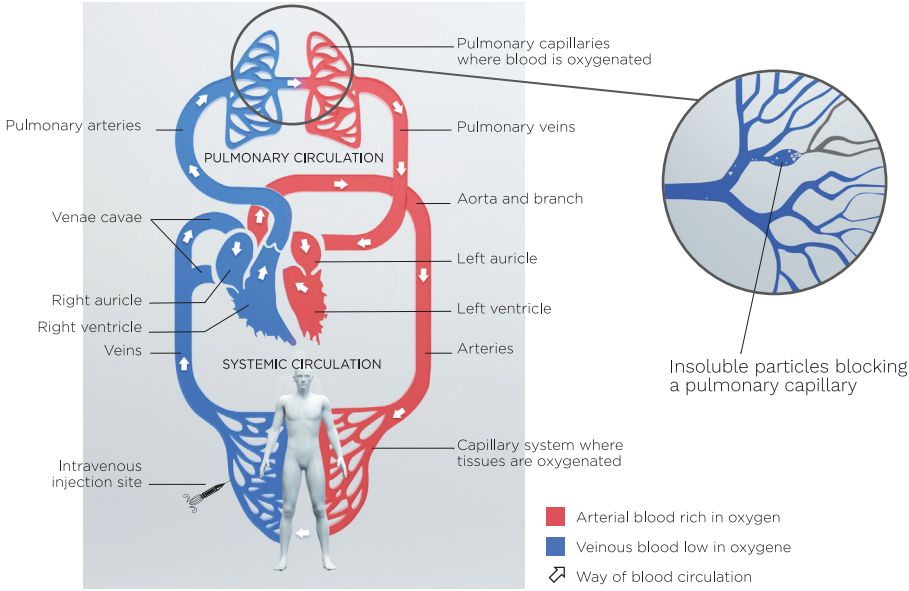
Understand the route of insoluble particles during an intravenous injection **and the associated risks**

The heart acts as a pump that keeps blood flowing through blood vessels throughout the body. There are several types of blood vessels: the **veins**, which carry blood from organs to the heart; the **arteries**, which carry blood from the heart to the organs; the **capillaries** which are the finest vessels. It is at this last level that exchanges between the blood and the organs take place and that insoluble particles can block.



During an injection, the content of the syringe is inserted into a vein, usually in the arm. The injected mix is conveyed through the veins up to the heart.
Blood then circulates towards the **lungs** where it is oxygenated. This is where it reaches the first capillaries, which is why insoluble particles are often found there. After passing through the lungs, reoxygenated blood reaches the rest of the organs.

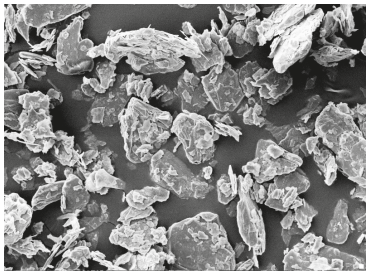
If certain insoluble particles succed in passing through the pulmonary capillaries without being blocked, they can then **spread throughout the body**.

This mechanism is the cause of many medical complications.

INSOLUBLE PARTICLES:
WHAT ARE THEY AND WHY SHOULD THEY BE FILTERED?

***Insoluble particles** are **solid** particles present in almost all preparations injected by PWID. Depending on the nature of the used substances, insoluble particles such as talc or starch are:*

- ***cutting agents** added to street drugs,*
- ***excipients**[1] of tablets or capsules intended for oral administration, such as Subutex® or micro-granules of Skenan®.*



Particles of talc observed with electronic microscope — 20 µm

Insoluble particles remain solid in liquids such as water or blood, and can cause problems when injected repeatedly intravenously. As for cutting agents and excipients, when they are soluble, they cannot be removed.

The average **size** of the insoluble particles involved in complications observed among people who inject drugs is between **nine and twenty-three microns** (µm). They pile up in the capillaries, block the blood flow and settle in the organs that it supplies to. In the long term, this mechanism can affect the function of these organs: lungs, heart, liver, kidneys, brain and eyes.

For example, the accumulation of insoluble particles in the pulmonary capillaries can disrupt gas exchanges allowing the oxygenation of the tissues. This can lead to various complications, from respiratory discomfort to certain serious cardio-respiratory disorders.

