



Infection Control Questions Initiated by COVID-19... and Beyond

Dr. Rella Christensen answers some of the most common questions on infection control

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Aerosol Control with Isolite

IsoLite is NOT an answer to the dental aerosol problem. Company sponsored research showed the IsoLite action is more analogous to a saliva ejector than HVE. We have studied dental air for years and agonized over the total lack of interest by frankly ANYONE in the fact that it was very highly colonized—especially in about a 36” arc radiating out and up from the patient’s right to left shoulder. Honestly, dentistry really needs to just bite the bullet and invest in good air filtration with high air exchange (close to complete room-air clearance per minute) for the entire office and then operate it 24/7. We had to find a system for our sterile harvest work so we could prove that the microbes we were reporting came only from within the lesion itself. We settled on a system designed for cleanrooms which we purchased from Gordon Cleanroom Products in Louisiana that completely clears our operating area over 50 times per hour or about once a minute.

Aerosol Control with Laser Tooth Prep and Laser Plume Virus Infection

Regarding the claims that laser cavity preparations do not create aerosols, I have to strongly question that statement. However, we do not have research right now one way or another related to aerosols from dental cavity preparations and lasers. As you know, there is research regarding soft tissue surgery related to laser plume generation. You will find reports in the literature showing herpes and papilloma viruses found within laser plume emitted during excision of these types of soft tissue infections. Today there are special “laser masks” to address specifically the problem of viruses in laser plumes.

From what we have learned about caries lesions after our sterile caries harvest work this past 15 years, I can tell you that these lesions are virtually teeming with millions of microorganisms of various genus-specie categories. As you know, a vital tooth circulates small but continuous amounts of fluids both to and from the pulp chamber. With these two pieces of information, I would fully expect microbe infection of the ambient air due to laser cavity preparations—especially since all lasers have either air or water coolant used during their cutting procedures which “kick up” the microbes AND the lasers DO NOT kill the microbes during the excision process (we do have test data on this point).

I do not see cavity preparations with lasers as a solution to the aerosol problem in dental offices. I think we can control the dental air through the use of active air filtration 24/7, and it will end up costing about the same in a large dental office as the purchase of one cavity preparation laser!

Aerosol Products for Ambient Air Clearance

ECM Phantom sold by Gordon Cleanroom Products. This is the ceiling mounted, either embedded within a drop ceiling or hung closely below the ceiling. It gains its efficiency with its very high whole room clearance rate by taking in ambient air through ducts in the wall, passing it through a series of HEPA filters and expelling purified air over the patient's head. The ECM Phantom installed in all operatories and the reception area, and operated 24/7 would produce a VERY highly pure air. We suggest calling Gordon Cleanroom Products in Louisiana (888-315-1561) and getting their suggestions on how to efficiently cover your entire office. To approach the problem conservatively, you could start by installing the system in one restorative and one hygiene operatory and designate these as your spaces to be used for tooth excavation/preparation and ultrasonic scaling areas. You may be able to lower your operatory walls so they do not connect to the ceiling, but still offer some privacy and relieve yourself from installing a unit in each separate operatory, but this would lower the air clearance efficiency significantly.

Aerosol Suction Systems for Ambient Air. These systems have an arm with a hood at the end to try to suction in the aerosols as they escape the oral cavity before they scatter widely in the operatory. We have evaluated these designs several times in the past. Immediately apparent problems were:

1. The suction motor needs to be fairly strong without being too noisy.
2. The suction becomes attenuated as it travels the arm, and is then spread at the end where the hood opens up.
3. The unit's exhaust is in the immediate vicinity of the patient and the clinicians, and this exhaust needs to be highly purified or the central heating/air conditioning will circulate unprocessed residuals (microbes) throughout the entire office.
4. Clinical access is severely hampered, particularly in the posterior region of the oral cavity. Clinicians tend to pull the hood away from the oral cavity farther than is ideal—and then block the suction partially by locating portions of their body between the oral cavity and the hood.
5. We have determined the suction process may be most efficient if it is located slightly **above the operating area** with the suction pulled up towards the ceiling, rather than located on the chest of the patient where most tend to place it.
6. We have advised clinicians interested in this kind of design to try to arrange an **on-site trial** before they purchase, even if the trial costs money.

