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Original Article

Risk Assessment of Drinking Water Supply System of Talesh Based on World Health Organization Water Safety Plan in 2021: A Case Study

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Abstract

Water safety plan (WSP) is a new way to ensure the safety of drinking water by risk assessment and systematic prevention approach. The purpose of this study was to assess the risk and identify hazards from the production source to the point of use and plan to reduce or eliminate these hazards to provide safe drinking water. This study was conducted on the water supply system of Talesh city in 2021. The WSP has 12 stages and the third stage is risk assessment and hazard identification. This stage scored 69 points out of a total of 100 raw points, which indicates 69% coordination with the WSP. Based on the analysis, 47 hazards were identified in production sources, transmission lines, distribution network, and point of use. The presence of domestic sewage wells near the source of supply, undesirable chlorine concentration, and old pipes in the distribution network, as well as the failure of the check valve at the point of consumption are the most important risks. With the implementation of different phases of WSP, especially the stage of identification and assessment of microbial contamination risk in the distribution network, has been decreased to 0% and the desired residual chlorine concentration has been increased to 100%. Currently, water supply system of Talesh has a moderate level of safety.

Keywords: Hazard identification, Matrix, Risk assessment, Supply sources, Water safety plan

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1. Introduction

Providing safe drinking water is very important for maintaining health and survival (1,2). Inadequate management of supply sources leads to the spread of diseases in developed and developing countries and threatens the safety of drinking water when delivered to consumers (3). In developing countries, 2.2 million people die annually due to the lack of drinking water, water-borne diseases, and lack of adequate sanitation (1). Therefore, water supply managers in the world are obliged to provide drinking water with appropriate quantity and quality (4,5).

Traditional monitoring methods and reliance on the final test of drinking water at the time of the accident are not enough, Because of the time-consuming test results and limitations in performing some microbiological indicators, the consumer uses contaminated water. With the introduction of a new plan by the world health organization, those measures are becoming obsolete (2,6,7). The water safety plan (WSP), based on hazard identification and evaluation and risk management from the catchment to the point of use, is now considered as the most reliable means of providing safe water (8,9). In 2004, the World Health Organization (WHO) introduced a guideline for drinking water quality (10). In 2009, the WHO published a booklet outlining the 10 steps of the WSP (11,12). In order to evaluate the implementation of various stages of the WSP, in 2010, the WHO and the International Water Association (IWA) introduced a software called WSP-QA TOOL. This software is a tool that identifies the weaknesses and strengths of each step of the WSP (13,14). To assess risk and prioritize risks, WHO has proposed a semi-quantitative risk matrix approach that uses a 5 * 5 table (15). The safety of drinking water supply depends on various factors such as the quality of raw water, the effectiveness of treatment, distribution of water, and the correct use of it by consumers (6). The goals of WSPs are to prevent the contamination of raw water sources, to purify water to eliminate pollution, and to prevent re-contamination during storage, water distribution, use, and the provision of quality water that can affect health-based goals (5,16). In addition, WSPs can be implemented in developing countries and have significant cost savings in water quality control (12). Conforming to the WHO, the WSP has been performed in 93 countries. These countries include Uganda, South Africa, Ethiopia, Australia, the Pacific Islands, Iceland, Germany, Portugal, Italy, France, Spain, Bangladesh, Guyana and so on (7,17). The objective of this study was to evaluate and identify exposed areas with a very high and high risk of drinking water supply in the supply system of Talesh city according to the WSP of the World Health Organization in 2021. Identifying and predicting weaknesses in the water supply system using WSP-QA TOOL will help us to identify zone that need improvement. Therefore, by controlling these factors, healthy drinking water can be delivered to consumers (18). Due to the importance of implementing WSP in resources, treatment plant, distribution network, and consumption points, the identification and evaluation of hazards have been done in several cities, including Qom, Ardabil, Hamedan, Semnan, and Zanjan, and good results have been obtained from these studies. Therefore, by identifying, evaluating, and providing appropriate solutions by experts, the risks can be reduced to increase the safety of drinking water in water supply systems of all urban and rural communities.

