Among the many diseases, the harm of infectious diseases is undoubtedly the first in terms of the scope of the disease and the threat to humans. In addition, most infectious diseases were regarded as terminal illnesses in the early stage of the outbreak. For example, smallpox and plague in history have even chosen to isolate patients and abandon them to prevent the spread of infectious diseases due to the lack of protection and treatment methods. Therefore, in the treatment of infectious diseases, epidemic prevention is very important. Based on this, this article discusses the research of special medical clothing design for epidemic prevention based on mathematical model analysis, hoping to provide strong help and support for epidemic prevention. First of all, this article understands the application status of mathematical models in the medical field and clothing design industry through literature research. Then, according to the functional requirements of antiepidemic medical special clothing in terms of protection from virus invasion and infection by other contact methods, this article established an antiepidemic clothing quality evaluation index system. Then, this article designs a simulation penetration test of pathogenic bacteria to test the protective function of the antiepidemic clothing and uses mathematical models to analyze the molecular structure and physical properties of the antiepidemic clothing materials. Finally, this article builds an analytic hierarchy model for the quality evaluation of epidemic prevention clothing based on the principle of analytic hierarchy process, analyzes the simulated experimental data and predicts the service life of the epidemic prevention clothing according to the performance degradation so that medical staff can replace it in time. The experimental results show that with the aid of mathematical model analysis, the quality of the epidemic prevention clothing is higher than the previous antiepidemic clothing design in terms of epidemic prevention performance, and in addition to the disposable epidemic prevention clothing, the multiple-use epidemic prevention clothing is not serious in the epidemic. Under these circumstances, it can maintain the antiepidemic performance for more than 2 months.

1. Introduction

1.1. Background and Significance. With environmental pollution and the use and proliferation of chemical pesticide products, ecosystems in more and more regions have been destroyed, which eventually brought the consequences of an epidemic outbreak to humans. Since the first case of unidentified pneumonia was discovered on December 8, 2019, the new crown pneumonia epidemic has been out of control. In the process of humans fighting the epidemic, the importance of special medical clothing for epidemic prevention is self-evident [1]. In this protracted struggle between humans and the epidemic virus, the quality and quantity requirements of special antiepidemic medical clothing are increasing day by day. The design of special antiepidemic medical clothing is not only an important strategic resource in the fight against the epidemic but also a guarantee for the safety of great medical staff. According to relevant research on antiepidemic clothing design, the primary requirement of antiepidemic clothing design is to protect against infections by viruses and bacteria and other microorganisms and to isolate the bites of viral vectors and other means of infection [2]. Secondly, it takes into account the needs of medical staff for ventilation and heat dissipation, and in the process of epidemic treatment and protection, due to the needs of various treatment methods such as medical surgery, the tightness of the material molecules, electrostatic characteristics, and microorganisms of the epidemic prevention
1.2. Related Research at Home and Abroad. At present, there are many applications of mathematical models in the medical field, and their applications in the apparel design industry are also very popular. However, there are not many researches on the application of mathematical models to the design of epidemic prevention clothing. Therefore, this article analyzes the application status of mathematical models in the field of epidemic prevention and clothing design. Research Background. Treble used mathematical models to predict and analyze the heat treatment of the crystal design for medical implant applications to stabilize the short-term aging characteristics of the crystal. The experiments have found that the mathematical model analysis not only takes into account the reliability of all aspects but also has higher accuracy in predicting the stability and aging of the crystal. Gentle used computer software tools combined with mathematical model analysis to study drug treatment decision-making under the drug interaction of elderly depression [5]. Studies have shown that this method uses new decision support tools for drug genetic testing, drug interaction evaluation, and therapeutic drug monitoring, which can improve informed decision-making on antidepressant prescriptions. Mehmet used a mathematical model to compare and analyze the success rate of silodosin and the most commonly used exclusive medical therapy in the management of ureteral stones. He used the Review Manager software to calculate meta-analysis and forest plot data to compare the stone excretion rates of the two therapies [6]. The results showed that good results were observed for the stone removal rate of silodosin, and its hazard ratio was 1.33. Eliton used predictive mathematical models to simulate to obtain information about parameters such as temperature, relative humidity, and vapor pressure so as to measure the moisture accumulated in the clothing insulating materials [7]. Experiments show that the application of mathematical models can simulate the heat transfer and moisture transfer in fabric samples, and the finite volume method is combined to verify the consistency of the simulation results with physical reality.

The application of mathematical models in various fields in China has also been developing rapidly, and rich research results have been obtained. Yue et al. proposed the use of computer technology combined with mathematical models to design the emergency diagnosis trauma orthopedics consultation strategy during the epidemic of new coronary pneumonia [8]. The investigation found that during the epidemic of new coronary pneumonia from January 21, 2020, to February 15, 2020, 128 orthopedic trauma patients in Wuhan University People’s Hospital sought emergency treatment in orthopedic surgery, including 71 men and 57 women [9]. The timely treatment of these patients benefited from the admission strategy of the mathematical model based on the patient’s order of treatment. Cai et al. studied the construction of many departmental dynamic information monitoring platforms in Shanghai’s precision epidemic prevention during the 2019 new crown pneumonia epidemic [10]. The study found that the information monitoring platform combines the application of mathematical models and computer communication technology, breaking the information sharing barriers during the epidemic, and is essential for controlling the source of infection, cutting off the route of transmission, and protecting vulnerable groups. Xu et al. proposed the use of the Bayesian inference method to solve the corresponding inverse problem of textile material design by reconstructing the mathematical model of heat and moisture transfer in textiles to verify the transfer of the heat and moisture transfer model to ensure the thermal comfort of clothing [11]. Experiments have proved that the Bayesian inference method can provide more accurate solutions to the corresponding inverse problems in textile material design.

