



# Could X-Ray Irradiation Be Used as an “Irradiation Vaccine”?

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## Abstract

In medical practice, X-ray is mainly used as a diagnostic test and a type of radiation therapy for cancer and other diseases. However, the X-rays seem no use in the prevention of diseases. Since X-rays can alter gene expression patterns in host cells, it might have capacity to protect people from all viral infections based on our antiviral theory. We assume that X-ray irradiation on the upper respiratory tract could protect normal people from respiratory viral infections. If a low-dose X-ray irradiation could protect people for 6 to 12 months, the X-ray irradiation could be taken as an “irradiation vaccine”, which could replace normally used antigen-based vaccines for preventing all viral infections.

## Subject Areas

Pharmacology

## Keywords

X-Ray Irradiation, “Irradiation Vaccine”, Preventive X-Ray Machine, Respiratory Viruses, Pandemic

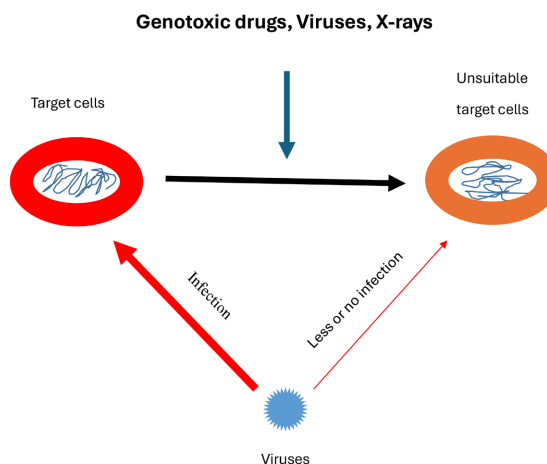
## 1. Introduction

Respiratory viral infections can bring about seasonal epidemics and pandemics. In the last two decades, major viral pandemics including coronavirus disease 2019 (COVID-19) pandemic are caused by respiratory viruses [1] [2], which suggest that prevention of respiratory viral infections is very important. Immunization with antigen-based vaccines is the most effective and safe way to prevent viral infections. However, development of antigen-based vaccine takes a long time and variant of a virus could make the original vaccine useless. Therefore, an alternative to antigen-based vaccines should be explored. Clinically,

X-ray is a common imaging test that has been used for more than 100 years [3] and a type of radiation therapy to treat cancer and other diseases [4] [5]. Currently, there is no report that X-rays could be used in the prevention of diseases. In 2020, we first published a novel antiviral theory that suggests that any genotoxic agents including X-ray irradiation could protect people from viral infections [6] [7]. In December 2021, we uploaded a poster entitled as “low-dose X-ray irradiation (‘irradiation vaccine’) could be used as an ‘ultimate weapon’ to end COVID-19 pandemic” to ResearchGate (<https://doi.org/10.13140/RG.2.2.25589.29925>). Now the similar idea of using X-ray irradiation on human body to protect people from viral infections is presented in this paper.

## 2. X-Ray Irradiation for Preventing Respiratory Viral Infections

Based on our antiviral theory, the reason why a virus can infect its target cells is because the gene expression pattern in the target cells is suitable for the viral infection. If gene expression patterns in the target cells could be temporarily altered, the susceptibility of target cells to viral infection will be reduced. This strategy could be used to prevent all viral infections. Since the three-dimensional (3D) genome architecture determines gene expression patterns, altering 3D genome architecture means altering gene expression patterns. The agents that can affect 3D genome architecture include chemical agents (genotoxic drugs), biological agents (viruses) and physical agents (X-ray) [6] [7]. Genotoxic drugs, viruses and X-ray share the same mechanism of antiviral action, which is altering gene expression patterns in target cells (**Figure 1**).



**Figure 1.** Genotoxic drugs, viruses and X-ray share the same mechanism of antiviral action. Red cell = normal cells; Orange cell = the cells with altered gene expression patterns. The antiviral theory states that the reason why a virus can infect its target cells is because gene expression patterns in the target cells are suitable for viral infection. Therefore, alteration of gene expression patterns in host target cells could prevent viral infections. The 3D genome architecture in host target cells could be affected by either of genotoxic drugs, viruses, and X-ray irradiation, leading to alteration of gene expression patterns, which might perturb multiple biological pathways in host cells and thus make the host cells unsuitable for viral infections.