2. Materials and Methods

2.1. Study Area

Talesh is one of the largest cities in Guilan province with a population of 59 159 people in 2019. This city with an area of 1427 km^2, 56 meters above sea level, longitude 48.906337 degrees and latitude 37.796390 degrees are located in northern Iran (Fig. 1). The drinking water of the city is supplied from 15 deep wells with a flow rate of 240 L/s. The length of the transmission line and water distribution network of this city is 14.5 and 138 km. Additionally, 24.65% of the water produced from these sources is unaccounted for water.

2.2. Part I: Water Safety Plan in Talesh

To implement this plan in Talesh, the WSP guide provided by WHO/IWA and the WSP quality assurance tool (WSP-QA Tool) were used. Water quality assurance tool is an excel-based tool which can be used in a wide range of situations. The checklist consisted of 85 questions in 12 stages and was completed using data from the Talesh Water and Sewerage Company, interviews with experts, and field visits. After completing the relevant checklist, the answers of each section were entered into WSP-QA Tool software and the results were obtained in the form of tables and graphs. The data obtained from the recorded information are entered into WSP-QA Tool software in both quantitative and qualitative forms. The answers to the relevant questions in the software are recorded quantitatively and in the same way as the questions, but the necessary answers to the questions entered were based on the scoring system according to the instructions. Numbers 0-4 were used to complete the checklist and answer its questions in this study. Number zero for a step that has not yet begun, number one for a step that has just been completed, number two for a step that has been completed and archived on average, number three for a step that has been significantly completed and registered and the number four for the step that has been completed and their implementation document is easily accessible). After completing the checklist questions, the scores obtained in each step are determined by the software.

2.3. Part II: Risk Assessment and Hazard Analysis

This study includes resource risk assessment, transmission line system, distribution network, and point of use of Talesh water supply system. Hazards were identified and assessed in Talesh by 10 water and wastewater experts who had sufficient experience and expertise. According to the guidelines of the WHO, examples of the most common hazards in the water supply system will be based on

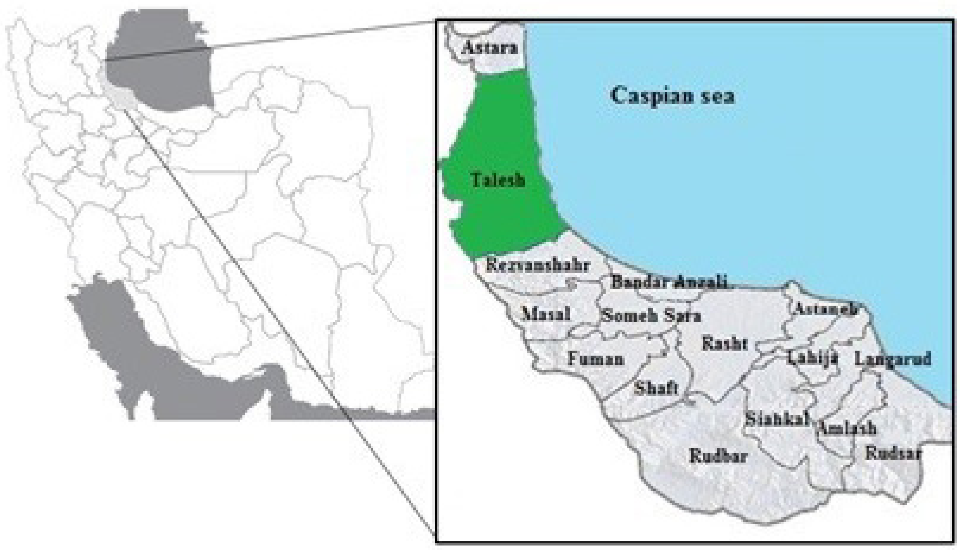

Fig. 1. Location of Talesh.

various research books and articles (19). The purpose of the prioritization matrix is to rank hazardous events to focus on the most important hazards. In this study, experts were asked to rate each risk according to the priority of the identified hazards in each of the following steps. Common hazards to water supply systems according to the WHO WSP include:

- Threatening threats at the source
- Threatening hazards in the treatment plant
- Threatening threats in the distribution network
- Dangers at the point of use (20).

