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THE EFFECTIVENESS OF A G-11 SOAP
FOR THE SURGICAL SCRUB AND SKIN PREPARATION

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THE EFFECTIVENESS OF A G-11 SOAP*
FOR THE SURGICAL SCRUB AND SKIN PREPARATION

The compound, hexachlorophene (G-11), or AT-7 [bis-(3,5,6-trichloro-2-hydroxyphenyl) methane], as an effective bacteriostatic agent in reducing the numbers of bacterial flora of human skin has been studied extensively by Traub, et al., (1944 and 1945); and by Price, et al., in 1948. Clark and co-workers in 1947 studied this agent for its effectiveness from the standpoint of its use incorporated in liquid soap in the preparation of the surgeon's hands. All of the above authors felt their experiments demonstrated that the compound G-11 did significantly reduce numbers of skin flora. Special note was taken of an even greater effectiveness if the persons who used a soap containing G-11 in all daily ablutions, as well as just at the time of a scrub. In 1947 and again in 1949, Seastone, et al., further studied G-11 incorporated in bar and liquid vehicles as surgical scrub agents. These authors report favorably that the use of this agent makes it possible to shorten the scrub time very considerably from most modern techniques and to eliminate the necessity of using a brush for the scrub and suggest that an alcohol rinse is unnecessary following the scrub. They also felt that perhaps, if the soap

* The bar soap (Dial), containing 2% hexachlorophene or G-11, was supplied by Armour and Company.

were employed routinely for the operating room scrub, it would not be necessary for the personnel to have further constant daily contact with the agent. Fuller, et al., in 1948, reported favorably a definite reduction in numbers of pyogenic skin infections among the inmates of an institution for mental defectives when a bar soap containing G-11 was used by all for their daily washing and bathing. In their paper studying G-11 in the surgical scrub, Seastone and Erickson (1949) also investigated the compound in a liquid soap as an effective agent for preparation of the skin before elective surgery.

The purpose of this present work has been to further investigate the effectiveness of hexachlorophene, G-11, incorporated in a bar soap (Dial) as a bacteriostatic agent and to apply our present knowledge of this compound for the surgical scrub and the preoperative preparation of the skin. The problem has been broken down into three separate studies which will be described and discussed individually.

PART I

This segment of the work was set up to study the effectiveness of G-11 incorporated in a bar soap (Dial) as a suitable bacteriostatic agent for the preparation of a site for surgery. This bar soap contains 2% hexachlorophene or G-11. It was compared to a soap identical in all respects to Dial, except that it did not contain any G-11, and to the ordinary bar wool fat soap in routine use at this institution.

Material and Methods

The subjects of the experiments have all been patients on the wards of the University Hospital, Nebraska College of Medicine. Those chosen all had intact abdominal walls as regards recent operative maneuvers. Only female patients were used because it was not then necessary to perform a preliminary shaving of the area as would frequently be necessary on male patients. All cultures were made directly by contact of the scrubbed areas with spot culture plates containing sterile blood agar.

A total of 120 patients were used in this experiment.

The technique was as follows:

1. The person executing the experiment donned sterile rubber gloves to eliminate the factor of contamination from his hands in all cases.
2. For the first 60 patients (1-60 incl.), the right half of the abdomen of each was washed for four minutes with the 2% G-11 soap, covering an area from the right costal margin to the midline and inferiorly to within an inch of the pubic hair. Sterile gauze sponges and sterile water were used to build up the lather.
3. On these same patients the left half of the abdomen, covering a similar area, was used as the control side, but the agent or rinse varied.
 - a. Subjects 1 to 20 had the left side washed for four minutes with the ordinary bar wool fat soap used

routinely on the wards. The technique was identical with that used for the G-11 soap. An alcohol rinse (70% by vol.) was used bilaterally in this series. Care was taken that the alcohol from one side did not flood over onto the other and both sides were carefully wiped dry with sterile towels.

b. Subjects 21 to 40 were washed with the same control soap and in the same manner as above 2 and 3a for four minutes each, but the alcohol rinse was omitted and the abdomen wiped dry and free of lather with sterile towels.

c. Subjects 41 to 60 were washed on the control side with Dial soap not containing G-11 in place of the wool fat soap, and again no alcohol rinse was used.

