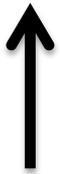
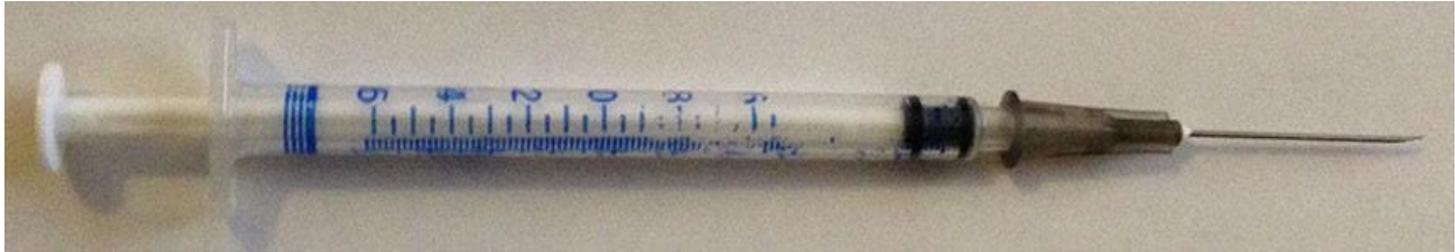


# Syringes

2013-05-11

# 1 mL Syringe, Assembled



End of  
plunger



Barrel

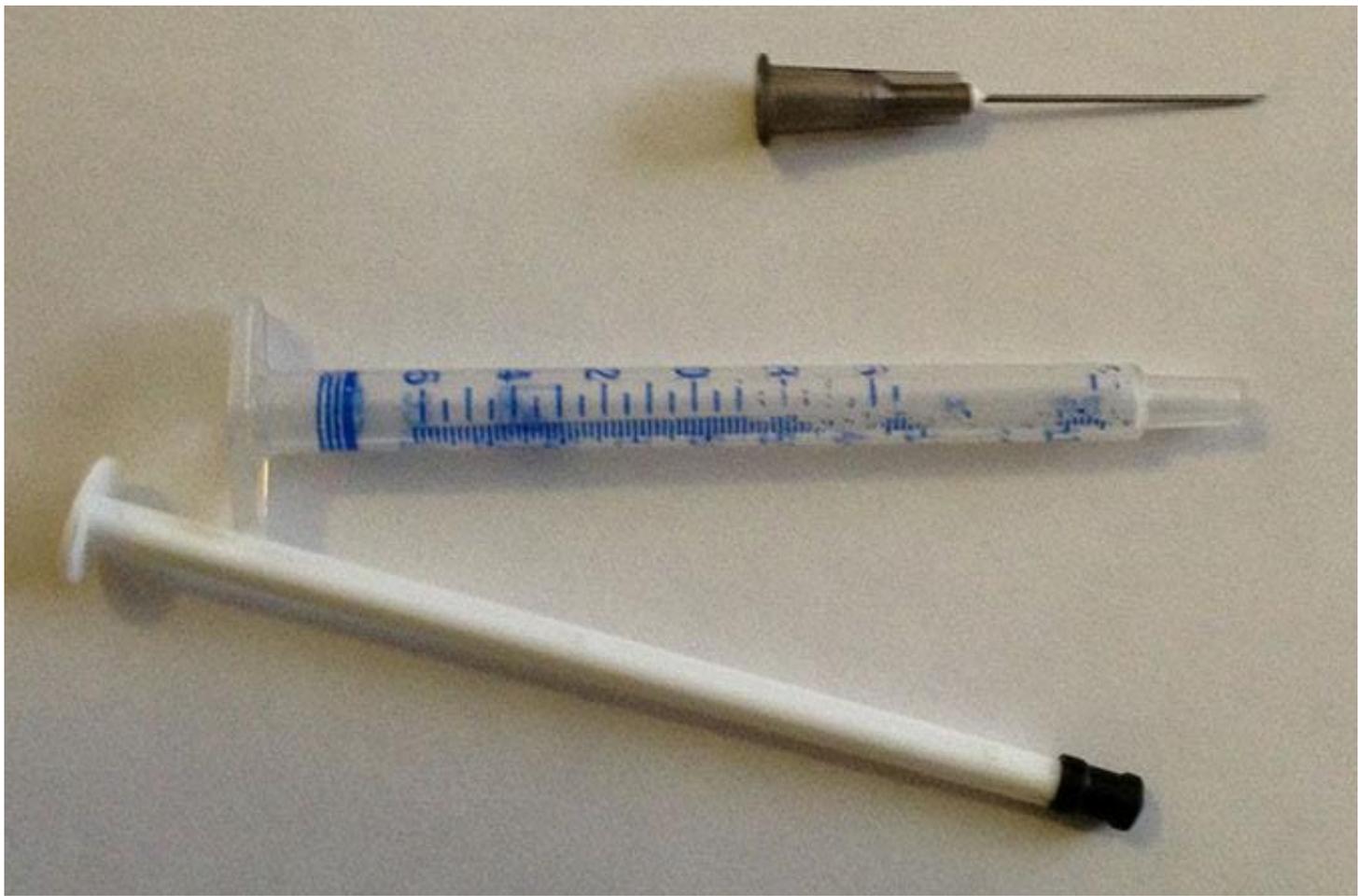


Tip  
(nozzle)



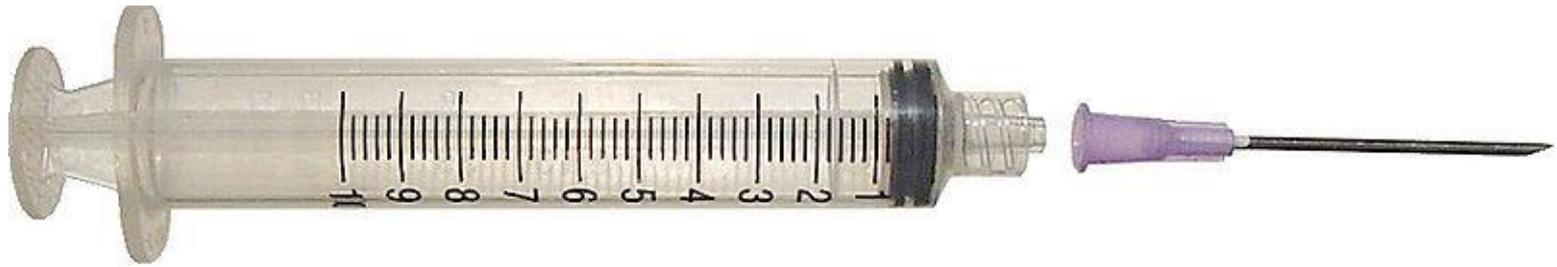
Needle

This photo is released under a Creative Commons CC-BY license. Author: Zak Fallows, 2013.



Top: needle, middle: barrel, bottom: plunger

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Note the Luer lock tip, which has a screw-thread to secure the needle to the barrel. The nozzle of the needle has a small bump that engages the screw thread on the Luer lock tip of the barrel.

This photo is released under a CC-BY license. Author: William Rafti of the William Rafti Institute, 2005.

# Glossary

Syringe – A simple type of pump, may or may not include a needle.

Hypodermic needle – This term refers to either the needle or the whole syringe apparatus

Bevel or chamfer – This is the sharp tip of the needle.

Tip or nozzle – See previous slide.

# Glossary

Plunger – See previous slide. This the moving piston.

Barrel – See previous slide. This is the tube that the plunger moves in.

Aspirate – To pull the plunger back and suck fluid into the barrel.

Expel (or inject) – To push the plunger down and expel fluid.

# Why Use a Syringe?

1. Fastest drug onset
2. Higher bioavailability (no first-pass metabolism)
3. Localized administration (more on this later)

# Fastest Drug Onset

Injecting a drug intravenously (into a vein) causes the fastest possible onset of effects. This is desired by drug abusers because **faster onset → more euphoria** (and also more risk of addiction).

# Higher Bioavailability

By definition, IV injection has a bioavailability of 100%. That means 100% of the drug in the syringe winds up in the systemic bloodstream.

Other routes of administration have lower bioavailability.

# IV vs. Smoking

Both are very fast, and thus very euphoric.  
IV is a bit faster.

IV bioavailability = 100%

Smoking bioavailability = 50% or less

# Smoking Bioavailability

Cocaine (crack or freebase) and methamphetamine generally have 30 to 50% bioavailability. This means 30 to 50% of the drug in the pipe makes it into the blood, and the rest is burned or exhaled and thus lost.

Nicotine in cigarettes has a bioavailability of about 2%, because nicotine is quite flammable. This is why eating cigarettes is dangerous.

# IV vs. Snorting

IV injection is **much faster onset** than snorting, so it is much more euphoric.