In addition, insoluble particles cause **microlesions in blood vessels** at the injection site: these are referred to as phlebitis and thrombophlebitis. These lesions favour the settlement of bacteria. Injecting such particles can then lead to or contribute to the development of **bacterial infections** such as abscesses. The same mechanism may occur in the heart valves. Located at the entrance of the heart, these are "bombarded" of particles and can become infected, leading to endocarditis, a potentially fatal heart infection.

Finally, the particles being "foreign bodies", they are likely to cause a reaction in the body that can last several hours, with acute pain and fever, and called "cotton fever".

Filtering is the only efficient way to reduce these risks.

[1] Excipients are inactive substances which are used in the formulation of tablets and capsules in order to give them their shape, coulour, texture or even taste.

Understand infectious risks and contaminant sources

During the injection, live micro-organisms, bacteria or fungi, can be introduced into the body. These can cause abscesses or more or less deep infections of the skin and surrounding tissues.

Like insoluble particles, they can migrate through bloodstream.

When the bacteria grow, they can reach different organs (sepsis), potentially causing serious infections, especially in the lungs, bones, brain and heart. The bacteria most frequently involved in these infections are staphylococci and streptococci. When they do not survive, these bacteria can, while they die, secrete endotoxins likely responsible for "cotton fever".

The fungus most commonly implicated in fungal infections in PWIDs is *Candida albicans*. Like bacteria, it can spread throughout the body and sometimes cause serious damages.

Contaminant sources

Contamination can come from the preparation to be injected and from several sources:

- Contamination of the preparation by the **hands** of the person who prepares it (*Staphylococcus aureus* is the most commonly found bacterium) or by the person's **mouth** if he/she licks the needle (it is then streptococci) – this is the most usual.
- Use of **non-sterile preparation tools**.
- Addition of **non-sterile water**.
- Injection of a **drug itself contaminated** (*Clostridium*, anthrax) — which can cause less common but potentially serious infections.

Filtration and filters

The filtration of substances prior to their injection is common, for it limits certain complications caused by insoluble particles, vein damage and needle blockage.

The filters commonly used by people who inject drugs can be divided into three main categories:

"MAKESHIFT" FILTERS

- Cigarette (industrial or rolling) filters
- Pieces of cotton (cotton bud, cotton ball)

These filters are **not sterile** and **necessarily manipulated** with the hands or the mouth before being used, which brings about a risk of bacterial and/or fungal (produced by fungi) infection. When shared, they become vectors of viral transmission, including HIV and hepatitis.

COTTON FILTERS

These filters, **designed to reduce harms** associated with drug injection, are sterile and can be used without any direct contact with hands nor mouth.

However, it is observed that they are often handled and stored for later use. In that case, they become a source of bacterial infection; if they have come into contact with a used syringe, they can even become vectors of viral transmission.

SINGLE-USE MEMBRANE FILTERS

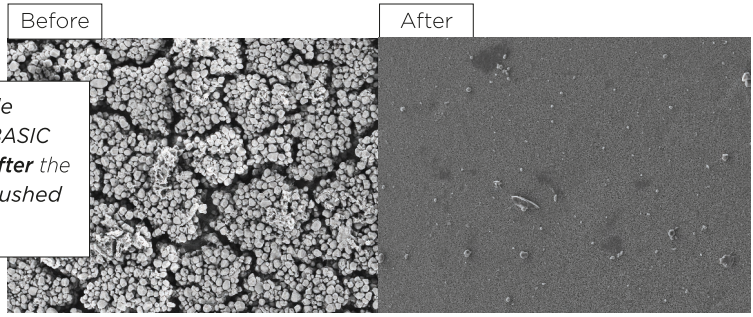
- Particle membrane filters (10 µm)

- Antibacterial membrane filters (0.22 µm)

Syringe
"wheel" filter

All membrane filters are **sterile**. They enable to remove insoluble particles very efficiently.

*Elimination of insoluble particles by Sterifilt® BASIC and FAST: **before** and **after** the filtration of a tablet crushed to be injected.*



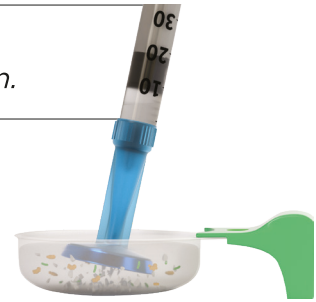
(Image: Dr Bouquié, Hospital Center of Thuir, France)

All membrane filters remove most insoluble particles, while cotton filters only remove part of them.