1.3. Innovations in this Article. In this article, the design of special clothing for epidemic prevention and medical treatment is taken as the research object, and the mathematical model analysis method is creatively used to combine the research of epidemic prevention and clothing design in the medical field through computer science and technology, which opens up a new perspective for the design of special clothing for epidemic prevention and medical treatment [12]. Theoretically speaking, the design of special clothing for epidemic prevention and medical treatment based on mathematical model abandons the previous model of mechanical design on demand and evaluates and considers the quality of special clothing for epidemic prevention and medical treatment from all aspects through the analytic hierarchy process, so as to extract the key factors that should be considered in the design of special clothing for epidemic prevention and medical treatment [13]. From a practical point of view, the design of special clothing for epidemic prevention based on mathematical model analysis in this article can more accurately find out the shortcomings of the design of epidemic prevention clothing, help to improve the design scheme of epidemic prevention clothing in time, change the design mode that people used to find problems and then improve after use, and improve the quality of epidemic prevention work [14]. Finally, this article has carried out the simulated infiltration experiment of pathogenic bacteria to test and verify the epidemic prevention function of the epidemic prevention clothing so as to ensure the excellent function of the design of the epidemic prevention clothing. According to the test results of the simulated invasion experiment of pathogenic bacteria, the design method of epidemic prevention clothing based on mathematical model analysis studied in this article can better control the protection function of epidemic prevention clothing.
2. Mathematical Model of Medical Clothing Design for Epidemic Prevention

2.1. Molecular Spatial Structure of Materials for Epidemic Prevention Clothing. The most important thing in the design of antiepidemic medical special clothing is the selection and treatment of clothing fabrics. Therefore, the molecular spatial structure of clothing fabrics needs to be analyzed during the design of antiepidemic clothing. For the case where the material design of the antiepidemic clothing has a plane scale that is much larger than the vertical three-dimensional scale, due to clothing thickness, molecular diffusion, and other parameters that affect the material’s molecular structure over time and space, the change in the vertical direction, that is, the thickness, is much smaller than the horizontal direction [15]. Therefore, the control equation of the three-dimensional molecular structure of the antiepidemic clothing is studied by the clothing thickness integral, and the average thickness of the clothing is taken to obtain the two-dimensional molecular flow control equation averaged along the clothing thickness. The plane two-dimensional molecular flow continuity equation of the antiepidemic clothing material is as follows:

\[
\begin{align*}
\frac{\partial h}{\partial t} + \frac{\partial U_x}{\partial x} + \frac{\partial U_y}{\partial y} &= S_h,
\end{align*}
\]

where \(h\) is the thickness of the antiepidemic clothing, \(U_x\) and \(U_y\) are the average flow velocity of the antiepidemic clothing material molecules in the \(x\)-direction and \(y\)-direction, \(t\) is the use time of the antiepidemic clothing, and \(S_h\) is the size of the air molecule flow rate at the bonding point of the material molecular spatial structure. Through this equation, we can understand the change process of the material molecules of the antiepidemic clothing over time and analyze the performance degradation of the antiepidemic clothing over time [17]. Since the accumulation of microorganisms and dust particles will have absorbed the ventilation and heat dissipation properties of the epidemic prevention suit, this article also studied the spatial dispersion process of material molecules based on the principle of molecular diffusion. The spatial dispersion equation of the surface layer of the epidemic prevention suit is as follows:

\[
\begin{align*}
\frac{\partial U}{\partial t} + \nabla \cdot F(U) = \frac{\partial}{\partial t} \left( \frac{\partial F_x}{\partial x} \right) + \frac{\partial}{\partial y} \left( \frac{\partial F_y}{\partial y} \right) = S(U).
\end{align*}
\]

Among them, \(U\) represents the plane subdivision of the antiepidemic clothing material into a large number of nonoverlapping units and \(I\) and \(J\), respectively, represent the nonviscous flux and viscous flux of the antiepidemic clothing, that is, the molecular flow of molecules in the air that diffuse through the antiepidemic clothing. \(F_x\) and \(F_y\) denote the cell boundaries in the \(x\)-direction and \(y\)-direction in the Cartesian coordinate system, respectively. \(S(U)\) represents the molecular flow of the molecular unit in the material plane of the antiepidemic suit. This molecular space discrete equation is established based on the finite space volume method, and integrated by Gauss’s theorem, the equation can be written as follows:

\[
\begin{align*}
\int_{\Omega_i} \frac{\partial U}{\partial t} \, d\Omega + \int_{\Gamma_i} (F \cdot n) ds = \frac{\partial U_i}{\partial t} + \frac{1}{A_{\Omega_i}} \sum_{i=1}^{N} F \cdot n \Delta t, \\
S(U) d\Omega = S_i,
\end{align*}
\]

where \(A_{\Omega_i}\) is the area of the spatial molecular unit \(A_{\Omega_i}, U_i\) and \(S_i\) are the average number of molecules and the molecular flux of \(i\) unit, and \(\Delta t\) is the length of the unit. According to Gauss’s theorem, the time integration can also be used to obtain the time dispersion equation of the molecular diffusion of the antiepidemic clothing material, where \(n\) represents the number of plane molecular units of the antiepidemic clothing material and \(\Delta t\) represents the use time.