Snorting can damage your nose, because all the drug for your whole body is sitting in your nose. The drug concentration in your nose may be 1,000 times higher than the drug concentration in your blood.

# Types of Injection

IV (intravenous): Into a vein. This is traditionally used for heroin and cocaine, among many other drugs.

IM (intramuscular): Into a muscle. Slower onset than IV. This is traditionally used for anabolic steroids (e.g. testosterone).

SC (subcutaneous): Under the skin. Slower onset than IV. This is traditionally used for insulin, and it is the least painful.

# “Local” Injection

A “local” injection is meant to deliver the drug to a specific place. For instance, dentists inject local anesthetics (e.g. lidocaine) into your mouth, ideally just a few millimeters from a nerve. The term “local” is orthogonal to terms like IV, IM, and SC. Dental anesthetic is definitely injected locally, but the injection cannot be termed IV, IM, or SC.

# Injecting the Spine

Many drugs are injected into the spine. This is sometimes called “axial drug administration”. The spinal cord is wrapped in several layers of tissue, and depending on how many layers you puncture you can get different effects. Common spinal injection techniques include **epidural** and **intrathecal**, and they differ by how many layers were pierced.

# Spinal Block

By injecting local anesthetics (e.g. lidocaine or cocaine) into the spine, you can make the patient **insensitive** (numb) and **paralyzed** below a certain point. Inject higher in the spine to paralyze more of their body.

Common block points:

Nipple-line

Umbilical (belly button)

Pelvic (good for child birth)

# Spinal Block

A nipple-line spinal block is occasionally used in very severe pain, such as cancer pain.

# Intrathecal Morphine

Intrathecal morphine (injected into the spine) is about 25 times more potent than IV morphine. This is used in cases of extreme pain.

## **Equivalent morphine doses:**

30 mg orally

10 mg IV

0.4 mg intrathecally

Each of the above doses will cause significant pain relief in an opioid-naïve patient. Suitable for moderate to severe pain, such as a car accident.

# Invention of Spinal Block

The spinal block was invented by Dr. August Bier in 1898. He injected 5 mg of cocaine into the subarachnoid space of his friend Hildebrandt. When Bier pressed a lit cigarette into Hildebrandt's leg, he could feel the heat but felt no pain. Hildebrandt could not feel when his pubic hairs were pulled out, nor could he feel when his testicles were strongly pressed. The anesthesia lasted 45 minutes.

# Invention of Spinal Block, cont'd

Hildebrandt also administered a subarachnoid injection of cocaine into Bier's spine. However, Hildebrandt did not attach the syringe to the needle quickly enough, so a large volume of cerebrospinal fluid leaked out. Bier did not experience anesthesia.

The two doctors celebrated the discovery with dinner, wine and cigarettes.

# Invention of Spinal Block, cont'd

Shortly after the celebratory dinner, Dr. Bier developed an extreme headache and dizziness, and Dr. Hildebrandt began vomiting incessantly.

Over the next few years, Dr. Bier perfected the technique and largely eliminated the awful after effects.

# Invention of IV Regional Block

**Intravenous regional block** is unusual because it is an intravenous injection, but it is also local. Normally veins carry blood back to the heart, so any drug delivered to a vein will spread throughout the whole body immediately.

IV regional block was invented in 1908, also by Dr. August Bier.

# Invention of IV Regional Block, cont'd

To perform IV regional block on an arm:

1. Wrap the arm in very tight bandages, to squeeze out almost all of the blood.
2. Apply two tourniquets, one just above the elbow (proximal) and one just below the elbow (distal).
3. “Dissect” the antecubital region. This means surgically open the interior face of the elbow so that you can see the veins.

# Invention of IV Regional Block, cont'd

4. Inject the local anesthetic (cocaine or procaine) into a vein. Note that because the blood has been squeezed out of the arm, it was necessary to use surgery to find the vein.
5. Loosen the distal tourniquet (the one below the elbow).
6. Massage the arm, to spread the local anesthetic around. Note that the proximal tourniquet is still in place.

# IV Regional Block, cont'd

After this procedure, you can perform surgery for several hours on the arm without pain.

Procaine (brand name Novocaine) and cocaine are both vasoconstrictors, so they tend to slow bleeding, which is good. Bleeding is also significantly slowed by the tourniquet.

Note that in the decades soon after 1908, it was traditional to *not* anesthetize the patient before dissecting their antecubital vein. Painful!