4. Subjects 61 to 80, inclusive, were washed on both sides of the abdomen with the 2% G-11 soap, four minutes to a side; the left was rinsed with 70% alcohol and wiped dry with a sterile towel, while the test side, the right, was merely wiped dry as above with no rinse used.

5. The remaining 40 patients (81-120, incl.) were likewise washed only with Dial soap containing G-11 as in 4, but the time of washing shortened to 4 minutes to the whole abdomen. The rinsing technique also varied as follows:

á. Subjects 81 to 100 had the left side of the abdomen

rinsed with 70% alcohol, while the right side was rinsed with sterile water. Both were then dried with a sterile towel.

b. Subjects 101 to 120 received an alcohol rinse to the left side and a sterile water rinse to the right side preceding the washing. Following this the entire abdomen was again washed for four minutes with Dial soap containing 2% G-11. Upon completion of the wash the entire area was dried with a sterile towel.

6. In order to evaluate the approximate numbers of bacteria left on the skin after the above washings, comparable areas of both sides of the abdomen were checked by the method of Brown, et al., 1944. Using this method, small, sterile aluminum culture cups, filled with sterile blood agar were placed on the washed areas as indicated in Figure 1. Eight cups were used per patient, four to each side, and held in place by a small strip of adhesive. In this way a cup from the one side and its comparable cup from the opposite side were removed at thirty-minute intervals until all were removed by the end of a two-hour period--1 and 1A in 30 minutes, 2 and 2A in 60 minutes, et cetera.
7. The cups were placed back in their Petri dish containers as they were removed, and incubated for 48 hours at 37.5° C. at which time the colonies on the surface of the plates were counted.



Fig. 1. Diagram of technique.
Plates were removed at one-half-
hour intervals. (See text)

DISCUSSION

In the first twenty washes, Dial soap containing 2% G-11 was compared to ordinary wool fat soap to determine which soap was more effective in reducing the numbers of skin flora when preparing an operative site. A 70% alcohol rinse was used on both sides following the washing. According to the results tabulated by us, there would seem to be very little difference between the two soaps, certainly any differences were not significant (Table I).

In 1947, Seastone had noted that an alcoholic solution used as a rinse after washing in a G-11 soap seemed to reduce the effectiveness of the G-11, perhaps by acting as a solvent that would extract appreciable amounts of the compound from the skin which would otherwise remain there to give a greater bacteriostatic effect. Because of this and because of the neutral results obtained by us in the first twenty washes, the next forty subjects were washed as usual with Dial containing 2% G-11 and this compared with plain wool fat soap (Table II), and with Dial minus the G-11 (Table III). No alcohol rinse was used on either side but rather both sides were merely wiped dry with a sterile towel. The results, as tabulated in Tables II and III, appear to show a consistent superiority of the Dial soap containing 2% G-11 over the other types of soaps in reducing the number of skin bacteria following a short washing period. This would seem to bear out the suggestion that not only is an alcohol rinse not necessary,

but also that such a rinse is actually detrimental to the prolonged effects of the G-11 compound as a bacteriostatic agent.

Keeping the above noted effects of alcohol as a rinse in mind, the next series of twenty patients were used in an attempt to further study this phenomenon. Here the entire abdomen was washed, four minutes to a side, with Dial containing 2% G-11 and then one side only, the control side, was rinsed in 70% alcohol. The test side was dried with a sterile towel. The results of this experiment are tabulated in Table IV. At first glance it appears as if our premise had been faulty because in the early minutes of testing, 30 and 60 minutes especially, it appears as if the alcohol rinse had actually enhanced the Dial effectiveness. As the testing time lengthened, however, it can be noted that the numbers of bacteria from comparable areas became more nearly equal on an average until finally, at the end of the two-hour period, the areas not rinsed with alcohol had, in the majority of cases, the lower counts (Table IV). It was suggested by one of our group that one possible explanation for the apparent reversal of results in the early minutes of testing time might be that the numbers of bacteria washed up in the lathering process were being more effectively mechanically removed by the alcoholic solution than were being removed by merely wiping up the lather with a sterile towel. In addition, this rinse probably also removed enough of the G-11 compound from the skin so that by the time the two-hour period was completed the bacterial

population on the alcohol rinsed side was beginning to increase at a more rapid rate.