In order to prioritize risks, according to coordination with experts, the lowest risk score is 1 (lowest priority) and the most important risk score is 19 (highest priority). The total number of questions from experts about risk prioritization is 47, which are: 19 risks in water supply, 19 risks in distribution network and tanks, and 9 risks in the place of use. Risks were prioritized by experts in two stages, two weeks after the first stage. The risks that scored the most points in the two stages were selected and the experts were asked to determine the severity and probability for each risk according to the matrix (Table 1). Then, the risks with the highest score (according to equation 1) were introduced as dangerous risks. During this project, the most important hazards and dangerous events affecting the source, transmission lines, and drinking water distribution network of Talesh city were predicted, identified, and analyzed. Finally, in order to review and decrease the specified risks, experts were asked to suggest appropriate corrective measures (17). Internal correlation coefficient (ICC) was used by SPSS software to calculate reproducibility and reliability (Table 2).

$$\text{Intensity} \times \text{Probability} = \text{Danger} \quad (1)$$

3. Results and Discussion

In this study, after entering the information and analysis by WSP-QA Tool, the outcome was reported in the form of tables and diagrams. Table 3 shows the overall evaluation of the WSP steps by each step and the score earned. In this research, the main sectors of the water supply system including wells, network, and point of use in the software were analyzed. In Talesh city, due to the lack of a treatment plant, this part has not been evaluated and is without points. The highest score (100%) and the lowest score (50%) were assigned to the system description stage and management procedures, respectively. In general, the execution of this scheme in the city of Talesh is 50.45% in line with the WSP.

Table 4 also shows progress stages in the main portion of the water supply of Talesh city. The supply source and point of use with 64% have the most and the distribution network with 48% has the least proportionality with the WSP.

Figure 2 shows the third phase of implementing a WSP, which includes three sections: stakeholder identification, risk identification, and risk assessment. In this study, the score of the above section is 68.75, 62.5 and 80%, respectively. The average of this phase is 69% and shows risk identification and risk assessment have scored well.

Based on the analysis of the results presented in Table 5, 19 risks in source supply, 19 risks in the water distribution network and 9 risks at the consumption point have been identified by experts. The most important hazards of water supply sources include 4 hazards (increased microbial contamination due to proximity to domestic sewage wells, poisoning due to chlorine gas leakage in chlorine chamber, microbial contamination due to insects and rodents entering the well due to non-blockage, well panel failure, Burning pump and well motor) with a score of "very high". The other 3 hazards (increased nitrate concentration due to the possibility of domestic sewage infiltration into wells, contamination of wells with chemical fertilizers and pesticides due to farmers' use in farms and orchards and the entry of unknown individuals for bioterrorism) have a "high" score. Among all the dangerous events in the source of supply (increased concentration of microbial contamination due to proximity to domestic sewage wells) if not properly managed, there is a possibility of microbial contamination. The rest of the dangerous events are eliminated or reduced by taking control measures.

Important hazards identified in the distribution network are 6 hazards (increased contamination due to undesirable residual chlorine in the network, contamination created during pipe repairs, entry of unknown individuals into the tank area and bioterrorism activities, biofilm formation and algal blooms inside the tanks, number Many fractures in the distribution network and subscribers due to infrastructure problems and old pipes) were rated "very high" and only one hazard (presence of turbid water at the end of the distribution network) was rated "high". Hazardous events in the distribution network (entry of pollution during repairs, number of incidents in the

Table 1. Semi-quantitative Risk Matrix Approach

Likelihood	Intensity				
	Insignificant, Rating: 1	**Minor, Rating: 2**	**Moderate, Rating: 3**	**Major, Rating: 4**	**Calamitous, Rating: 5**
Approximately sure/once a day, grade: 5	5	10	15	20	25
Presumably/once a week, grade: 4	4	8	12	16	20
Intermediate/once a month, grade: 3	3	6	9	12	15
Not likely/once a year, grade: 2	2	4	6	8	10
Rarely/once every 5 years, grade: 1	1	2	3	4	5
Risk concession/Risk grading	<6 Low	6–9 Medium	10–15 High	>15 Very High	