We have been collecting products for testing and still have a great deal to do, but it has been hard to find something effective in the “roll it in—plug it in—go for it” category of products. We are still looking.

Aerosols in Dental Environments

• Efficiency of “air scrubbers” for your central heating/air conditioning system.

This approach is helpful, but inadequate as the total answer for your dental aerosol situation. Dentistry has been in need of treatment for its aerosol problem for many years. I believe the time has finally arrived when many clinicians will actually try to do something. My main worry is that they will select what they hope are easy, inexpensive solutions, but they will miss the efficiency they need.

In our own treatment facility, we use the **ECM Phantom** by Gordon Cleanroom Products in Louisiana, which has the air clearance rate I believe is necessary in dental offices (total turnover of operatory air close to each minute). The main problem in current design of dental offices is that we have broken the space up with floor to ceiling walls, and our operatories lack doors that can be closed off. I like to see the exchange rate per operatory as close as possible to one complete exchange per minute and this favors the small rooms, but requires doors that shut. This efficiency is going to require a true air purification unit, and perhaps the placement of a system in each operatory. You could limit costs by designating one or two operatories for the worst of the procedures, which would be use of high and low speed handpieces, and use of ultrasonic scalers and air polishing instruments and prophy cups. Procedures like hand scaling, denture adjustments, and other low aerosol generation procedures could be performed in other operatories. I have a dental hygienist friend who works with an assistant in two adjacent operatories where the hygienist does all of the hand scaling, and then sends the patient next door for the dental assistant to perform the Prophy Jet or rubber cup polishing. You could see how an arrangement like that could work for other procedures as well.

Clinical Attire Protocol

• Scrubs worn UNDER a disposable gown

As you probably already know, the criteria for personal protection equipment is that it must be any one of the following:

1. Single use and discarded.
2. Single-use and sterilized.
3. Washed on site, without the wearer leaving the clinical environment while wearing the covering.
4. Professionally laundered, without the wearer leaving the clinical site while wearing the protection.

If you want to wear scrubs to work and then at work leave them on UNDER a disposable gown, much the way we might wear street clothes under a disposable gown, that is legitimate. This is assuming that the scrubs are simply “under clothes” and not worn as clinical personal protection at any time during the day. As you know, this is the way a medical surgeon wears scrubs. I, myself, have a top and pants in a style that is comfortable with several changes available to me which I wear every day under my clinical attire. My clinical attire is fluid resistant and does a nice job repelling literally everything that drops on it, since it has a good close weave. I launder my top and pants worn under my clinical attire after each use and do not attempt to ever wear them more than once.

• Do you need to change gowns when doing a hygiene check?

I would suggest that you place a disposable gown over whatever you were wearing to treat your first patient, and use that for a hygiene check and sterilize it for reuse. The habit we have developed in dentistry of moving back and forth many times between multiple operatories is an infection control nightmare. I would keep a stack of packaged folded disposable gowns at the entrance of the dental hygiene area so the patient can see you put on clean covering just for them. You could accomplish this by removing the disposable covering in your sterilization room, after the hygiene check, and placing it in your sterilizer and then thoroughly drying it before you fold and place it in a Ziploc bag for use with the next patient.

I know the above sounds a bit arduous, but we are starting a whole new era of infection control, and patients will be particularly attentive to how we are handling things after the COVID-19 pandemic.

Disinfection of Surfaces: Lysol and Clorox

Lysol Spray Brand II is no longer available and has not been since 2007. Originally, it was the only formulation available worldwide containing almost 90% ethyl alcohol by volume, along with several other key trace ingredients that allowed it to be the most potent commercial product on the world market at that time. The California VOC (Volatile Organic Compounds) law forced the company to lower the ethyl alcohol content down to just a little less than 70% by volume, and they renamed the product Lysol Spray Brand III. The change in formulation caused the original 30-second kill time to be increased to a 9-minute kill time of poliovirus in 10% human whole blood!