We believed that further investigation along the same lines was indicated following the above work; therefore, forty additional patients were studied. The entire abdominal area of 20 persons was washed with Dial soap for four minutes, and following the wash one side was rinsed with 70% alcohol, while the other side was rinsed with sterile water and both sides were then dried with a sterile towel. It was hoped that by these tests we might determine how much of the differences noted above could be attributed to pure mechanical effect as opposed to a solvent action by the alcoholic solution. Table V is a tabulation of the counts of this series. As in the previous run, the counts made at the end of 30 minutes of contact were lower, in general, on the side that had been rinsed with 70% alcohol. In the remaining time segments of this experiment, however, the counts tended in a majority of cases to be lower from the side rinsed with sterile water. In the previous run, by contrast, this effect was not so definitely seen until the last thirty minutes of the test period. These results still do not give a clear-cut answer to the problem. The alcoholic rinse, we believe, does initially remove greater numbers of bacteria by virtue of its better wetting action. We feel, however, that these results and those of our earlier experiments, where an alcohol rinse was used, indicate that the predominant action of the alcoholic solution is as a solvent removing

TABLE I (With Alcohol Rinse)

The right half of the abdomen in subjects 1 to 20, inclusive, was scrubbed with bar soap containing hexachlorophene for four minutes, followed with an alcohol rinse. There does not appear to be any advantage with the bar soap containing hexachlorophene when followed by an alcohol rinse in a single scrub. The time designates the minutes which the culture cups were left in contact with the skin after the washing. The colony growths after twenty-four hours were about the same for both soaps.

Experiment No.	Dial 30'	Control 30'	Dial 60'	Control 60'	Dial 90'	Control 90'	Dial 120'	Control 120'
1	0*	1	3	1	2	1	35	43
2	6	16	5	8	63	6	81	1
3	12	12	12	67	118	70	112	145
4	24	71	88	116	230	247	TNTC	TNTC*
5	2	40	1	67	147	184	251	269
6	1	1	33	6	16	94	3	99
7	4	11	26	8	88	232	50	192
8	3	3	2	167	141	38	127	72
9	0	0	2	2	6	2	62	3
10	0	1	22	2	2	2	3	2
11	2	12	212	18	120	142	40	166
12	22	3	31	8	116	128	196	125
13	209	201	TNTC	269	TNTC	286	TNTC	TNTC
14	5	6	31	36	177	105	89	169
15	0	6	20	9	26	42	73	71
16	1	1	3	5	18	31	9	21
17	127	114	57	5	TNTC	61	131	90
18	77	138	15	31	224	123	193	TNTC
19	36	57	196	117	60	40	244	263
20	0	1	1	36	2	16	67	7
TOTALS	531	695	1,060	978	2,156	1,850	2,366	2,638
AVERAGES	26.6	34.8	53	48.9	107.8	92.5	118.3	131.9

* Numerals in the tabulated columns refer to number of colonies counted on each plate after 48 hours of incubation at 37.5° C. All plates with more than 300 colonies were labelled, "too numerous to count" (TNTC).

TABLE II (Without Alcohol Rinse)

Subjects 21 to 40, inclusive, were washed in the same manner as subjects 1 to 20, except that the alcohol rinse was omitted and the abdomen wiped dry with sterile towels. The control was hospital stock bar soap. The effect of a soap containing hexachlorophene on lessening colony growth is demonstrated when the alcohol rinse is omitted. The time designates the minutes which the culture cups were left in contact with the skin after washing. Omitting the alcohol rinse has permitted the continuation of the hexachlorophene bacteriostatic action and a definite reduction of colonies up through the 120-minute period.