Table 2. Intra-class Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	0.689[a]	0.536	0.835	21.941	18	162	0.000
Average Measures	0.957[c]	0.920	0.981	21.941	18	162	0.000
Intraclass Correlation Coefficient							
	Intraclass Correlation[b]	**95% Confidence Interval**		**F Test with True Value 0**			
		Lower Bound	**Upper Bound**	**Value**	**df1**	**df2**	**Sig**
Single Measures	0.640[a]	0.479	0.804	17.825	18	162	0.000
Average Measures	0.947[c]	0.902	0.976	17.825	18	162	0.000
Intraclass Correlation Coefficient							
	Intraclass Correlation[b]	**95% Confidence Interval**		**F Test with True Value 0**			
		Lower Bound	**Upper Bound**	**Value**	**df1**	**df2**	**Sig**
Single Measures	0.346[a]	0.136	0.697	5.706	8	72	0.000
Average Measures	0.841[c]	0.612	0.958	5.706	8	72	0.000

Table 3. Results of Evaluation of WSP Stages of Talesh Water Supply in 2021

Table	No. of Questions	Whole Conceivable Scores	Score (%Accomplishment)
Table 3 – WSP team	5	20	16/20 (80%)
Table 4 – System description	2	8	8/8 (100%)
Table 5 – Hazard identification and risk assessment	7	100	69/100 (69%)
Table 6 – Control measures and validation	5	68	39/68 (57.35%)
Table 7 – Improvement plan	3	48	-
Table 8 – Operational monitoring	4	64	35/64 (54.69%)
Table 9 – Verification	8	32	31/32 (96.88%)
Table 10 – Management procedures	3	36	18/36 (50%)
Table 11 – Supporting programs	2	8	6/8 (75%)
Table 12 – Review of the WSP	5	56	-
Total	**44**	**440**	**222/440 (50.45%)**

Table 4. Outcomes of Public Appraisement of WSP Steps Using Software for Talesh Water Supply in 2021

System Ingredients	No. of Questions	Whole Conceivable Scores	Score (% Implemented)
Catchment	23	88	56/88 (64%)
Treatment	23	88	-
Distribution	23	88	42/88 (48%)
Point of use	23	88	56/88 (64%)
Total	**92**	**352**	**154/352 (43.75%)**

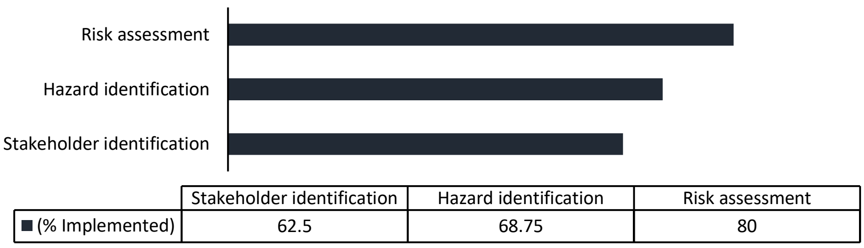

Figure 2. Results by Component.

distribution network and a large number of fractures due to infrastructure problems and old pipes and direct pumping of water to distribution network) even with the implementation of control measures it is still in the "high" ranking. Other hazards in the reservoirs and distribution network have been eliminated or reduced by taking control measures.

Of the 9 risks identified at the point of use, 2 risks (Mixing

Table 5. Risk Assessment Matrix of Talesh Water Supply System and Corrective Measures in 2021