Most anticancer drugs are genotoxic, which is the reason why most anticancer drugs have antiviral effects [8]. Viruses belonging to biological agent can change host genome structure for their use [9] [10], which indicates that viruses could alter gene expression patterns. Usually, when the first virus invades cells, it might change host genome structure for its replication, which could alter gene expression patterns and thus prevent other viral infections. This view could be used to explain the reason why one virus infection could prevent other viral infections [11]. X-rays belonging to physical agent can change 3D genome architecture [12], which suggests that X-ray irradiation could alter gene expression patterns. In fact, many research results have exhibited that X-ray irradiation can alter gene expression patterns in different cells [13] [14] [15] [16] [17].

The target cells of respiratory viruses are epithelial cells of upper respiratory tract. How long the target cells with altered gene expression patterns last will determine the period of protection. If nose, mouth, and throat (NMT) are irradiated by a low-dose X-ray (the dose should be the same as or less than X-ray imaging dose), the target cells with altered gene expression patterns will disappear about 2 months later because the turnover rate of airway epithelial cells is only 30 - 50 days [18]. However, if epithelial stem cells are considered, the things will be different. X-ray irradiation can cause epigenetic changes in stem cells which will pass the epigenetic aberrations to new cells for few generations [19] [20]. Additionally, epigenetic changes could affect 3D genome architecture [21], which suggests that few generations of regenerated epithelial cells will contain altered gene expression patterns even without X-ray irradiation and thus could prolong the protected period. Certainly, more laboratory experiments should be conducted to prove the length of the protected period and what dose of X-ray should be used. If the results of human trials show that one low-dose X-ray irradiation on human NMT can protect people for 6 - 12 months, this X-ray “irradiation vaccine” could be used to replace antigen-based vaccines. The X-ray machine maker could produce a high-tech preventive X-ray machines that could be installed in airport, hospital, school, shopping center, hotel, and sports stadium, etc., for irradiating or “immunizing” people. If large portion of population are irradiated, quite like “population immunity”, the “population irradiation” could be realized, which will block viral transmission within population and thus end the viral pandemic in a short period of time. To avoid repeated irradiation on one person during valid protected period, the preventive X-ray machine can produce an X-ray irradiation record paper or pass, which could be used as evidence.

X-ray irradiation on human NMT is only for preventing respiratory-viral infections. Liver irradiation could be used to prevent hepatitis and malaria. But to protect whole body from viral infections, study of low-dose X-ray irradiation on whole body is necessary. If gene expression patterns in lymphocytes are altered by whole body X-ray irradiation, prevention of HIV infection could be possible. Besides, whole body X-ray irradiation might be able to prevent cancer. Development of cancer usually takes about 10 years. At early stage, a small number of

cancer cells exist in human body. If whole body X-ray irradiation is applied, the gene expression patterns in cancer cells will be altered, which could make the cancer cells be killed by immune system or regain apoptotic control, leading to suicide.

Collectively, the “irradiation vaccine” delivered by the preventive X-ray machine is a cure-all “vaccine” for preventing known or unknown virus infections. The “vaccine” is non-antigen-based, non-invasive, low cost, as safe as taking X-ray imaging test, easy to realize “population irradiation”, and could be repeatedly used to combat the epidemics or pandemics caused by any viruses.

### 3. Conclusion

During COVID-19 pandemic, one lesson we have learnt is that development of vaccines takes a long time and variant of a virus could make the original vaccine useless. Therefore, to combat the next epidemics or pandemics caused by known or unknown viruses, it is necessary to explore an alternative to antigen-based vaccines. We propose that study of using X-ray irradiation as an “irradiation vaccine” to prevent seasonal viral infections or combat epidemics or pandemics is of crucial importance. We also assume that “population irradiation” through rollout of X-ray irradiation could be easily realized, which could quicken the process for ending the pandemics. To support this non-antigen-based vaccine exploration, many laboratory experiments and human trials should be conducted. Hopefully, the preventive X-ray machine could become an important weapon against the epidemics or pandemics caused by known or unknown viruses.

### Conflicts of Interest

The author declares no conflicts of interest.

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