Experiment No.	Dial 30'	Control 30'	Dial 60'	Control 60'	Dial 90'	Control 90'	Dial 120'	Control 120'
21	16	7	33	211	84	166	50	178
22	4	0	0	1	0	1	178	32
23	98	278	176	TNTC*	91	236	20	178
24	55	140**	102	131	142	168	205	111
25	6	TNTC	1	3	1	29	9	99
26	22	86	44	103	73	149	101	192
27	1	8	1	16	7	37	12	58
28	0	4	1	8	23	22	28	56
29	28	83	48	101	56	173	124	212
30	4	13	21	20	14	39	36	104
31	0	8	0	23	1	35	13	96
32	50	23	20	69	26	59	57	200
33	148	TNTC	196	258	111	TNTC	208	TNTC
34	1	4	0	19	1	81	7	119
35	5	17	27	70	7	22	3	23
36	2	9	165	106	92	226	221	176
37	16	38	38	65	24	84	55	101
38	1	7	23	11	49	63	40	132
39	40**	85	54	82	60	166	116	175
40	28	8	0	14	11	17	1	44
TOTALS	525	1,418	950	1,312	873	2,073	1,484	2,586
AVERAGES	26.3	70.9	47.5	65.6	43.7	103.7	74.2	129.3

* All plates with more than 300 colonies were labelled, "too numerous to count" (TNTC).

** Contaminated.

TABLE III (Control - Dial without G-11)

Subjects 41 to 60 received scrubs similar to subjects 21 to 40, but the control bar soap was the same basic soap as the soap containing hexachlorophene, i.e., without hexachlorophene. The abdomen was merely wiped dry with sterile towels. The effect of a bar soap containing hexachlorophene not followed by an alcohol rinse in diminishing colony growth is demonstrated. The sustained bacteriostatic action of the hexachlorophene up through the 120-minute period is again shown.

Experiment No.	Dial 30'	Control 30'	Dial 60'	Control 60'	Dial 90'	Control 90'	Dial 120'	Control 120'
41	0	21	6	21	24	74	47	38
42	3	32	10	19	25	42	25	66
43	7	53	3	29	24	104	24	104
44	0	1	0	5	3	3	4	23
45	12	12	30	40	61	184	166	241
46	8	181	13	233	55	256	15	108
47	2	9	0	12	1	19	3	59
48	11	180	22	194	37	212	7	214
49	3	12	14	47	5	22	1	55
50	0	67	9	24	5	90	2	49
51	24	250	51	TNTC*	20	TNTC	16	TNTC
52	55	70	51	TNTC	TNTC	TNTC	49	TNTC
53	1	5	0	12	1	19	4	7
54	1	3	0	6	0	6	5	19
55	3	12	6	18	16	48	4	43
56	0	39	7	25	9	40	20	60
57	3	5	33	78	63	90	TNTC	TNTC
58	3	130	1	28	1	26	0	23
59	TNTC	TNTC	50	TNTC	197	TNTC	165	TNTC
60	23	40	26	55	66	17	32	65
TOTALS	468	1,422	332	1,746	913	2,152	889	2,374
AVERAGES	23.4	71.1	11.6	87.3	45.7	107.6	44.5	118.7

* All plates with more than 300 colonies were labelled, "too numerous to count" (TNTC).

TABLE IV (Both Sides, Dial - Control, Alcohol Rinse)

The entire abdomen of subjects 61 to 80 were washed with the bar soap containing hexachlorophene. The right half of the abdomen was merely wiped dry with a sterile towel and the left half was rinsed with alcohol. The lower colony count on the side washed with alcohol during the first hour may have been the result of more effective mechanical removal by the alcohol. After the one-hour period the sustained bacteriostatic effect of hexachlorophene becomes noticeable, which suggests the value of using a soap containing hexachlorophene in the daily wash or scrub. Again it is demonstrated that alcohol is valueless in scrubs using soap with hexachlorophene.