Location	Hazard Type	Hazardous Events	Risk assessment (Before Corrective Action)			Risk Rating	Corrective Action	Risk Assessment (After corrective Action)		
			L	S	R			L	S	R
Catchment (source)	Microbial	Increased microbial contamination due to disposal well in the vicinity of the water source and lack of privacy of the well	5	5	25	V-H	Installing Chlorination devices on the well Microbial monthly sampling of raw water Prevent the construction of wells in residential areas Selecting the appropriate length of conductor pipe	2	4	8
	Chemical	Poisoning of residents around the well due to leakage of chlorine gas	5	5	25	V-H	Collecting gas cylinder Use of Per chlorine or bleach	1	1	1
	Microbial	Microbial pollution caused by insects and rodents entering the well	5	4	20	V-H	Installing net on the wellhead Installing netting on doors and windows Raising well casing pipe	1	4	4
	Physical	Failure of well equipment including pumps, electric motor pumps, electrical panels and dosing pumps	5	4	20	V-H	Reserve of pump, electromotor, electrical panel and dosing pump in the required number in crisis warehouse Service and repair of pumps, electrical panels and dosing pumps of damaged available by the contractor	3	2	6
	Chemical	Increasing the NO3 concentration of well during the agricultural seasons	2	5	10	H	Mixing of water with sources of low nitrate Chemical sampling in agricultural seasons Guide farmers to use green manure instead of chemical fertilizers Collection and management of agricultural runoff Preventing domestic sewage from entering surface water collection canals	2	2	4
	Chemical	Pollution from agricultural fertilizers and pesticides	2	5	10	H	Encouragement farmers to use Without-nitrogen fertilizers Educate farmers to use biological methods Sampling of pesticides and pesticides in supply sources in agricultural seasons	2	2	4
	Physical, microbial, chemical	Pollution caused by the entry of various people for sabotage	2	5	10	H	Construction of chamber on the wells Protection of wells outside the chamber by cover and shield	1	5	5
Reservoir	Physical, Chemical, microbial	Entering the Reservoirs yard and applying sabotage	5	5	25	V-H	Installation of CCTV cameras Possibility of automatic closing of outlets in emergencies Daily visits to the reservoirs Fencing the reservoir yard	1	5	5
	Microbial, chemical	Formation of biofilms and algal bloom due to failure of NaCl electrolysis system	5	5	25	V-H	Reservation of liquid chlorinator device Education of Manual chlorination to the operator Reservation of electronic panel in the warehouse	2	4	8
Distribution system	Chemical	Increased microbial pollution due to inadequate residual chlorine in the distribution network	5	5	25	V-H	Replacing old and worn-out devices Monthly service and cleaning of dosing pump and chlorine injection line Daily monitoring Installation of instrumentation devices to display the residual chlorine in the distribution network	2	4	8
	Physical, microbial, chemical	Entry of pollution during repair and service of transmission lines and distribution network and branches	5	5	25	V-H	Washing the distribution network after repairs Keeping enough chlorine in the distribution network Training Ministry of Energy instructions to staff	3	4	12
	Physical	Number of incidents and events in the distribution network and transmission lines	5	5	25	V-H	Identify and fix fracture events Replacing worn pipes Existence of a contractor with equipment to repair the events	5	2	10
	Physical	Many fractures due to old and poor-quality pipes	5	4	20	V-H	Providing the necessary credit for replacement and repair of worn networks Replacement of asbestos and galvanized pipes in the network with pressure polyethylene pipe- 10 Bar Regulation of pressure in the distribution network	5	2	10
	Physical, microbial	Dead water formation at the end of the distribution network	3	4	12	V-H	Visibility of the distribution network drain valves Regular cleaning monthly of the distribution network Design of ring network system in distribution network Installation of drain valve at the end of the alley, network and transmission line in the required number	3	2	6

Table 5. Continued.

Location	Hazard Type	Hazardous Events	Risk assessment (Before Corrective Action)			Risk Rating	Corrective Action	Risk Assessment (After corrective Action)		
			L	S	R			L	S	R
Point of use	Physical, microbial, chemical	Infiltration due to the connection of domestic wells and springs with the distribution network	5	5	25	V-H	Increasing awareness of consumers about the health risks of using unsanitary water Installation of the one-way valve Separation of common internal branch pipe from municipal water	1	5	5
	Microbial	Lack of proper operation of the check valve	5	4	20	V-H	Do not use the pump directly and installed the storage tank Defective one-way valve replacement Control the amount of monthly water consumption	2	4	8
	Physical	Increasing water turbidity at the point of use	5	3	15	H	Educate the consumer not to use a direct pump Use of storage tank Washing home tanks Regular washing of the distribution network	2	3	6
	physical	Low awareness of consumers about the health risks of using unsanitary water	3	5	15	H	Increasing awareness of consumers by health care centers Development of health education program	2	3	6
	Physical, chemical	Presence of color, turbidity, taste & smell in the water, and consumers dissatisfaction	3	4	12	H	Washing the end of the network Proper regulation of residual chlorine in the distribution network Open the well drain valve	2	3	6