Today, we suggest strongly that you try the product **BioSURF Bag-in-a-Box**, which will **kill resistant viruses in the presence of human protein in about one minute**. We requested that you leave it on as long as possible so the surface can have the benefit of **contact time**. We demonstrated 3 minutes, knowing that clinicians will always shorten recommended times. ***Do not shorten the time less than one minute if you want a high kill potential on your surfaces in operatories, in your sterilization area, at your front desk, in your reception area, and on all commonly touched surfaces such as light switches, door handles, toilet handles, etc.***

Clorox Original can be a good disinfectant, but it cannot be diluted beyond one part Clorox to one part water, or you begin to lose its ability to kill. The CDC 1:10 up to 1:100 dilution is too diluted with water to kill effectively. Remember you purchase Clorox Original at 5.25%—it is already diluted by almost 95% water. Using Clorox 1:1 will definitely bleach, and it will cause a potent chlorine odor after several uses. Therefore, we suggested that this was more appropriate for home use and emergency use (such as after floods, earthquakes, etc.), rather than routine use in a public facility such as a dental office.

Face Mask: Critical Cover PFL with Magic Arch

The **Critical Cover PFL Mask with Magic Arch** is a **Level 3 mask**. I also showed a mask with a similar design available from Crosstex that is an N95 mask called the Isolator Plus. In the program I showed them side by side in the image to show they are almost identical in overall design, but the N95 Isolator Plus differs in that it (1) has more filtration layers, (2) it has two elastic headbands, and (3) it is clearly stamped, as law requires, as a NIOSH N95 mask. Since the N95s are in high demand in all areas of medicine right now, I suggest a good second-best is the Critical Cover PFL with Magic Arch, which has >99% filtration of 0.1 μm particles and >99% peripheral fit leakage resistance.

Face Mask Sterilization and Re-use

Can you decontaminate an N95 mask to extend your supply, since this item is so difficult to order currently? I will be honest with you, **if I were to use such a mask, I would not feel entirely safe**. I have read about people treating the N95 masks by washing, autoclaving, dry heat sterilizing, double masking over, and just about anything else you could think of!

The reason I say that I would not feel safe after any of the above—or treatment with a UV curing oven such as the Triad has suggested—is that I would want verification following treatment that the mask was again sterile. A face mask is actually **a filter**. An N95 face mask is actually a very good filter with a very tight border all the way around to fit the face without leakage. Either way, the material the mask is made from is meant to actually **entrap** incoming and outgoing debris in the form of droplets, aerosols, dust particles, and free-floating bacteria or viruses. Like your furnace filter, the filtration material is impregnated with whatever is in the air, and at some point “fills up,” and then begins to allow material to pass through and loses its filtration capability. While you are hoping to kill the infectious viruses or bacteria through some type of sterilization or cleaning method, you really have no way to clear the face mask material of the particles that have become entrapped within it. In your mind's-eye, you may be able to see that at some point the mask material “fills up” and allows passage of new material. Although you may have killed the bacteria and viruses attached to various types of particles, the filtration material, at some point, loses its efficacy—and you do not know the point at which this happens, even if you have managed to sterilize the mask prior to trying to reuse it.

I definitely understand your limited choices. You only have so many N95 masks, and then you either have to go back to your former less effective clinical masks, or you have to wear no mask at all, or perhaps you have a mask you have made yourself. No matter what you try to do, you reach a point where you lose the security that a new certified N95 mask offers you. The best clinical mask we were ever able to identify is called the Critical Cover PFL with Magic Arch by AlphaProTech. This particular clinical mask is not an N95 mask, but it does offer the possibility of a tight peripheral fit and very good filtration, and is a Level 3 mask. It filters >99% of 0.1 μm particles and has >99% seal at its periphery when put on properly. I would opt for its use over trying to re-use an N95 mask you have attempted to somehow sterilize. In the absence of the AlphaProTech mask, I would hesitate to see patients, or take patients to a location and treat them where there is negative air filtration, and possibly a decent mask that is new and unused.

Handwashing

We have conducted a number of large hand washing and hand antiseptic tests at Brigham Young University, which is close by. Our work consistently has shown clearly over the years that there are really only two hand antiseptics of high value. The first is Hibiclens, which is a 4% chlorhexidine gluconate, which has an excellent bacterial kill, but almost no activity on viruses. We actually showed the Petri plate results of the before and after organisms present on the hands in the presentation. The second product of value is Purell hand rub. We tested a number of high ethyl alcohol rubs and foams with other active ingredients, and the brand Purell was the consistent best performer. However, we showed you in the video that it must be used properly, and very few people are aware of two critical criteria:

1. The hand rub must use **ethyl** alcohol at the 70% volume level, and not isopropyl (rubbing alcohol), which is not a good anti-viral chemical.
2. A large enough amount must be dispensed to allow the hands to be **wet for 30 seconds** as the material is spread and rubbed into the hands to achieve the chemical contact time needed to kill.