Experiment No.	Dial 30'	Control 30'	Dial 60'	Control 60'	Dial 90'	Control 90'	Dial 120'	Control 120'
61	19	3	5	2	1	8	2	2
62	100	21	20	TNTC*	102	35	65	75
63	82	51	30	TNTC	100	65	16	210
64	75	16	215	17	18	25	59	12
65	18	5	9	30	11	15	27	20
66	58	3	4	1	19	24	3	31
67	0	3	6	70	3	0	21	87
68	1	1	0	0	1	5	0	3
69	6	0	4	4	9	2	19	4
70	10	5	29	5	81	14	100	30
71	70	3	2	1	3	5	2	6
72	1	8	17	50	43	34	53	14
73	3	11	3	12	230	TNTC	TNTC	TNTC
74	13	100	14	70	59	29	150	115
75	2	0	TNTC	TNTC	5	60	8	52
76	5	11	7	13	6	27	7	40
77	110	12	120	11	280	230	200	250
78	6	4	6	6	37	31	57	23
79	160	145	159	150	90	170	200	TNTC
80	5	1	5	2	25	11	17	20
TOTALS	744	403	655	444	1,123	1,090	1,306	1,594
AVERAGES	37.2	20.2	34.5	26.1	56.2	54.5	65.3	79.7

* All plates with more than 300 colonies were labelled, "too numerous to count" (TNTC).

TABLE V

With each one of the subjects 81 to 100, the entire abdomen was washed with bar soap containing hexachlorophene as with subjects 61 to 80, but the right abdomen was rinsed with sterile water and the left abdomen was rinsed with 70% alcohol. As in Table IV, the sustained effect of the hexachlorophene becomes noticeable after the first thirty minutes. Also the alcohol rinse is shown to be valueless when a soap containing hexachlorophene is used.

Experiment No.	Dial 30'	Control 30'	Dial 60'	Control 60'	Dial 90'	Control 90'	Dial 120'	Control 120'
81	14	12	25	45	24	40	43	41
82	5	3	12	2	4	4	7	1
83	1	2	1	2	18	1	70	15
84	TNTC*	70	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC
85	90	70	44	90	TNTC	TNTC	70	TNTC
86	135	17	TNTC	57	30	18	27	31
87	1	2	12	3	6	4	7	4
88	0	3	11	1	30	46	TNTC	16
89	70	15	100	30	95	27	55	18
90	90	TNTC	60	50	27	TNTC	8	175
91	12	7	9	9	65	70	31	34
92	18	9	80	130	120	67	50	80
93	50	30	11	43	28	TNTC	50	TNTC
94	40	20	12	7	TNTC	10	70	60
95	0	1	2	50	3	4	5	2
96	50	20	120	150	TNTC	TNTC	TNTC	TNTC
97	2	1	1	3	6	17	18	60
98	20	5	7	23	1	8	19	90
99	3	1	40	80	TNTC	60	18	TNTC
100	6	12	4	4	4	10	60	15
TOTALS	797	500	951	979	1,261	1,386	1,208	1,642
AVERAGES	39.9	25.0	47.6	49	66.4	69.3	60.4	82.1

* All plates with more than 200 colonies were labelled, "too numerous to count" (TNTC).

significant amounts of G-11 from the skin. Because of this, an alcohol rinse should not follow a G-11 soap scrub, if its desired bacteriostatic effects are to be obtained.

As a matter of interest, the final twenty patients were studied using alcohol or water rinse before the G-11 soap scrub. Nothing of significance could be interpreted as to the value of the alcohol wash previous to the scrub.

PART II

In the second part of this work, the primary purpose was to determine the cumulative effectiveness of the G-11, or hexachlorophene, in the bar soap.

Materials and Methods

Twenty subjects agreed to take part in the experiment. Ten of the group were a mixed group consisting of medical technicians, clerical workers, one medical student, and other laboratory personnel. The remaining ten were student nurses on duty in various wards of the University Hospital.

The experiment was run over a three-week period as follows:

1. During the first week all subjects washed their hands and wrists and bathed as was their usual pattern with whatever toilet soap they had been accustomed to using.
2. During the second week all subjects were given bars of Dial soap containing 2% G-11 and instructed to use this soap in place of their usual toilet soap. They were

likewise urged not to wash any more frequently than usual, but that when they did wash or bathe to use Dial soap, exclusively.