\[
\begin{align*}
U_{n+1/2} &= U_n + G(U_n) \Delta t/2, \\
U_{n+1} &= U_n + G(U_{n+1/2}) \Delta t.
\end{align*}
\]

2.2. Establishing Quality Evaluation Index System for Epidemic Prevention Clothing. According to the research on the design of special antiepidemic medical clothing, this article evaluates the quality of antiepidemic clothing from the aspects of functionality, material properties, comfort, ease of handling, and economy [18]. At the beginning of the design of antiepidemic clothing, this article took into account the needs of epidemic protection and established a quality evaluation index system for the design of antiepidemic clothing according to various factors such as policy factors, economic factors, technical factors, management factors, and disposal of antiepidemic clothing design [19]. Through the above analysis of the influencing factors of the quality evaluation of epidemic prevention clothing, this article first establishes the first-level quality index set \(A\) of the epidemic prevention clothing quality evaluation and the second-level evaluation index set \(B\) under it as follows:

\[
A = \{a_1, a_2, \ldots, a_m | m = 7\}, \\
B = \{b_1, b_2, \ldots, b_n | n = 14\}.
\]

Among them, \(a_i\) represents the seven first-level indicators of material molecules, coating technology, special fabrics, fabric stitching, customized prices, use time, and disposal, and \(b_j\) represents the 14 second-level indicators in the specific design process of epidemic prevention clothing under the first-level evaluation indicators. According to the second-level indicators, it can be subdivided into about 30 third-level indicators. After the above analysis, the first-level indicator weight set \(W\) is established.
The evaluation index set, the second-level index weight set weights of evaluation indicators at all levels [20]. Similar to hierarchy process and entropy method to determine the epidemic clothing is the determination and calculation of the most important step in evaluating the quality of antiepidemic medical clothing can start from the aspects of protection, comfort, physical properties, chemical properties, and other durability properties and water shrinkage of the finished antiepidemic clothing, including material molecules, coating technologies, special fabrics, seven first-level indicators such as fabric stitching, customized price, use time, and waste disposal. The quality evaluation index system of antiepidemic clothing design in this study is shown in Table 1.

\[
W = \{w_1, w_2, \ldots, w_n \mid n = 7\}, \quad \sum_{i=1}^{n} w_i = 1,
\]
\[
W_i = \{w_{i1}, w_{i2}, \ldots, w_{in} \mid i = 1, \ldots, 14\}, \quad \sum_{j=1}^{n} w_{ij} = 1.
\]

In the design of special antiepidemic medical clothing, the most important step in evaluating the quality of antiepidemic clothing is the determination and calculation of weights. This article mainly draws on the ideas of analytic hierarchy process and entropy method to determine the weights of evaluation indicators at all levels [20]. Similar to the evaluation index set, the second-level index weight set \( W_{ij} \) represents the weight of the \( j \)-th second-level evaluation index under the \( i \)-th first-level evaluation index. In addition, it should be noted that the weight index set needs to meet the condition that the sum of the weight of each index set is 1. After the weight set is determined according to the entropy method, the index evaluation set and the membership elements of these evaluation sets correspond to the membership matrix operations to calculate the weights of evaluation indicators at different levels [22]. The calculation of each quality impact index in the design of epidemic prevention clothing at different levels [22]. The calculation of the weight is transformed into the corresponding evaluation index set, and then, the quality level of the antiepidemic clothing design is analyzed according to the principle of membership degree. The quality assessment of special antiepidemic medical clothing can start from the aspects of protection, comfort, physical properties, chemical analysis set can be established, which can be expressed in the following form:

\[
E = \{e_1, e_2, e_3, e_4, e_5\},
\]
\[
M = \{1, 3, 5, 7, 9\}.
\]

Each element in the antiepidemic clothing index evaluation set \( E \) represents the quality level from low to high, namely, five levels of extremely poor quality, poor quality, average quality, good quality, and excellent quality [21]. The elements of these evaluation sets correspond to the membership degree set is \( M \). Through experimental tests, the evaluation scores of all levels of evaluation indicators for the quality of epidemic prevention clothing can be obtained, and then, the membership vector \( E \) of the corresponding first-level index can be obtained, and the comprehensive evaluation set of the second-level quality evaluation index under the first-level evaluation index can be further obtained \( U \).