As you know, most people will squeeze out a pea sized amount and rub their hands together palm to palm quickly. These people have accomplished virtually nothing. You need the 30-second contact time with the hands **wet**, and gradually the material will evaporate during that time period—in order to achieve virus kill.

Head Caps

You could use either a disposable head cap that you sterilize or a reusable head cap that you wash at the office (not at home). Once I put a head cap on, my short hair style is completely ruined, so I do not take the cap off until I am ready go home at the end of the day, but I also do not stop for lunch in the middle of the day. Instead, I work straight through and eat in the late afternoon a lunch/dinner. If you have long hair and can wear a pony tail, or if you are not self-conscious about your appearance, certainly the best procedure would be to remove the head cap if you break for lunch. I, myself, do not like the looks of the head caps that use the style of a shower cap, and prefer the cap that I showed in the video called the Easy-Tie Cap, which we purchased from the Schein catalog.

High Velocity Evacuation (HVE) during Cavitron and Polishing Procedures

HVE, as you know, stands for high velocity evacuation, and this would be your suction tip, not your saliva ejector. The saliva ejector is mainly for pick up of saliva secretion and other liquids that pool under the tongue and accumulate. Your HVE tip is designed to be used very close to your operating site and positioned opposite your operating instrument so that it pulls the coolant water across the tooth and does not pick it up before it hits the tooth. HVE is achieved by using a central evacuation pump located somewhere in your office or perhaps the basement of your building. HVE should be used during air polishing as well as during prophylaxis cup polishing. Many hygienists are very adept at using the HVE simultaneously with their polishing procedures with a device in each hand. I have personally always pushed for each hygienist having a dental assistant!

Post COVID-19 Procedures

- **How to clean and disinfect the front desk and reception area.**

In our own clinical facility, these areas receive the same treatment as the clinical operatories. This is because patients touch and breathe in all of this environment, and the aerosols from operatories find their way to these areas through your central heating/air conditioning system. The difference is the frequency with which we disinfect these areas. During COVID-19 and immediately after COVID-19, I am sure you would want to be disinfecting your front desk counter and places where patients touch **often**. However, please read the steps below and see if we could save some time, energy, and money by the steps which I propose below regarding receiving patients in the office during and immediately after COVID-19.

You have a handout called “Items to Consider for Treatment of COVID-19 Emergency Patients.” You will notice as you review this document that we suggest some steps you may want to keep well past this time of critical emergency with COVID-19. They include the following:

1. Take steps to clean up the dental office air. I list this step as #1 because it will solve a lot of the problems.
2. Cover entry door handles with a barrier on both sides (inside and outside handle).
3. Take patient temperature and put gloves on the patient (they can be any glove and do not have to fit well).
4. Try to seat the patient in an operatory as soon after they enter the office as possible—avoid their sitting in the reception area, if possible.
5. Get rid of all items in the reception area and in the individual operatories that are not necessary in the treatment of that patient (this means magazines). In the place of magazines, stream dental related videos so your patients can be educated in what you can do for them, rather than wasting the time on soap operas and news transmissions.

From the above, you can get the idea that you can go item by item down the list of “Items to Consider When Treating a COVID-19 Emergency Patient” that you and your patients might be interested in continuing post COVID-19.

A word about “post COVID-19.” Please **keep in mind that epidemic and pandemic viruses do NOT suddenly disappear. Generally, they will continue to circulate while mutating and adapting.** The Mexican-Swine-H1N1 flu epidemic of 2009 resulted in strains of that virus being included in the annual flu vaccine for the past 10 years, including what is proposed to be part of the 2020 flu vaccine. This is an example of how viruses continue to circulate and do not just disappear. We must remain vigilant.