Antibacterial filters remove, in addition, certain micro-organisms, fungi and bacteria, whose size is greater than 0.22 µm. As for **viruses**, which are about **a thousand times smaller than bacteria** —around a nanometer (thousandth of a micron) — they cannot be eliminated by filtration. This is why nothing but single, or at least personal, use of preparation and injection equipment can prevent the viral transmission of HIV and hepatitis.

Active substances, such as cocaine or morphine sulphate are molecules. Their size never exceeds a nanometer level. These substances are soluble and are therefore **not removed** by filtration. **Their action is therefore preserved.**

Filtration does not alter the desired effect of the injection.



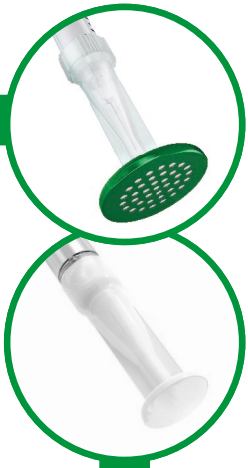
ELIMINATION OF PARTICLES,

Size scale (1 mm = 1000 µm)

FILTRATION

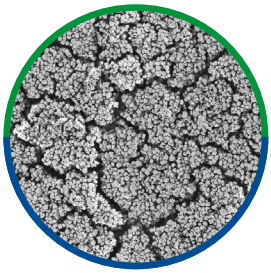
FILTRATION

Sterifilt FAST
Sterifilt BASIC



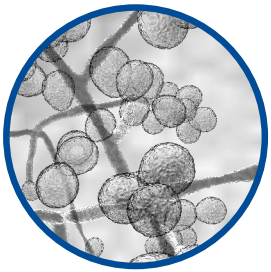
Sterifilt⊕
“Wheel” filter

Insoluble particles
15 µm

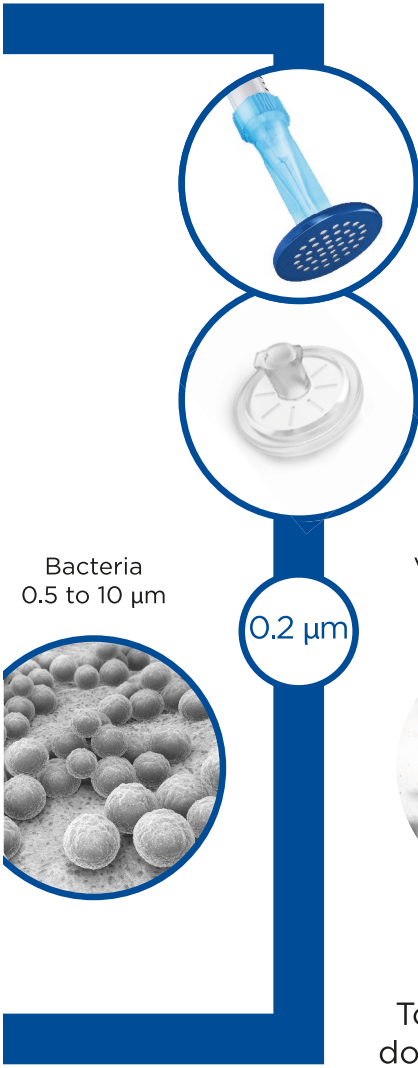


10 µm

Fungi (yeasts)
10 µm



FUNGI AND BACTERIA



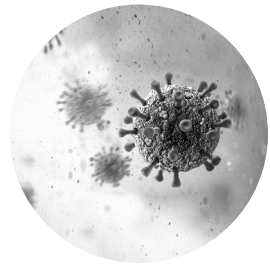
NON-FILTERED ELEMENTS

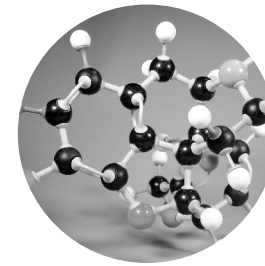
Bacteria
0.5 to 10 µm

0.2 µm

Viruses (HIV, HCV)
0.05 to 0.15 µm

Molecules (cocaine, morphine...)
0.001 to 0.01 µm





To avoid viruses, do not share tools.

Filtration does not remove active product!

Sharing and reusing filters: the associated risks

Although considered as dangerous, sharing and reusing filters are common practices among people who inject drugs.

These two practices are particularly motivated by:

- the retention of liquid in the filter after use, which encourages its conservation for future use,
- the difficulties in getting sterile and single-use filters.