\[
\vec{E} = (e_1, e_2, \ldots, e_n)^T, \quad n = 7,
\]
\[
U = W \cdot \vec{E} = (w_{11}, \ldots, w_{1n}) \cdot (e_1, e_2, \ldots, e_n)^T = (u_1, u_2, \ldots, u_n),
\]

2.3. Constructing the Analytic Hierarchy Model for Quality Evaluation of Epidemic Clothing. Epidemic-preventing clothing’s protection requirements for viruses, bacteria, etc., and complex functional requirements in various situations determine that it is difficult to use a single standardized method to evaluate its quality. According to the analytic hierarchy process, this article decomposes the quality evaluation of epidemic prevention clothing into multiple indicators and then uses linear algebra knowledge such as matrix operations to calculate the weights of evaluation indicators at various levels so as to determine the importance of each quality impact index in the design of epidemic prevention clothing at different levels [22]. The calculation of the weight is transformed into the corresponding evaluation index set, and then, the quality level of the antiepidemic clothing design is analyzed according to the principle of membership degree. The quality assessment of special antiepidemic medical clothing can start from the aspects of protection, comfort, physical properties, chemical properties, and other durability properties and water shrinkage of the finished antiepidemic clothing, including material molecules, coating technologies, special fabrics, seven first-level indicators such as fabric stitching, customized price, use time, and disposal. The first-level index evaluation matrix for the quality of epidemic prevention clothing in this article is as follows:

\[
E = \begin{bmatrix}
Y & A_1 & A_2 & A_3 & \ldots & A_7 \\
A_1 & a_{11} & a_{12} & a_{13} & \ldots & a_{17} \\
A_2 & a_{21} & a_{22} & a_{23} & \ldots & a_{27} \\
A_3 & a_{31} & a_{32} & a_{33} & \ldots & a_{37} \\
\vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\
A_7 & a_{71} & a_{72} & a_{73} & \ldots & a_{77}
\end{bmatrix},
\]

The first-level index judgment matrix \( E \) represents the importance judgment value of two insulation evaluation indexes compared with each other and \( a_{ij} \) represents the judgment value of the importance of the evaluation index \( a_i \) compared to the evaluation index \( a_j \). In the above judgment matrix, the left side is the importance level evaluation matrix of the criterion layer, \( u_i \) represents the product of each row element of the importance evaluation matrix, \( v_i \) represents the value of the square root of each element in \( U \) according to the matrix order, and then \( w_i \) represents the value of each element in \( V \) and the ratio of the sum of all elements. According to the knowledge of matrix normalization operations, their calculation formulas are as follows:
Table 1: Design quality evaluation index system for epidemic prevention clothing.

| First level | Meaning     | Second level | Meaning   | Third level | Meaning     |
|------------|-------------|--------------|-----------|-------------|-------------|
| A1         | Material    | B1           | Comfort   | C1–C2       | Edition type |
| A2         | Coating     | B3           | Skin-friendly | C5–C7     | Craft       |
| A3         | Fabrics     | B5           | Physical  | C10–C12     | Policy       |
| A4         | Stitching   | B7           | Breathable| C15–C16     | Supervision  |
| A5         | Prices      | B9           | Parity    | C19–C21     | Sales        |
| A6         | Usage time  | B11          | One time  | C24–C25     | Promotion    |
| A7         | Disposal    | B13          | Biodegradable | C28–C29   | Pollution    |

\[
\begin{align*}
    &\left\{ \begin{array}{l}
    u_i = \prod_{j=1}^{n} a_{ij}, i = 1, \ldots, 7, \\
    v_i = \sqrt[n]{u_i}, w_i = \frac{v_i}{\sum_{i=1}^{n} v_i}
    \end{array} \right. \\
    \lambda_{\text{max}} = \sum_{i=1}^{n} \frac{(E \ast W)_{ii}}{nw_i}
\end{align*}
\]

In order to verify the consistency of the evaluation indicators of the antiepidemic clothing quality evaluation hierarchy analysis model in this article, after calculating the weights of the antiepidemic clothing quality evaluation indicators through the judgment matrix and the weight matrix, the model needs to be CR verified. The main principle of CR verification is to calculate the consistency ratio of the evaluation matrix of the model by the ratio of the consistency index of the evaluation matrix to the average random consistency index of the same order matrix and analyze the evaluation performance of the model [23]. The consistency index of the evaluation matrix also needs to be obtained by the maximum eigenvalue of the matrix. The calculation formula for the maximum eigenvalue \(\lambda_{\text{max}}\) of the evaluation matrix is as follows:

\[
\lambda_{\text{max}} = \sum_{i=1}^{n} \frac{(E \ast W)_{ii}}{nw_i}
\]

According to the principle of consistency verification, when the consistency ratio is zero, the judgment matrix has complete consistency. This verification method can also flexibly grasp the weight of each indicator in the evaluation indicator system according to one’s own tendency and realize the reasonable distribution of weight through appropriate weight adjustment. According to the calculation of the maximum eigenvalue of the evaluation matrix, the calculation formulas of the consistency index CI and the consistency ratio CR of the evaluation matrix can be obtained as follows, where the average random consistency index of the seventh-order matrix is RI = 1.32 according to previous studies.