Pre-treatment Rinse

The reason for two 30-second rinses, regardless of the product you use, is that the first rinse will mainly become entrapped in the mucin and debris in the saliva, so we would recommend that you swish for 30 seconds and spit it out into an empty cup, and then rinse a second time immediately following. The second rinse will be your main source of antimicrobial activity. The second rinse would ideally be chlorhexidine-based for bacteria kill, and high ethyl alcohol based for virus kill. Right now, Peridex 0.12% chlorhexidine is a natural for the bacteria kill, but I am at a loss to suggest a high ethyl alcohol rinse, since most have been removed from the market about 10 years ago when people thought they might be harming cells. There really is no antiviral rinse commercially available, but you may see some appear now that we have an obvious problem with viruses that are definitely present in the saliva. It is difficult to become excited about a hydrogen peroxide rinse for several reasons: (1) it is easily neutralized by mucin and other human secretions, and (2) many bacteria and red blood cells are equipped with the enzyme catalase which enables them to release this enzyme on contact with hydrogen peroxide and neutralize it.

Surface Disinfection: BioSURF—Why is it not on the EPA COVID-19 list—as of April 16, 2020

BioSURF is not listed on the EPA list of COVID-19 disinfectants because the company did not apply for this listing as quickly as the other companies, but **its application is in now and will definitely**

gain approval since it has commercial laboratory proof of kill of a very resistant virus (parvo) tested in bioburden, which it passed within 50 seconds. This is not data from our lab, but from the commercial lab which was hired to do the EPA testing by Micrylium, which is the company that formulates BioSURF. Bear in mind that the disinfectants on the list have not been tested specifically against COVID-19, but since they have passed tests using other viruses, EPA has allowed entry on its list. Generally, if a company can show inactivation against a resistant **non-envelope virus** such as parvo virus, or the one we use, poliovirus, it can be reasonably assumed the disinfectant will easily inactivate an **envelope virus**, such as COVID-19. Envelope viruses are notably less resistant to chemical inactivation.

The fact that Micrylium tested in the presence of what we call bioburden, which is generally some type of animal protein such as sheep blood or horse serum, and managed to inactivate an extremely resistant virus, which is actually prevalent in dogs, it should have no trouble gaining entry onto the list and should have no problem inactivating COVID-19 in the presence of human secretions. Micrylium is one of the few companies that has elected to submit testing using a bioburden. For such testing, I would prefer use of human proteins (saliva, blood, mucous, nasal secretions, etc.) in relevant concentrations. I would like to see all Hospital/Healthcare Level disinfectants required to pass testing using human secretions in the test because this is what we face clinically when we try to disinfect our operatories. We do not face bacteria and viruses in pure culture, but wrapped within mucous, blood, pus, crevicular fluid, etc.

Surface Disinfection: Optim 1

Optim 1 is a hydrogen peroxide-based hard surface disinfectant sold by SciCan. They claim a very short contact time and make it look great. **The game changer in this equation is the human proteins that the disinfectant must overcome in order to achieve kill of the microbes wrapped within—such as blood, saliva, pus, nasal secretions, crevicular fluid, etc.** Unfortunately, hydrogen peroxide does not perform well in the presence of these types of proteins. Instead, it is quickly neutralized. Notably many bacteria and red blood cells all have a specific enzyme called catalase, which specifically neutralizes hydrogen peroxide to preserve their life. If you have ever placed hydrogen peroxide onto a bloody surface or lesion, you will notice an immediate furious bubbling, which indicates the reaction taking place between catalase and the hydrogen peroxide. Many people see this bubbling as “hydrogen peroxide cleansing action” and do not actually realize it is a chemical reaction indicating the neutralization of the hydrogen peroxide.

Surface Disinfection: Wetting your own wipes and storing them for use as needed

The practice of pre-wetting wipe material in the office is something that has been prevalent in dentistry for many years. We just can't seem to get rid of it, even though it is a very poor practice. **Your wipe needs to be wet immediately before use** in order to gain the full kill potential of any type of environmental surface disinfectant, regardless of its formulation.

There is one other way a **pre-wet** wipe could be dispensed and retain its efficacy, but it is not on the market. The wet wipe could be **individually sealed within an air-tight wrapper**, something like the

hand non-disinfectant wipes at Colonel Sanders given out to clean up after eating the greasy chicken. Right now, there is no such disinfecting wipe packaged in this manner on the world market, but we are hoping such a product will come available in the future. The goal is to keep a highly effective high ethyl alcohol formulation on a pre-wet wipe sealed and free of evaporation and volatilization of the active ingredient. Although the wipes that are homemade in your office are wet—a formulation that was a poor antimicrobial to begin with—then becomes degraded due to the inability to seal after wetting. Even if you use a Tupperware-type container, you do not have a 100% seal, free of any chemical evaporation and volatilization.