# How Addicts Inject

1. Mix the drug with water
2. (Optional) Heat the drug to help it dissolve. This is called “cooking”. Cooking is often not necessary with cocaine and methamphetamine, but it is almost universally practiced with heroin.
3. (Optional) For crushed tablets, filter the drug liquid with a coarse wheel filter. Pore sizes of between 20 microns and 0.5 microns will remove particles of talc, wax, starch, and other insoluble matter.

# How Addicts Inject

4. (Optional) Filter the drug liquid with a fine wheel filter, ideally 0.1 micron pore size. This will remove bacteria and fungal spores. It will not remove viruses such as HIV.
5. (Optional) Filter the drug with cotton wool, usually from cotton balls. This is traditional but largely useless. It can prevent the needle from clogging.

# How Addicts Inject

6. Aspirate the drug liquid into the syringe.
7. (Optional) Expel any air from the syringe. This is done by pointing the needle up and pressing the plunger until a little liquid comes out. Injecting air is bad, but not very bad (more on this later).
8. Insert the needle into a vein. This may be very difficult for inveterate addicts, because their veins are “ruined” (more on this later).

# How Addicts Inject

9. (Optional) Aspirate a little bit of blood to ensure that you are in a vein. This is important because accidentally injecting street drugs outside of a vein (generally into fat and/or muscle) can cause serious injury and infection. All the drug intended for your whole body is in one small pocket of tissue, and it just sits there. This often causes swelling and pain, and sometimes causes infection and tissue death.

# How Addicts Inject

10. Press down the plunger all the way to inject the drug.
11. (Optional) Aspirate a bunch of blood, and then inject the blood. This is most often called **booting**, it is sometimes called **flushing**. The original motivation was probably to salvage the small amount of drug liquid trapped in the tip of the syringe.

# Booting (Flushing)

Booting is actually logical insomuch as it does salvage the drug liquid in the tip of the syringe. Many IV drug addicts claim that booting also washes residual drug off the walls of the barrel. Many IV drug addicts boot several times, and they are apparently just playing, or performing a superstitious ritual.

# Booting (Flushing)

Booting is dangerous because it exposes the syringe to a lot of excess blood, thus greatly increasing the danger of transmitting blood-borne diseases such as HIV.

In Africa, it is common for one addict to inject heroin and boot several times, and then share their syringe full of blood. Another addict who does not have any heroin will then inject this blood. This is extremely stupid, and frighteningly widespread in Africa.

# Sharing Blood in Africa

Many Africans inject one another's blood because they think it will get them just a little high. The placebo effect is very strong when it comes to relieving opioid withdrawal, so it is unsurprising that many Africans swear this works. Many practitioners of blood sharing do realize that it transmits HIV, but opioid withdrawal is extremely unpleasant and can lead to irrational decisions.

# Water for Injection

You should always use sterile water for injection. Ideally, this water should come from a fresh glass ampoule. Failing that, you should boil the water.

When IV drug addicts do not have any water, they may substitute **saliva**. This is incredibly stupid. This is depicted in the movie *Permanent Midnight*.

# Water for Injection

Another thing IV drug addicts do when they lack water is the following:

Pull the plunger all the way out of the syringe, put the dry powdered drug directly into the barrel through the opening at the back, and then reinsert the plunger. Now pierce a vein and aspirate a bunch of blood. The blood will hopefully dissolve the drug inside the syringe. Then inject the blood.

# Water for Injection

Dissolving dry powder with blood in this way is **extremely stupid**, and it can be watched on Youtube. This practice can probably lead to pulmonary embolism, which is a blood clot lodged in your lungs.

# Filtering

IV drug users most commonly filter drugs with cotton wool from **cotton balls** or **tampons**.

This can remove very large particles, but it does not remove fungal spores, bacteria, viruses, or small particles.

Using cotton wool is dangerous in and of itself, it can cause **cotton fever**.

Reusing filter material repeatedly is popular to salvage drugs, but it is dangerous because wet cotton allows bacteria and fungi to flourish, causing infections such as **endocarditis** and **sepsis**.

# Injecting Air

Most IV drug users, and even medical professionals, greatly overestimate the danger of injecting air.

Injecting air into a vein is generally **harmless**. The vein carries the bubble to the right side of the heart, and then the bubble is pumped into the lungs. The bubble gets trapped in the lungs and either dissolves in blood or escapes with exhalation.

# Injecting Air

Injecting air into an artery is much more dangerous, although usually it only causes a localized injury. Injecting illicit drugs into an artery is much more dangerous.