\[
\text{CI} = \frac{\lambda_{\text{max}} - n}{n - 1}, \quad \text{CR} = \frac{\text{CI}}{\text{RI}}
\]

2.4. Verification of Physical Properties and Antiepidemic Performance of Antiepidemic Clothing. The most important performance of antiepidemic clothing is to protect users from infection by pathogenic bacteria and other pollution sources. However, when medical personnel use antiepidemic clothing, the diffusion of molecules in the air and the heat generated by the users themselves aggravate the movement of molecules. The performance of antiepidemic clothing will inevitably decline. In addition, medical staff may also be contaminated during the replacement and removal of epidemic prevention suits [24]. Therefore, it is necessary to carry out high-precision testing of the physical properties of the antiepidemic clothing and also to analyze the antiepidemic performance of the antiepidemic clothing and predict the failure time of the antiepidemic performance so that users can replace it in time. The infiltration equation of dust particles in antiepidemic suits over time is as follows:

\[
\frac{\partial c_i}{\partial t} + \frac{\partial (uc_i)}{\partial x} + \frac{\partial (vc_i)}{\partial y} = P_i - Q_i.
\]

Among them, \(u\) and \(v\) represent the components of the penetration velocity of dust particles in the \(x\)- and \(y\)-directions, and \(c_i\) is the dust particle molecular content of the \(i\) th antiepidemic clothing material plane unit, that is, the relative volume ratio of all molecules. \(P_i\) and \(Q_i\) indicate the amount of dust particles attached to the surface of the antiepidemic clothing and the content of dust particles that penetrate into the inner layer of the antiepidemic clothing. The infiltration equation of pathogenic bacteria in antiepidemic clothing over time is as follows [25]:
where $R_i$ represents the penetration rate of pathogenic bacteria in the material plane unit, $U_i$ is the comprehensive penetration rate of pathogenic bacteria in the unit, $\lambda$ is the penetration influence coefficient, and $d_i$ is the average particle radius of pathogenic bacteria. According to the permeation equation of dust particles and pathogenic bacteria and related knowledge of physics, the deformation equation of the antiepidemic suit over time can be obtained as follows, where $P_{ni}$ is the number of suspected penetrating molecules of the material plane unit, $P_{ni}$ is the number of penetrating molecules of the unit over time, $z_i$ is the amount of material deformation, and $C_m$ is the highest molecular penetration amount that maintains the functional characteristics of the antiepidemic clothing material to prevent bacterial penetration [26].

$$\sum_{i=1}^n P_{ni} (P_i - Q_i) + \sum_{i=1}^n P_{ni} \left( \frac{\partial R_{si}}{\partial x} + \frac{\partial R_{si}}{\partial y} \right) \frac{1}{\lambda} + C_m \frac{dz}{dt} = 0.$$  

(15)

The molecular movement of a larger area close to the plane of the antiepidemic clothing material will cause the infiltration of pathogenic bacteria and dust particles to increase, and when the rate of outward diffusion of pathogenic bacteria on the contact surface is greater than the rate of sedimentation or inward diffusion, the dust on the outer layer of the contact surface particles and pathogenic bacteria will continue to spread and gradually penetrate into the inner layer. The penetration amount of these pollutants can be determined by the following formula. Among them, $t_i$ is the start time of the antiepidemic clothing, and $t_{ci}$ is the pollutant penetration time.

$$\frac{P_i}{Q_i} = \frac{1}{2\pi} \int_{t_i}^{t_{ci}} \left( \frac{1}{t_{ci}} - 1 \right) e^{-t/\sqrt{2C_i^2}} dt = f \left( \frac{t_i}{t_{ci}} \right), \quad t_{ci} = \frac{t_i}{\sqrt{2C_i^2}}.$$  

(16)

### 3. Simulated Penetration Experiment of Virus in Antiepidemic Prevention Clothing

#### 3.1. Research Object.

The research object of this article is the research of special clothing design for epidemic prevention and medical treatment based on mathematical model analysis. According to the principle of mathematical model analysis and analytic hierarchy process, this article considers and tests various factors, such as the spatial structure of material molecules and the penetration rate of dust particles and pathogenic bacteria, of special medical clothing for epidemic prevention. From this, the key points of the design of special antiepidemic medical clothing are extracted and promoted to the production and use of antiepidemic clothing. This article uses the finished product of the antiepidemic suit as a sample to conduct a simulated penetration test of pathogenic bacteria. Under the premise of ensuring the most important antiepidemic function requirements of antiepidemic clothing and controlling a certain cost, the design of special antiepidemic medical clothing through this research can provide excellent antiepidemic clothing options for antiepidemic clothing manufacturers. This research proposes designing and improving the performance of antiepidemic clothing according to the needs of different users, improving the quality of antiepidemic work, and saving certain production costs.

