



# Substitution list

## for hazardous chemicals

The National Substitution Group for Chemical Products (NSG Chemical Products) is a network of people from different county/regional councils and universities who are working on issues relating to chemicals from a health and environment perspective. The group aims to find and promote substitutes for hazardous chemicals.

Substitutions can be made in many different operations, and our substitution list is thus divided into four sections representing different areas:

Laboratory chemicals  
 Health care  
 Cleaning/disinfection  
 Miscellaneous

This document lists substitutions that have been successfully implemented in the specified operation. Thus, they are meant to be good examples that can be implemented elsewhere. However, there is no guarantee that the substitutions below will work in other contexts; each operation must test and evaluate a possible substitution.

If you have any suggestions for substitutions that you would like to share, please contact one of the following people and we will add your suggestion to the list:

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If you would like to know more about the group's work, please visit our website!  
<http://www.vgregion.se/nsg>

## Laboratory chemicals

### Product substitution of laboratory chemicals

Pink background = CMR product

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
<b>Boric acid in TBE buffer</b> CAS: 10043-35-3	In buffer for gel electrophoresis.	Boric acid may cause birth defects and reproductive toxicity.	<b>Acetic acid (TAE buffer)</b> CAS: 64-19-7	TAE buffer is slightly worse than TBE buffer for certain separations.	Akademiska sjukhuset, Klinisk mikrobiologi
<b>Blue gel/silica gel (cobalt chloride)</b> CAS: 7646-79-9	Dehumidifier with humidity indicator.	Colour indicator: cobalt chloride.	<b>Safe-gel, yellow/orange silica gel with yellow or orange humidity indicator</b>	Colour indicator: iron salts.	Klinisk Kemi SU
<b>Brilliance candida selective supplement SR0231</b>	Substrate for differentiation of yeasts.	CMR product (R45) Contains chloramphenicol. CAS: 56-75-7 H350	<b>Chromagar Candida (CA222)</b>	Works well; has been used in Växjö before without problems. Causes eye, skin and respiratory tract irritation.	Mikrobiologen Karlskrona Johanna Bergström, miljösamordnare
<b>Chloramphenicol antimicrobial supplement,</b> CAS: 56-75-7	Making agar plates	CMR product H350	<b>Chloramphenicol Ready Made Solution 100 mg/mL</b>	Works well, prepared solution. H351 Suspected of causing cancer	Klinisk mikrobiologi, Region Östergötland
<b>Cycloheximide Solution 50 mg/mL,</b> CAS: 66-81-9	Making DTM-agar plates	CMR product H360D	<b>Dermatophyte Agar</b>	Prepared culture plates, works well.	Klinisk mikrobiologi, Region Östergötland
<b>Detergent, Extran</b>	Cleaning of laboratory equipment.	Nitritotriacetic acid (NTA). CAS: 139-13-9	<b>Same product but with altered content</b>	The supplier does not want to say what the new substance is, but it is supposed to be less hazardous.	Universitetssjukhuset i Lund
<b>Dimethyl formamide</b> CAS: 68-12-2	Analysis of alkaline phosphatase in leukocytes. Used to dissolve naphthol AS phosphate.	CMR product H360D.	<b>Ethanol</b> CAS: 64-17-5	Naphthol AS phosphate is slightly slower to dissolve in ethanol.	Klinisk Kemi SU
<b>DPX mounting medium</b>		CMR product H360Df.	<b>Pertex mounting medium</b>	Contains xylene and ethylbenzene.	Klinisk kemi, Region Kronoberg
<b>Ethidium bromide</b> CAS: 1293-45-8	Visualisation (staining) of DNA and RNA.	Risks include splashes in the eyes, but above all, inhalation of dust from dried-up EtBr from corks, spills, dye baths, bags, equipment, etc. This also applies during waste management.	<b>GELRED in water (Bionuclear)</b>	Modified so as not to penetrate cell membranes.	Folkhälsomyndigheten Göteborgs Universitet, Sahlgrenska akademien