Ultraviolet (UV) Light Disinfection

We HAVE worked with UV disinfection for both air and surfaces, and we use this technology in our virology cleanroom. HOWEVER, it provides **supplemental** disinfection, and is not the whole answer. It has limitations in the distance it can be from its target, shaded areas it cannot contact, and percent kill, which is not 100%. You may see advertisements of anywhere from 95–99% kill, and although this sounds impressive, if you use a conventional 1 million organism test challenge, even a 99% kill leaves 10,000 organisms still viable!

In our cleanroom, we use the UV light as a supplemental disinfection along with use of an 89% ethyl alcohol disinfectant formulation for surfaces, and negative air filtration for ambient air.

BOTTOM LINE—UV disinfection can help, but it doesn't do the whole job.

The conventional UV germicidal lamps transferred electromagnetic energy from a mercury arc lamp to the organism's genetic material (DNA or RNA) and terminated the microbe's ability to replicate. These lamps operate at 254 nm. The problem with them was that they can cause **carcinogenic effects** and **cataracts**, and they **emit the germicidal energy for a measured amount of time and then, although they continue to emit light, they are no longer germicidal**. Therefore, you need to operate them on a timer so you could tell when they "burned out." Another disadvantage is that the light cannot be germicidal to surfaces that do not directly "see" the light (in other words in shadows and under countertops).

Of interest to us right now is **far-UVC light (207-222 nm)**. This wavelength does not have the negative affect on skin and eyes that the conventional UV germicidal light wavelength (254 nm) has had. HOWEVER, testing I have seen reports a 95% reduction in the test challenge. This is NOT adequate in my opinion. I still opt for air filtration as the main strategy. UV light can be a supplemental measure.

Rella P. Christensen, RDH, PhD

Dr. Rella Christensen co-founded CR Foundation and directed this well-known dental products testing institute for 27 years. Subsequently she served as Chairman of the Board of Directors. Currently she is the team leader of a non-profit institute dedicated to in-depth and long-term clinical studies of restorative materials, preventive dentistry, and dental caries, known as Technologies in Restoratives and Caries Research (TRAC Research) which is the human studies section of CR. Her studies follow treatments within dental practices.

Rella received her BS in Dental Hygiene from the University of Southern California, and practiced dental hygiene for 25 years. She earned a PhD in physiology with an emphasis in microbiology from Brigham Young University, and completed a post-graduate course in anaerobic microbiology at Virginia Polytechnic State University. In 2002, she received an honorary doctorate from Utah Valley University. In 2012, Rella received a Congressional Record Tribute for her life-long contributions to the profession of dentistry.

She is a member of International College of Dentists, American Academy of Esthetic Dentistry, Academy of General Dentistry, and International Association for Dental Research.

Streaming Video Available for Purchase from PCC

Preparing for Your Return to Dental Practice in the New COVID-19 World

Instructor: Rella P. Christensen, RDH, PhD

www.pccdental.com/online-infection-control-with-rella

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June 2020, Volume 13 Issue 6 (Coming Soon)

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<https://www.cliniciansreport.org/products/dental-reports/>

May 2020, Volume 13 Issue 5

- COVID-19: Updated and Latest Dental Implications and Solutions
- TRAC Research: Dental Office Infection Control Myths and Dangerous Beliefs
- What Essential Armor Do You Need for the COVID-19 Battle?

<https://www.cliniciansreport.org/products/dental-reports/clinicians-report-may-2020-volume-13-issue-5.php>

March 2019, Volume 12 Issue 3

- Make Excellent Air Quality a Priority in Your Practice

<https://www.cliniciansreport.org/products/dental-reports/clinicians-report-march-2019-volume-12-issue-3.php>

July 2018, Volume 11 Issue 7

- Is Your Face Mask Really Protecting You?

<https://www.cliniciansreport.org/products/dental-reports/july-2018-volume-11-issue-7.php>