#### 3.2. Pathogenic Bacteria Simulated Permeation Experiment Design.

The purpose of this research is to analyze, design, and improve the design of special medical clothing for epidemic prevention through mathematical models, including the evaluation of various factors such as fabric selection, stitching technology, and finished product production. In this article, the pathogenic bacteria simulation penetration experiment is divided into the following steps. The first step is to understand the key points and quality evaluation methods of epidemic prevention clothing design through literature research and consultation with professionals and establish a quality evaluation index system for epidemic prevention clothing. The second step is to understand the current application of mathematical models in the medical field and clothing design, analyze the problems in the design of antiepidemic clothing in the past, and establish a hierarchical analysis model for the quality of antiepidemic clothing based on mathematical model analysis. The third step is to detect the functional characteristics of the antiepidemic clothing through the pathogenic bacteria simulation penetration test and predict the performance failure time of the antiepidemic clothing under different conditions based on the performance of the antiepidemic clothing in various aspects over time until it fails to remind the user to replace it in time. Finally, through the established analytic hierarchy model for the quality evaluation of epidemic prevention clothing, data processing and error analysis are performed on the results of the simulation experiment to verify the feasibility of the design scheme and the reliability of the quality of the epidemic prevention clothing. Based on this, it can provide manufacturers with antiepidemic clothing design plans and suggestions on production factors such as fabric selection and stitching technology. The main framework of this research is shown in Figure 1.

#### 3.3. Experimental Data Processing and Error Analysis.

According to the requirements of the simulation test, this article improves the detection method of the antiepidemic clothing material space structure and the pollutant penetration rate and further calculates some important indicators that need to be used in the analysis of the simulation test results. The service life of the antiepidemic clothing, that is, the failure time of the antiepidemic performance of the antiepidemic clothing, is mainly affected by the penetration of pollutants, temperature, and material deformation. To this end, this article discusses the detection methods of the above two factors, mainly through the average rate of
pollutant penetration and the mechanical stress of the material deformation of the epidemic prevention clothing to evaluate the failure time of its epidemic prevention performance. Among them, the mechanical stress $M_x$ of the deformation of the antiepidemic clothing material can be calculated by the following formula:

$$M_{sx} = \rho g \frac{\sqrt{u^2 + v^2}}{C_s},$$

$$M_{sy} = \rho g \frac{\sqrt{u^2 + v^2}}{C_s},$$

$$M_x = \sqrt{M_{sx}^2 + M_{sy}^2}.$$  \hspace{1cm} (17)

Among them, $M_{sx}$ and $M_{sy}$ represent the component stress of the mechanical stress of material deformation in the $x$-direction and $y$-direction, respectively. $\rho$ and $g$ are the density and gravitational acceleration of the antiepidemic clothing material. The pollutant average penetration rate $\overline{w}$ can be obtained by the following formula, where $w_{\text{max}}$ and $w_{\text{min}}$ are the maximum and minimum penetration rates of the pollutants.

$$\overline{w} = \frac{w_{\text{max}} + w_{\text{min}} + \sqrt{w_{\text{max}}^2 + w_{\text{min}}}}{3}. \hspace{1cm} (18)$$

### 4. Discussion on Penetration Experiment of Virus in Antiepidemic Clothing Quality

#### 4.1. Analysis of the Selection of Design Fabrics for Epidemic Prevention Clothing

Antiepidemic clothing is also called isolation gown. Its most important functional requirement is to prevent viruses, bacteria, and other infectious agents from contacting the human body. Therefore, the choice of fabric for antiepidemic clothing should meet the requirements of good skin-friendliness and comfortable wearing and has the advantages of being nontoxic and odorless, efficient bacteria isolation, high strength, and good filtration performance and can achieve antistatic, antialcohol, antiplasma, and water-repellent properties and water production and other performance requirements. The general components of antiepidemic clothing fabrics include spun-bonded nonwoven fabric SNF, melt-blown nonwoven fabric MNF, composite nonwoven fabric CNF, PE waterproof and breathable film PEF, TPU composite film, and three-layer thousand mesh TTM. In this article, the moisture resistance of these fabric components was investigated, and the results are shown in Table 2.

According to related research, this article analyzes the moisture permeability of the antiepidemic clothing fabric components and compares spun-bonded nonwoven fabrics, melt-blown nonwoven fabrics, composite nonwoven fabrics, PE waterproof breathable membrane, TPU composite membrane, and three-layer thousand net. The moisture permeability of the material composition is examined by evaluating the resistance of the fabric composition under different humidity. As shown in Figure 2, among all the fabric components, PE film and TPU composite film have the lowest moisture resistance and the best waterproof and moisture permeability, which can be used as an important reference factor for fabric selection.

#### 4.2. Analysis on Spinning Technology of Antiepidemic Clothing Design

According to the survey, the current spinning technologies for apparel design and production mainly include five commonly used spinning technologies, including electric spinning, liquid crystal spinning, melt-jet spinning, solution spinning, and electrostatic spinning. As shown in Table 3, this article compares the heat dissipation performance, waterproof and breathable performance, moisture permeability, and bacteria isolation and electrostatic characteristics of clothing made by five spinning technologies. Antiepidemic clothing is special medical clothing with special functional requirements. Considering the needs of isolation of bacteria and viruses and repeated use of disinfection and sterilization, this article uses electrostatic spinning technology to carry out the antiepidemic
clothing waterproof and breathable composite membrane experiment.