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
			<b>Gel Star Nucleic Acid Gel Stain</b>	More sensitive than EtBr, strands become visible without UV light. Dissolved in DMSO, thus labelled an irritant.	Klinisk Kemi SU
			<b>SYBR Safe</b>	The strand resolution is comparable to that of equivalent products containing EtBr.	Landstinget i Östergötland Göteborgs Universitet, Sahlgrenska akademien
<b>Fast Blue B salt</b> CAS: 20282-70-6	Analysis of Aflatoxins, fungi.	CMR product, H350.	<b>Fast Blue BB salt hemi (zinc chloride) salt</b> CAS:5486-84-0	Contains 4-(Benzoylamino)-2,5-diethoxybenzenediazonium tetrachlorozincate. Suspected carcinogen, H351.	Klinisk kemi, Region Kronoberg
<b>Phenylmethanesulfonyl fluoride, PMSF</b> CAS: 329-98-6	Used as protease inhibitor in Western blotting.	Toxic and corrosive.	<b>"Pefabloc"</b> <b>4-(2-aminoethyl)benzenesulfonyl fluoride hydrochloride, AEBF</b> CAS: 30827-99-7	Pefabloc worked just as well or even better. Not classified as toxic, only corrosive.	Uppsala universitet
<b>Formaldehyde</b> CAS: 50-00-0	Testing and analysis of parasites.		<b>ParasiTrap Dual</b>		Region Östergötland
<b>Formamide</b> CAS: 75-12-7	Denaturation of FISH glass. Fluorescent in situ hybridisation.	CMR product H360D.	<b>NaOH &amp; ethanol</b> CAS: 1310-73-2 CAS: 64-17-5	NaOH in 70% ethanol. Then 70%, 90% and absolute alcohol.	Göteborgs Universitet, Sahlgrenska akademien
<b>Formamide</b> CAS: 75-12-7	Fragment analysis on ABI373xl (capillary instrument from Life Technologies).		<b>EDTA 0,1 mM pH 8</b>	Slightly stronger signal strength. The analysis must be run a little faster, as EDTA evaporates faster, but there is no need to work inside a fume hood.	Uppsala universitet
<b>n-Hexane</b> CAS: 110-54-3	E.g. HPLC	n-Hexane is particularly hazardous to the peripheral nervous system.	<b>Heptane</b> CAS: 142-82-5 <b>Pentane</b> CAS: 109-66-0	In many applications, n-Hexane can be substituted for another solvent.	Klinisk Kemi SU

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
<b>Hydrazine sulphate</b> CAS: 10034-93-2	Calibrator for water analysis.		<b>Stable calibrator</b>		Uppsala universitet
<b>Immersion oil with chlorinated paraffins and phthalates, e.g. Zeiss Immersol 518 F</b> CAS: 84-74-2 (dibutyl phthalate) CAS: 63449-39-8	Microscopy.		<b>Immersion oil with benzyl benzoate, e.g. Zeiss Immersol 518 N</b> CAS: 120-51-4		Akademiska sjukhuset, flera labb
<b>Carbol fuchsin solution</b> CAS: 632-99-5	For gram staining of bacteria.	Solution in ethanol or water.	<b>Safranin</b> CAS: 477-73-6	Works on bacteria, but not on malaria parasites.	Karolinska Universitetssjukhuset
					Akademiska sjukhuset, Klinisk mikrobiologi
<b>Kanamycin sulphate</b> CAS: 25389-94-0	Select gram-negative anaerobic bacteria.	CMR-product. H360.	Kanamycin solution (Sigma, K0254)	Still kanamycin (CMR), but prepared solution reduces the handling of the substance.	Mikrobiologen Karlskrona
<b>Chloroform</b> CAS: 67-66-3	RNA isolation.		<b>Bromochloropropane (BCP)</b> CAS: 109-70-6		Klinisk Kemi SU
<b>Chromic acid (Parengy's decalcification solution)</b> CAS: 1333-82-0	Decalcification solution for decalcifying bones during pathological work.	Chromic acid (chromium trioxide) is carcinogenic, mutagenic, allergenic, hazardous to the environment, suspected to cause reproductive damage, etc. Chromic acid is included in the Annex XIV list of licensed chemicals in REACH.	<b>Hydrochloric Acid (Decalcifying Solution)</b> CAS: 7647-01-0		Region Jönköpings Län, Avd för Klinisk Patologi  Akademiska sjukhuset, Avd för Klinisk Patologi
<b>Mercuric chloride</b> CAS: 7487-94-7	Analysis of metabolic diseases.	Very toxic, hazardous to the environment. Requires exemption from the Swedish Chemicals Agency (KemI).	<b>Silver nitrate</b> CAS: 7761-88-8	Also hazardous to the environment, but disposed of as hazardous waste.	Klinisk Kemi SU