3. During the third week the group of ten student nurses were instructed to stop using Dial soap entirely and to revert to their previous soap, while the remaining ten continued to use Dial exclusively for one more week.

Utilizing the same spot culture cup method as was used in Part I, we again determined approximate numbers of viable bacteria on the skin. Culture cups containing sterile blood agar were applied to the subjects on the second, fourth, and seventh days of each week. All subjects washed their hands and wrists and dried them just before the cups were applied each time. One was placed on the palm, one to the back of the hand, one to the dorsal aspect of the wrist just above the hand, and one to the volar aspect at the same level. The plates were removed one at a time at half-hour intervals so that the fourth, and last one, was in contact with the skin for two hours before removal. After a 24-hour period of incubation the colonies were counted. All plates with more than 200 colonies were labelled, "too numerous to count", in the tabulation.

DISCUSSION

Tables VI and VII are the tabulated results of this experiment. A study of these tables reveals several very

interesting features, some of which we can attempt to explain, while in other cases this is not possible.

The most striking feature noted immediately is the marked difference in numbers of skin bacteria of the subjects during the first week as compared to the second week. The bacterial flora of the hand and wrist area in practically every case is definitely lowered as soon as Dial soap containing 2% G-11 becomes the exclusive soap used by the subjects. We have observed from the beginning of our work that certain individuals naturally have a much higher count than other individuals. During the time of use of a soap containing G-11, the counts of practically all subjects fell markedly, those with the naturally high counts as well as those with lower counts. Among the group of ten student nurses the fall in numbers was not so marked until the fourth day tests (second culture period) of the second week, while in the laboratory group the fall was quite marked by the second day tests (first culture period) of that same week. This we cannot explain. By the time of the last test day of the second week all participants but one were down to a much lower level as shown by our spot culture method. During the third week of testing the laboratory group, continuing to use G-11 soap, maintained the same low level; while the group of nurses, no longer using G-11 soap, began to show a return of higher counts as early as the first test day. We feel that this is definite supportive evidence that the use of a bar soap con-

TABLE VI

Culture and colony studies in ten subjects (laboratory personnel) were done to determine the relative value and cumulative effect of using a bar soap containing hexachlorophene in the daily routine. Each study extended over a week, and bacteriologic studies made on the second, fourth, and seventh days. Plate 1, palm of hand; plate 2, dorsum of hand; plate 3, volar surface of wrist; plate 4, dorsum of wrist. During the first week each subject used the control bar soap in the daily toilet routine. On the second, fourth, and seventh day, each subject washed his hands for four minutes, and cultures were taken. During the second week, each subject used a bar soap containing hexachlorophene in the daily toilet routine and cultures taken as in the control week. This was continued into the third week with similar studies. The cumulative effect of the hexachlorophene in diminishing colony counts is most evident.

Subj. No.	Culture Day	1st Week (Control Soap)				2nd Week (G-11 Bar Soap)				3rd Week (G-11 Bar Soap)			
		Plate				Plate				Plate			
		1	2	3	4	1	2	3	4	1	2	3	4
1	2nd	116	66	48	136	8	18	32	25	4	2	14	11
	4th	68	160	27	CONT	5	55	21	18	1	2	5	7
	7th					14	53	12	65	9	5	5	9
2	2nd	13	27	65	71	4	8	2	27				
	4th	CONT	140	30	110	2	2	4	21				
	7th	13	38	93	98								
3	2nd	97	TNTC	TNTC	TNTC	9	0	6	23	1	3	4	3
	4th	63	95	75	118	2	8	46	21	6	14	13	6
	7th	71	75	87	TNTC	1	5	4	CONT	1	14	20	41
4	2nd	101	54	62	90	0	2	2	13	1	1	0	11
	4th	10	120	80	140	9	2	4	150	1	0	1	6
	7th	22	40	29	34	5	6	3	43	4	2	4	7
5	2nd	85	71	TNTC	105	80	50	3	TNTC	1	3	3	3
	4th	41	77	70	100	2	2	3	8	37	13	20	8
	7th	TNTC	42	TNTC	140	4	0	4	15	22	17	1	12
6	2nd	103	45	100	38	1	6	3	9	3	7	5	4
	4th	50	17	35	65	25	6	8	5	5	75	15	14
	7th	22	160	33	120	6	20	5	34	3	12	4	3