According to survey statistics, among the five spinning technologies, the antiepidemic clothing made by electrostatic spinning technology has the most superior performance. As shown in Figure 3, this article uses a hundred-point system to score the performance of the epidemic prevention clothing under these spinning technologies. The heat dissipation performance, waterproof and breathable performance, moisture permeability, and bacteria isolation characteristics of the epidemic prevention clothing under the electrostatic spinning technology are all rated at 80 points and above. Its electrostatic characteristics are only 43.86, which best fits all the functional requirements of epidemic prevention clothing.

4.3. Protective Function of Antiepidemic Clothing Design.

For the design of medical clothing, the protective function is an indispensable factor in all considerations, and the design of special medical clothing for epidemic prevention is even more so. This article studies the protective functions of the antiepidemic clothing from its antifouling, antibacterial, anticorrosion, antiradiation, and antistatic properties. According to the principles of physical and chemical testing, this study conducted physical and chemical experimental tests on the above protective functions of the antiepidemic clothing design. The test results are shown in Table 4.

Through relevant case studies and consultation with experts, this article tested the main evaluation indicators of the protective function of the antiepidemic clothing and ranked the importance of the indicators according to the test results. As shown in Figure 4, it is obvious that the protective function of epidemic prevention clothing is mainly reflected in the performance of antifouling and antibacterial properties. Therefore, the advantages and disadvantages of these two properties are the main factors for evaluating the protection function of epidemic prevention clothing. On the whole, the importance of antifouling and antibacterial properties of antiepidemic clothing reached 0.5764 and 0.4386, respectively, which are the primary evaluation indicators for protective functions.

### Table 2: Waterproof and moisture permeability of antiepidemic clothing fabric components.

| Humidity | SNF  | MNF  | CNF  | PEF  | TTM  | TPUF |
|----------|------|------|------|------|------|------|
| 0        | 29.87| 15.36| 6.19 | 3.88 | 23.54| 27.68|
| 2        | 34.79| 27.44| 5.97 | 4.69 | 39.86| 31.87|
| 4        | 34.63| 29.38| 8.96 | 9.98 | 20.71| 15.54|
| 6        | 33.06| 33.87|10.39 | 8.99 | 8.64 | 13.65|
| 8        | 35.97| 51.65|17.48 | 9.97 | 15.69| 23.04|
| 10       | 39.86| 58.34|19.86 |12.28 |26.38 |18.97|

### Table 3: Comparison of performance of antiepidemic clothing with different spinning technologies.

| Spinning technology | Heat dissipation | Waterproof and breathable | Moisture permeability | Bacteria isolation | Static electricity |
|---------------------|------------------|---------------------------|----------------------|--------------------|-------------------|
| Electric            | 41.26            | 42.68                     | 54.42                | 66.25              | 91.54             |
| Liquid crystal      | 54.83            | 59.86                     | 47.36                | 51.44              | 87.63             |
| Melt-jet            | 46.34            | 48.75                     | 65.34                | 68.49              | 58.76             |
| Solution            | 78.36            | 66.87                     | 78.17                | 71.63              | 76.49             |
| Electrostatic       | 89.64            | 83.62                     | 90.38                | 88.74              | 43.68             |

Figure 2: Moisture resistance of fabric components of epidemic prevention clothing.
4.4. Antiepidemic Clothing Design Quality Evaluation Test.

According to the quality evaluation index system of antiepidemic clothing discussed and established in this article, this paper calculates and counts the weights of all first-level quality evaluation indexes, as shown in Table 5. Combined with the introduction of the quality evaluation index system and the data in the table below, it can be seen that the A1 index, which is the epidemic prevention performance index, accounts for the most weight among all the first-level quality evaluation indexes. It can be seen that the evaluation of antiepidemic performance should be the primary reference factor for the design of antiepidemic clothing and the first evaluation index for quality evaluation.

In the method part, this article discusses the index system for the quality evaluation of epidemic prevention clothing. The quality evaluation is divided into three levels according to the degree of importance and the different coverage. In the process of detecting the quality of antiepidemic clothing through the simulated invasion experiment of pathogenic bacteria, this article uses mathematical models and related computer software to calculate and process the weights of quality evaluation indicators. The weights of the first-level indicators obtained by the experimental statistics are shown in Figure 5. It can be seen from the figure that the weights of the three indicators A1, A2, and A3, namely, fabric selection, spinning coating, and epidemic
Table 5: Weights of quality evaluation indicators for epidemic prevention clothing.

| Expert | A1     | A2     | A3     | A4     | A5     | A6     | A7     |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 1      | 0.2973 | 0.3312 | 0.0525 | 0.0521 | 0.2005 | 0.0605 | 0.0861 |
| 2      | 0.1976 | 0.2523 | 0.0402 | 0.1245 | 0.2318 | 0.1633 | 0.0713 |
| 3      | 0.3876 | 0.2791 | 0.0263 | 0.0119 | 0.3195 | 0.1012 | 0.0123 |
| 4      | 0.3112 | 0.2274 | 0.1076 | 0.0428 | 0.1693 | 0.0655 | 0.0781 |
| 5      | 0.3745 | 0.1828 | 0.1485 | 0.0345 | 0.3198 | 0.0748 | 0.0432 |
| 6      | 0.1908 | 0.3968 | 0.0323 | 0.1253 | 0.2291 | 0.0895 | 0.0358 |
| 7      | 0.2923 | 0.1987 | 0.0709 | 0.0482 | 0.4712 | 0.1179 | 0.1371 |

Figure 5: Weights of evaluation indicators for the quality of antiepidemic clothing.