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
<b>Lactophenol aniline blue</b> CAS: 108-95-2 (phenol)	Staining (in mycology).		<b>Metylblue 0.1% in lactic acid</b> CAS: 28983-56-4(metylblue)		Karolinska Universitetssjukhuset
<b>Medical petroleum</b> CAS: 64742-49-0	Cleaning of medical equipment.		<b>Ethanol, mild soap solution</b> CAS: 64-17-5		Karolinska Universitetssjukhuset
	Removal of immersion oil.		<b>Ethanol, 70%</b> CAS: 64-17-5		Mikrobiologen, Uddevalla sjukhus
			<b>Window cleaner</b>	Any brand can be used.	Linköpings universitet
<b>2-Mercaptoethanol</b> CAS: 60-24-2	Reducing agent, used to prepare samples for electrophoresis, etc.	Very volatile, harmful through inhalation and skin contact, hazardous to the environment.	<b>1.4-Dithiothreitol</b> CAS: 3483-12-3		Karolinska Universitetssjukhuset, Gunilla Buss gunilla.buss@SLL.se
	RNA extraction with Qiagen's kit.				Folkhälsomyndigheten  Region Jönköpings län, laboratoriemedicin
<b>Metronidazole</b> CAS: 443-48-1	Making agar plates	CMR-product H350	<b>Metronidazole 5 mg/mL</b>	Works well, prepared solution.	Klinisk mikrobiologi, Region Östergötland
<b>Methanol</b> CAS: 67-56-1	Fixation of gels.	Toxic.	<b>Ethanol</b> CAS: 64-17-5	Did not work well in trials with PVDF membranes.	Folkhälsomyndigheten
				Fix: 3 parts absolute ethanol + 1 part acetic acid.	Göteborgs Universitet, Sahlgrenska akademien
<b>2-Methoxyethanol</b> CAS: 109-86-4	Analysis, dual esterase.	Licensed substance, included in the AV Group B list.	<b>Ethanol 99%</b> CAS: 64-17-5	We first switched to 2-Ethoxyethanol, but have now been able to replace this with pure ethanol.	Klinisk Kemi SU
<b>Petroleumether</b> CAS 64742-49-0	lipidanaysis	Chemsec SIN-list	2-metylpentan CAS: 107-83-5 n-pentan CAS: 109-66-0		Klinisk Kemi SU

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
<b>Picric acid</b> CAS: 88-89-1	Fixation.	Explosive when dry, toxic.	<b>Mixture of ethanol, acetic acid and water</b> CAS: 64-17-5 CAS: 64-19-7	Fixation and destaining liquid.	Universitetssjukhuset i Lund, Klinisk mikrobiologi
<b>Thiomersal</b> CAS: 54-64-8	Preservative.	Contains mercury.	<b>Sodium azide</b> CAS: 26628-22-8	NB! A general ban on mercury is in effect, but chemicals for analysis may be sold until 31 December 2014.	Karolinska Universitetssjukhuset
<b>Triton-x-100</b> CAS: 9002-93-1	Immunohistochemical staining Triton can be used as a detergent or for lysis of cells.	Environmentally hazardous substance and also subject to a permit from ECHA also for laboratories	<b>Tween 20</b> CAS: 9005-64-5	Non-hazardous substance. The substitution worked for some antibodies but not all, must be tested.	Karolinska institutet
<b>Trypan blue</b> CAS: 72-57-1	viability stain for manual cell counting	CMR-product	<b>Erythrosin extra bluish (Sigma E8886)</b> CAS: 16423-68-0	H411 Toxic to aquatic life with long lasting effects. H302 Harmful if swallowed Less hazardous	Karolinska institutet
<b>Xylene</b> CAS: 1330-20-7	Histology lab: deparaffinisation of tissue sections before staining.		<b>X-tra Solv and X-tra Kit</b>	When X-tra Solv is used instead of Xylene, the product X-tra Kit is also required when mounting sections on slides.	Karolinska Universitetssjukhuset
<b>Xylene</b> CAS: 1330-20-7	Histolab: dehydration of tissue samples before embedding paraffin.		<b>Isopropanol</b> CAS: 67-63-0		Göteborgs Universitet, Sahlgrenska akademien