Note. L = Likelihood; S = Severity; R = Risk; H = High; V-H = Very High

of raw water of domestic wells with distribution network and not installing check valve or its failure) have a "very high" rating and 3 risks (Increased turbidity at the end of the distribution network, low subscribers' awareness of raw water consumption and the presence of color, taste and odor in water) are in the "high" rank. Except for the malfunction of the check valve, which is classified as a medium-grade risk, there are other hazardous accidents at the point of use in the low-risk rating that do not pose any problem for the water supply system and have no negative impact on drinking water quality.

The average ICC for accidents detected in production sources, distribution network and point of consumption was 0.8, which indicates excellent reproducibility.

The percentages obtained from data analysis show that the organization pays more attention to sources of supply and point of consumption. Due to the withdrawal of drinking water from groundwater sources in Talesh city and the importance of water production volume, high maintenance costs of well equipment, the importance of water health, customer satisfaction and timely collection of water prices from subscribers, more attention has been paid to supply sources and points of use.

The results showed that out of 440 available points, 222 points and 50.45% matching with WSP were observed. The highest and lowest scores in this study were related to system descriptions and management procedures with 100 and 50%. According to Eslami et al, the maximum and minimum percentages of congruence belonged to "system description" with 87.5% and "management procedures" with 25% that are in concordance with the outcomes of the present study (21). In a study conducted by Baum et al, it was found that drinking water regulations in the United States complied with WSP steps in the areas of describing the water supply system (22).

Due to the lack of full implementation of this plan, it is not possible to evaluate the "improvement plan" and "WSP review". These two stages could not be evaluated in the study by Aghaei et al due to the lack of full implementation of the program in Ardabil (3). Talesh water supply system included supply sources, distribution network and consumption point. The scores of each section were 64%, 48% and 64%, respectively. Therefore, with the obtained scores, it shows that the organization has paid more attention to the sources of supply and consumption point. Based on a study conducted in Spain and France, more consideration is paid to treatment plant and distribution networks in France and the source of water supply in Spain (23). In the water supply system of Talesh city, due to the heavy expenses of installation and maintenance, relatively brief regard is for to the distribution network, and these factors can affect the ultimate quality of water hand over to point of use in the near future. A study by Nijhawan et al demonstrated that big pipelines in Nagpur, India, are highly vulnerable (24). Various components of the water system demonstrate that in these four parts, such as evaluating the overall implementation of the program, some parameters such as the improvement and review of the WSP have not privilege due to imperfect execution of the program. The distribution network and point of use have received a full score, indicating the attention of the water supply team to identify risk and hazardous events and risk assessment. Baum et al in 2017 reminded the significance of efficacious risk assessment and management at safe drinking water and public health (25). The hazard identification and risk assessment stage in this study was 69%. Risk identification and risk assessment were introduced as key components of WSP, which are applied in WSP in Japan (26).