Table 6: Survey of satisfaction with the quality of antiepidemic clothing.

| Objects | Style | Color | Comfort | Fabric | Sewing | Performance |
|---------|-------|-------|---------|--------|--------|-------------|
| A       | 54    | 58    | 74      | 78     | 66     | 72          |
| B       | 68    | 63    | 82      | 45     | 68     | 69          |
| C       | 75    | 74    | 67      | 54     | 61     | 83          |
| D       | 66    | 54    | 86      | 63     | 78     | 78          |
| E       | 72    | 49    | 91      | 38     | 84     | 94          |
| F       | 83    | 66    | 78      | 59     | 71     | 91          |

Figure 6: Satisfaction evaluation of antiepidemic clothing quality indicators.
prevention performance, are significantly higher than the other first-level indicators. Therefore, it is the main factor in the design of epidemic prevention clothing.

4.5. Satisfaction Survey on the Use of Antiepidemic Clothing. According to the quality evaluation and analysis of the antiepidemic clothing, this article randomly selected a part of medical staff as the survey subjects and conducted an interview survey on their satisfaction with the quality of the antiepidemic clothing samples designed in this study. This article mainly uses a hundred-point system to conduct a satisfaction survey from the aspects of antiepidemic clothing style, color, comfort, fabric, sewing technology, and performance. Table 6 shows the satisfaction survey results of some medical staff survey subjects.

In order to understand the medical staff survey subjects and the satisfaction of more users of the epidemic prevention clothes with the design of the epidemic prevention clothes in this study, this article divides the result data of the interview survey into six groups, each of 20 medical staff survey subjects, and selects their quality of the epidemic prevention clothes. The median of the satisfaction scores is plotted as a scatter plot as shown in Figure 6. As shown in the figure, the satisfaction scores of all the survey respondents for the antiepidemic performance of the antiepidemic clothing are higher than 60 points, which shows that the antiepidemic clothing designed in this study has a higher antiepidemic performance.

5. Conclusions
This article focuses on the shortage of medical resources in the epidemic prevention work of medical staff during the epidemic of new coronary pneumonia, especially the shortage of special epidemic prevention medical clothing and the failure of protection caused by the quality of epidemic prevention clothing, and proposes special epidemic prevention medical services based on mathematical model analysis. In the research on clothing design, during the investigation of the epidemic prevention work during the epidemic, this article found that with the prolonged wearing time of the epidemic prevention clothing of medical staff, the deformation of the epidemic prevention clothing is caused by the heat generated by the medical staff and the stretching activities of the limbs and the ineffectiveness of the epidemic prevention function is caused by the invasion of the virus to the doctors and nurses. The personnel caused a great threat to their lives. In addition, the inconvenience is caused by the cumbersome disinfection and replacement of antiepidemic suits and the waste of medical resources caused by accidental pollution under the exhausted state of long-term work hinders the smooth implementation of the epidemic prevention work. Based on this, this article proposes a design plan for special medical clothing for epidemic prevention based on mathematical model analysis. Under the premise of ensuring the soundness of the epidemic prevention function of the epidemic prevention clothing, it further predicts the time when the epidemic prevention clothing fails to remind medical staff to replace it in time. On the basis of ensuring quality, it can also be designed and improved according to the convenience of wearing, heat dissipation and ventilation, and comfort to provide technical support and safety guarantee for epidemic prevention.

Based on the mathematical model and the analytic hierarchy process, this paper establishes an analytic hierarchy model for the quality evaluation of epidemic prevention clothing to evaluate the quality of the design of the epidemic prevention clothing. Through the analysis of the results of the simulated penetration experiment of pathogenic bacteria, the antiepidemic clothing designed in this study can be used multiple times after disinfection without changing the molecular structure when the epidemic is not serious, and its antiepidemic function can be maintained for up to two months. Compared with the traditional clothing design method, the quality assessment of the antiepidemic clothing design method based on the mathematical model in this study is more accurate, the antiepidemic performance is more guaranteed, and the failure time of its antiepidemic function can be accurately predicted, and the designed antiepidemic clothing is convenient to wear and heat dissipation. The performance of breathability and comfort is also superior.

Since the antiepidemic clothing is designed with special functional requirements as the goal, this article mainly discusses the design factors of antiepidemic functions and performance degradation of the antiepidemic clothing, and there is no specific consideration for the production, sales, and disposal of the antiepidemic clothing. Therefore, this study still has many limitations. In particular, the impact of the industrial supply chain and external market environment, production costs, and sales prices of antiepidemic clothing operations on the design of antiepidemic clothing is not considered or analyzed. We hope that in the future, we can conduct in-depth research from these aspects, make full use of the characteristics of mathematical model analysis, and provide better solutions for the design of epidemic prevention clothing.

Data Availability
The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest
The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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