## Reduction or substitution of laboratory chemicals through a change of methods

Method / Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
<b>Acetonitrile, n-Hexane and other solvents</b> CAS: 75-05-8	HPLC		-	Reduced use due to switch to LC-MS/MS. 2010-09-28	
<b>Acrylamide gel (to be cast)</b> CAS: 79-06-1			<b>Acrylamide gel (pre-cast)</b>	Pre-cast gels contain significantly lower quantities of un-polymerised acrylamide. The substitution has clear work environment benefits, but we have not researched the potential environmental benefits.	Karolinska Universitetssjukhuset,
<b>Dichloromethane</b> CAS: 75-09-2	Liquid-phase extraction.		-	Reduced use due to switch to solid-phase extraction. 2010-09-28	Universitetssjukhuset i Lund
<b>Silver nitrate</b> CAS: 7761-88-8	Developer solution for proteins and DNA acrylamide gels (PAGE).	Particularly suitable for small amounts of DNA or proteins.	<b>Hydragel Isofocusing from SEBIA, for isoelectric focusing (IEF), special instruments + kits are often available.</b>		Universitetssjukhuset i Lund
<b>96-hole plates</b>	E.g. sequencing, fragment analysis, PVR reactions.		<b>384-hole plates</b>	Saves both chemicals and plastic when you have large series of samples. Requires a robot for pipetting.	Göteborgs Universitet, Sahlgrenska akademien
<b>Fluorochromes</b>	DNA sequencing.		<b>The volume of fluorochromes can be reduced compared to the recommended quantity.</b>	5µL instead of 10 or 20 µL works well. Then 1 µL terminator/reaction is sufficient.	Göteborgs Universitet, Sahlgrenska akademien
<b>32P isotopes</b>	In LOS (Loss of Heterozygosity) and fragment analysis.		<b>Fluorochromes</b>		Göteborgs Universitet, Sahlgrenska akademien

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<b>Mercuric chloride</b> CAS: 7487-94-7	Sampling of methane in sea water and sediments.	Very toxic, hazardous to the environment. Requires exemption from the Swedish Chemicals Agency (KemI).	<b>Zinc chloride</b> CAS: 7646-85-7	Corrosive, hazardous to the environment. Listed in the KemI PRIO database (but still better than mercury).	Stockholms universitet
<b>EPON (embedding plastic) Bisphenol A diglycidyl ether</b> CAS: 25068-38-6 <b>Propylene oxide</b> CAS: 75-56-9	Making thin sections of soft tissue. Embedding in plastic for better morphology and ultrathin sections (3 µm). Alcohol and propylene oxide required for dehydration.		<b>LR-White (embedding plastic)</b>  <b>Ethanol</b> CAS: 64-17-5	LR-white is a gentler plastic.  Dehydration solely with alcohol.	Göteborgs Universitet, Sahlgrenska akademien
<b>Trichloroacetic acid</b> CAS: 76-03-9	Fixation of acrylamide gels.		<b>Hydrigel Isofocusing from SEBIA, for isoelectric focusing (IEF), special instruments + kits are often available</b>		Karolinska Institutet
			<b>The TCA fix bath can be used many times, and the amount can thus be reduced considerably.</b>		Klinisk Kemi SU
<b>Water suction</b>			<b>Membrane pump for rotary evaporator is an alternative to water pump</b>	Significant reduction of the quantity of solvent flushed down the drain. The solvent is condensed and can be collected (Vacubrand is sold by Labinett).	SUs Lund
<b>Real-time PCR</b>			<b>TLDA card</b>	5-10 times less reagent is used.	Göteborgs Universitet, Sahlgrenska akademien
<b>Kanamycin sulphate</b> CAS: 25389-94-0	For selective cultivation of anaerobic bacteria.	Kanamycin may cause birth defects. Kanamycin is classified as a so-called CMR substance.	Operations have stopped using selective anaerobic culture plates. Today, only nutritious blood agar is used, adapted for the cultivation of anaerobic bacteria. Two antibiotic discs are placed on the cultivated sample (metrodinazol and tobramycin).	It is okay to only use anaerobic agar. It has been necessary to further identify the anaerobic bacterium even when using a selective medium, and now there is Maldi-Tof, which provides quick answers when identifying species.	Akademiska sjukhuset, Klinisk mikrobiologi,

Method / Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
<b>Electro etching</b> Nitric acid 33%			<b>Nitric acid 3%</b>	An etching method that uses 10 times weaker acid has been developed.	Göteborgs Universitet, Sahlgrenska akademien
<b>Phenol [108-95-2]</b>	Analysis of ammonium in salt water.	Toxic, hazardous to the environment and suspected mutagen.	<b>Sodium salicylate [54-21-7]</b>	The method requires a bit more precision.	Stockholms universitet
<b>Pepsin [9001-75-6 ] and formaldehyde [50-00-0]</b>	FISH-Fluorescence in situ hybridisation	Used as pre-treatment of slides	<b>Removed completely, it works well without it</b>	Does not work on paraffin-embedded material	Region Skåne, medicinsk Service