Contact between the filter and the needle or the syringe during the first use makes the filter a potential vector of viral transmission, in the event of non-personal use and sharing. Researchers have notably established that **18% to 36% of used cotton filters** contained traces of **HIV**[1]. The **hepatitis C virus** (HCV) was detected in **40% of used filters** examined during other research studies[2]. As this virus can remain viable and infectious in used filters[3], their sharing is associated with HCV seroconversion, with an adjusted relative risk of at least 2.4[4].

Moreover the filters already used constitute biological environments favorable to the growth of bacteria and fungi. When reused, they are therefore likely to contribute to the development of **non-viral infections**.

Membrane filters are found to be less often shared and stored for reuse than "makeshift" or cotton filters.

Minimizing these infectious risks necessarily comes with single and personal use of filters.

[1] Shah S.M., Shapshak P., Rivers J.E., Stewart R.V., Weatherby N.L., Xin K.Q., Page J.B., Chitwood D.D., Mash D.C., Vlahov D., McCoy C.B. (1996) Detection of HIV-1 DNA in needle/syringes, paraphernalia, and washes from shooting galleries in Miami: a preliminary laboratory report. *Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology*. 11, (3), 301-306

[2] Crofts N., Caruana S., Bowden S., Kerger M. (2000) Minimising harm from hepatitis C virus needs better strategies. *BMJ*. 7 octobre 2000 ; 321 (7265) : 899

[3] Thorpe L.E., Ouellet L.J., Hershow R., Bailey S.L., Williams I.T., Williamson J., Monterroso E.R., Garfein R.S. (2002) Risk of hepatitis C virus infection among young adult injection drug users who share injection equipment. *Am J Epidemiol*. 155 (7) : 645-653

[4] Doerrbecker J., Behrendt P., Mateu-Gelabert P., Ciesek S., Riebesehl N., Wilhelm C., Steinmann. J, Pietschmann T., Steinmann E. (2013) Transmission of hepatitis C virus among people who inject drugs: viral stability and association with drug preparation equipment. *J Infect Dis.* 207 (2) : 281-187

Reduce risks:
accurate steps and good practices

*Event though **antibacterial filtration** reduces the risk of infection by removing bacteria and fungi from the solution to be injected, **it is not enough**, by itself, **to guarantee an injection without any infectious risk**.*

HAND HYGIENE

The infectious risks associated with intravenous drug use mainly come from preparation and injection practices, perfomed without asepsis. The user's own skin and oral flora[1] is the main source of bacterial infections.

Contamination by the hands can occur on at least two occasions:

- contamination of the mix during its preparation,
- contamination of the injection site while looking for a vein.

In healthcare settings, hand hygiene has been shown to be the key measure to prevent infections. Hydroalcoholic friction is, according to the World Health Organization, the method of choice for hand antisepsis.
It requires the use of a hydroalcoholic product, in the form of gel or solution.

Thus, even when using an antibacterial filter, the user must **disinfect their hands** by hydroalcoholic friction or wash their hands with soap and water, and this **for each injection**.

OTHER GOOD PRACTICES

In addition to using an antibacterial filter and washing hands, people who inject drugs are encouraged to **systematically adopt the following practices:**

- use **sterile, single-use water and** preparation and injection **equipment**,
- **disinfect the injection site** with an alcohol swab,
- **never lick the needle**.

Finally, it should be remembered that **neither antibacterial filters nor any filter eliminate viruses**.
The only way to avoid viral transmissions (HIV, hepatitis) is **never to share one's equipment**, whether syringes or other paraphernalia (preparation spoon/cooker, filters, cottons...).

[1] Skin and oral flora: all of the micro-organisms (bacteria and fungi) naturally present on the skin and in the mouth.

IN BRIEF...

Around 15.6 million people inject drugs worldwide. This mode of drug use presents many health risks, including the risk of viral transmission (HIV, hepatitis), the risk of bacterial and fungal infections, and the risks associated with the injection of insoluble particles.
In a **harm reduction** approach, the filtration of drugs (powders and tablets/capsules) enables to eliminate, depending on the filter used, certain undesirable elements from the preparation to be injected and to reduce certain risks.

This booklet aims to detail the mechanisms and notions involved in filtration as well as to present the different kinds of filters and their specificities.

Since filtration alone is never sufficient to guarantee an injection without infectious risks, some preventive actions such as hand washing are essential to reduce the risks and should be systematically adopted.

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