# Hitting an Artery

Accidentally injecting illicit drugs into an artery is very dangerous. When injected into a vein, the drug gets diluted very quickly with all the blood passing through the right side of the heart toward the lungs. When injected into an artery, all of the drug intended for the whole body goes to one small region of the body, such as your left hand.

# Hitting an Artery

Injecting into an artery quickly causes pain in the area served by the artery, and then the area often swells and changes color. There is often a mosaic pattern of bruising. Accidentally injecting into the femoral artery (when trying to hit the femoral vein, in the groin) can be fatal.

# Vein Damage

IV drug abuse damages veins in several ways.

**Scar tissue:** Repeated injury causes scar tissue to form, such as callouses. Dull needles exacerbate this problem. As vein walls grow thick with scar tissue, it is harder to pierce them.

# Vein Damage

**Collapsed veins:** To inject into a vein, it should have a cross section like a capital **O**. Under normal circumstances, many veins can flatten out when they contain little blood, and the cross section becomes like an **I**. One purpose of the tourniquet is to fill the vein with blood so it regains the **O** shape. Damaged veins may be permanently collapsed, always in the **I** shape. Injecting in collapsed veins is nearly impossible because the needle immediately punctures the far wall and exits the vein.

# Vein Damage

Veins are also damaged by the chemicals in the illicit drugs. Small veins are most vulnerable to this damage. Some drugs contain especially caustic chemicals:

Injecting **crack cocaine** requires mixing the crack with lemon juice or vinegar to turn the freebase cocaine into a water soluble salt. The excess acid is harmful to veins.

# Vein Damage

**Heroin in Europe** often contains freebase heroin, so it must be mixed with lemon juice, vinegar, citric acid powder, or ascorbic acid powder (vitamin C) prior to dissolving in water. This is also harmful to veins.

**Homemade meth** often contains caustic chemicals.

Injecting **methadone syrup** intended for oral use is especially damaging.

# The Sequence of Veins Used

A right-handed drug user will usually start injecting in their left antecubital region. This is the crook of the left elbow. Over time, these veins will become “ruined”, and they will move on through a predictable sequence of less and less desirable veins.

# The Sequence of Veins Used

1. Left antecubital region
2. Left forearm
3. Left hand
4. Right antecubital region (may require practice, or a second person)
5. Right forearm
6. Right hand

# The Sequence of Veins Used

7. Superficial veins in feet and lower legs
8. Neck veins
9. Femoral vein (groin injecting)

# Femoral Vein Injecting

**Femoral vein injecting** (groin injecting) is the hallmark of a very long-term IV drug addict.

It requires a thick and long needle, usually 1.5 inches long.

Unlike all other veins, the femoral vein gets progressively easier to hit. Instead of thickening with scar tissue or collapsing, the femoral vein tends to inflate like a balloon.

# Femoral Vein Injecting

After being repeatedly punctured by needles, the femoral vein wall weakens, and it gets stretched out by the pressure of the blood it contains. It widens into a cavernous bulb called a **pseudoaneurysm**.

Because the pseudoaneurysm is large and has a thin wall, it is easy to hit with a needle.

# Femoral Vein Injecting

The pseudoaneurysm can rupture during physical activity, or it can be torn open by a needle. This causes rapid blood loss and often death.

The femoral vein is very close to the femoral artery, and accidentally injecting illicit drugs into the femoral artery often causes severe injury, leading to leg amputation or death.

# Femoral Vein Injecting

The femoral vein is also very close to a nerve, hitting the nerve is extremely painful and could theoretically cause nerve damage, although I found no reports of nerve damage.

# Bulb vs. Plunger

Most syringes have a plunger, which is a piston-style pump.

Some syringes have a bulb, similar to the bulb on an eye dropper.

The bulb is easier to use with one hand, especially your left hand (if you are right-handed).

# Bulb vs. Plunger

Using a bulb has two problems:

**Injecting air is almost guaranteed.** Unless you don't inject all the liquid, you are guaranteed to inject some air.

**Aspirating to check that you are in a vein is almost impossible.** This means you are more likely to inject into muscle or fat, which is bad.

# Broken Off Needles

Broken off needles are surprisingly common in drug addicts, and they cause long-term pain during movement.

Howard Hughes had several broken off needles in his body when he died.

# Lorem Ipsum

Image removed due to copyright restrictions.

[View](#) the photo of a CT scan of a man with several dozen heroin needles broken off in his neck.

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ES.S10 Drugs and the Brain  
Spring 2013

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