## Health care

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
<b>Phenol</b> CAS: 108-95-2	Excision of toenail bed (nail surgery)	Toxic, harmful to the environment, suspected of causing genetic defects, corrosive	<b>Sodiumhydroxide</b> CAS:1310-73-2	Classification of substitute: H290 May be corrosive to metals. H314 Causes severe skin burns and eye damage H318 Causes serious eye damage	NU-sjukvården (Västra Götalandsregionen)
<b>Hydroquinone (in developer solution)</b> CAS: 123-31-9	Developing agent for photographic film.		<b>Developer solution without hydroquinone</b>	Reduced use due to transition to digital x-ray. 2009-02-02	Region Uppland Akademiska sjukhuset,
<b>Hardening powder</b> CAS: 84-61-7 CAS:94-36-0	Moulding of thermosetting plastics	CMR substance, harmful to the environment, may cause allergic skin reactions, causes severe eye irritation, and is flammable.	<b>Hardening powder phthalat-free (617PG37=0.150)</b> CAS: 94-36-0 CAS: 94-49-5	Substitute is classified as environmentally hazardous, may cause allergic skin reactions, causes severe eye irritation, and is flammable.	Södra Älvsborgs Sjukhus (Västra Götalandsregionen)

<b>Chromium trioxide</b> CAS: 1333-82-0	Etching of blood vessels in case of severe epistaxis.	The handling of chromium trioxide is covered by AFS 2005:17 § 26 and § 27.	<b>Silver nitrate (lapis) sticks</b> CAS: 7761-88-8		Akademiska sjukhuset, Öron-näsa-halsmottagning, samt Primärvården, Region Uppland
<b>Medical petroleum</b> CAS: 64742-49-0	Cleaning of medical equipment.		<b>Ethanol, mild soap solution</b> CAS: 64-17-5		Karolinska Universitetssjukhuset,
	Removal of plaster residue.		<b>Remove</b>		Karolinska Universitetssjukhuset,
	Removal of plaster residue.		<b>KMI-Häftremover</b>		KK-Operation, Sahlgrenska Sjukhuset,
<b>Nail polish remover</b>	Removal of nail polish.	Contains acetone, ethyl acetate, isopropyl myristate, etc.	<b>KMI-Häftremover</b>		KK-Operation, Sahlgrenska Sjukhuset,
<b>Thiomersal 10% solution</b> CAS: 54-64-8	Preservative for dialysis equipment.		<b>Immuno-adsorba</b>	NB! A general ban on mercury is in effect, but chemicals for analysis may be sold until 31 December 2011.	Karolinska Universitetssjukhuset,
<b>Stammopur DR 8</b>	Detergent for colo / gastroscop and an ultrasound device for washing nipples for the scope	Toxic to aquatic life with long lasting effects. Suspected of damaging the fetus	<b>Sekusept Multienzyme</b>	Not hazardous, not even in higher concentrations	Region Halland, Hallands sjukhus,

## Cleaning/disinfection

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
<b>Glutaraldehyde</b> CAS:111-30-8	Disinfectant for instruments.		<b>Solution with peracetic acid + hydrogen peroxide, e.g. Endodis</b>		Akademiska sjukhuset

## Other

Product	Area of use	Comment	Substitute	Comment	Substitution coordinator - contact
<b>CRC 5–56 PFTE and CRC 5–56 + New 2025-03-14</b>	Lubricant and rust protection agent	Contains PFAS	<b>CRC 5–56 or WD40 PTFE</b>		Västra Götalandsregionen
<b>Photo Mount</b>	Mounting spray adhesive.	Contains isopentane, isoparaffin, etc.	<b>Display Mount Adhesive 7806</b>	Contain fewer hazardous substances.	Västra Götalandsregionen,
<b>Hydrofluoric acid in pickling paste</b> CAS 7664-39-3	Pickling paste is used to manually process stainless-steel welding joints in order to prevent corrosion.	Pickling paste typically contains both hydrofluoric acid and nitric acid.	<b>Phosphoric acid-based solution</b>	Substitution requires the purchase of an “electrolyte cleaning aggregate”, in which a phosphoric-acid based solution is used. There are several different brands on the market.	Region Uppland
<b>Ethanol 70% and lithium grease</b>	Lubrication of wheel axles (e.g. blood trays and chairs)	Lithium grease contains e.g. heptane and cyclohexane	<b>Baby oil (instead of ethanol) and white vaseline (instead of lithium grease)</b>		Region Skåne, medical service (medicinsk service)