This study showed that according to the score (50.45%) of WSP and also the attention of the water supply organization to the health of the water produced for the consumer, the water supply system studied is currently moderate and appropriate. The results of the overall evaluation of the WSP phases in the drinking water supply system of Zanjan also showed 52.95% compliance with the WSP (13). Therefore, in order to better implement the WSP in the water supply system of Talesh city and improve the quality of drinking water, the risk identification and risk assessment stage has been used. At this stage, in addition to identifying and assessing the risk, the organization's stakeholders can be used to eliminate them. Risks of Talesh water supply system after corrective actions were reduced to 4 very high risks and 3 high risks in supply sources, 6 very high risks and only 1 high risk in the distribution network and 2 very high risks and 3 high risks at the point of consumption. In supply sources, increasing the microbial contamination load due to the proximity of domestic sewage wells to supply sources increases the likelihood of contamination. Consumers' protest against the water outage is due to the breakdown of the electrical panel and the burning of the pump and electric motor. In addition, in supply sources using appropriate corrective measures, the risk of poisoning of residents around the well due to chlorine gas leakage in the chlorination system and microbial contamination due to insects and rodents entering the well, high nitrate concentration in well water in agricultural seasons, Contamination due to fertilizers and pesticides used in agriculture by farmers and the entry of contamination due to bioterrorism activities in the resources have been minimized. Other problems include the obsolescence of pipes and infrastructure facilities in the distribution network of the city of Talesh and the large number of accidents and incidents that reduce the residual chlorine in the distribution network and follow-up monitoring devices. Risks such as contamination during repair and service of transmission lines, distribution network and branches, large number of fractures in distribution network pipes, branches and transmission lines due to old and poor quality pipes are high risk and if not properly managed and managed, may cause Reduced water quality and consumer dissatisfaction. By providing appropriate solutions by expert and experienced colleagues from the entry of unknown individuals into the reservoirs for bioterrorism operations, biofilm formation and algal blooms due to failure of the salt electrolysis system, increase microbial contamination due to the presence of undesirable residual chlorine in the distribution network and create turbid water was reduced at the end of the distribution network. Due to the presence of worn pipes in the distribution network of some parts of Iceland, many bacteria were reported in water samples (27). At the point of consumption, due to the lack of awareness of subscribers about the problems of unsanitary water consumption and to increase the pressure, the water of domestic wells or springs is illegally connected to the main city network. Increased turbidity, color, taste, smell and taste in water and cause customer dissatisfaction and cause secondary pollution at the point of use. In addition, by providing appropriate solutions, training, and informing the subscribers, all the risks at the point of use after the implementation of the WSP are reduced and no danger with a very high risk is observed at the point of use. In addition, by continuing the planning, the non-functioning of the check valve, which is still at high risk, will be identified in the area, and by replacing them, secondary contamination can be prevented.

4. Conclusion

In general, the purpose of the risk identification and evaluation stage in the WSP is to identify the weaknesses of the water supply system and provide appropriate solutions appropriate to each risk. The results obtained from the quality assurance tool of the WSP, in addition to determining the requirements of the water supply system for upgrading, also showed the lack of permanent dependence on the microbial test, both of which were important objectives of this study. By implementing the risk assessment and identification stage in the water supply system of Talesh city, it showed that dangers such as the existence of domestic sewage wells near the water supply well, the presence of undesirable chlorine in the distribution network due to improper operation and equipment failure Injection, the existence of old infrastructure such as old pipelines and connecting wells and springs to the distribution network and the non-functioning of the check valve at the point of consumption caused secondary microbial contamination and increased water leakage in supply sources, distribution network and point used. The results of water quality tests after performing the risk identification and assessment step showed the average amount of chlorine remaining in the distribution network 0.62 part per million (PPM), turbidity of supply sources and distribution network 0.5 nephelometric turbidity units (NTU), total coliform and total in resources, network the distribution and consumption point are zero and the average heterotrophic test of the distribution network has reached 6 CFU/ml due to the appropriate residual chlorine. Also, no qualitative microbial and chemical defects were observed in the water supply system of Talesh city after the research period.

Due to the positive effects of WSP on the quality of drinking water from supply sources to the point of consumption and reducing water leakage, the implementation of this plan is recommended to water and wastewater organizations as the most effective tool to increase safety in water supply. Water supply system staff are aware of the dangers of the system, but due to lack of facilities, this awareness alone cannot prevent accidents. Therefore, to improve the water supply system and increase the quality of drinking water, it is necessary to provide sufficient funding, more training programs for employees, prioritization and full implementation of the program to reduce risks and the attention of officials to the proper implementation of WSP at the national and provincial levels. Therefore, due to the water and wastewater organization trying to identify the risk and assess the risk in all three main parts of the water supply system (resources, distribution network and point of consumption), the water supply system currently has a moderate level of safety.

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Conflict of Interest Disclosures
The authors declare that they have no conflict of interests.

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