(Continued on next page)

TABLE VI (Continued)

Subj. No.	Culture Day	1st Week (Control Soap)				2nd Week (G-11 Bar Soap)				3rd Week (G-11 Bar Soap)			
		Plate				Plate				Plate			
		1	2	3	4	1	2	3	4	1	2	3	4
7	2nd	23	25	16	27	3	7	24	17	1	3	1	1
	4th	5	4	9	27	11	2	32	30	1	2	2	5
	7th	37	26	24	56	0	CONT	28	24	8	0	2	CONT
8	2nd	TNTC	54	110	115	19	CONT	19	TNTC	3	11	8	36
	4th	32	2	101	14	10	32	10	TNTC	15	18	12	CONT
	7th	100	140	TNTC	TNTC	9	4	3	25	7	3	20	TNTC
9	2nd	34	28	31	11	2	1	5	2	9	2	7	1
	4th	50	7	8	29	1	11	3	2	21	2	5	4
	7th	10	24	17	31	1	11	3	2	21	2	5	4
10	2nd	8	15	10	10	24	21	42	19	46	65	TNTC	150
	4th	59	0	43	TNTC	85	72	TNTC	TNTC	105	TNTC	TNTC	TNTC
	7th	20	15	148	45	51	16	105	TNTC	3	25	3	65

All plates with more than 200 colonies were labelled, "too numerous to count" (TNTC); those contaminated as, "CONT".

TABLE VII

Culture and colony studies in ten subjects (nurse personnel) were done to determine the relative value and cumulative effect of using a bar soap containing hexachlorophene in the daily routine. These studies were similar to those tabulated in Table VI except that the subject returned to using the control soap in the third week. Notice the colony counts continue to be lower during this week than during the first week control period, demonstrating a sustained bacteriostatic effect.

Subj. No.	Culture Day	1st Week (Control Soap)				2nd Week (G-11 Bar Soap)				3rd Week (Control Soap)			
		Plate				Plate				Plate			
		1	2	3	4	1	2	3	4	1	2	3	4
11	2nd	TNTC	CONT	150	TNTC	CONT	21	11	53	19	11	4	11
	4th	18	19	23	98	150	50	150	39	14	12	12	49
	7th	7	45	14	26	9	8	10	6	37	15	41	12
12	2nd	50	127	200	95	8	27	120	TNTC	6	14	74	31
	4th	TNTC	TNTC	TNTC	TNTC	12	7	14	TNTC	14	15	67	TNTC
	7th	90	170	85	123	30	6	10	6	100	50	TNTC	TNTC
13	2nd	TNTC	TNTC	TNTC	TNTC	195	TNTC	49	TNTC	125	104	TNTC	TNTC
	4th	TNTC	TNTC	TNTC	TNTC	3	40	55	140	31	24	190	95
	7th	160	180	180	TNTC	11	18	30	18	117	70	105	130
14	2nd	91	7	16	38	5	8	4	16	23	5	1	16
	4th	24	30	10	135	2	0	2	3	3	14	17	9
	7th	90	52	95	TNTC	2	6	1	2	10	6	3	4
15	2nd	66	106	103	TNTC	11	12	45	25	12	9	29	102
	4th	150	192	200	TNTC	22	9	27	54	12	29	26	87
	7th	57	43	175	175	3	4	5	5	22	30	17	125
16	2nd	110	85	176	125	24	34	50	110				
	4th	66	100	TNTC	150	22	13	26	TNTC	16	23	43	80
	7th	160	113	150	TNTC					24	21	30	80
17	2nd	TNTC	200	TNTC	TNTC	40	23	34	29	15	30	35	16
	4th	17	30	40	95	3	105	TNTC	80	84	32	26	70
	7th	100	98	130	TNTC	3	6	3	5	26	30	55	17
18	2nd	22	75	36	119	100	TNTC	33	72	3	18	17	29
	4th	130	TNTC	95	93	34	103	TNTC	120	25	80	TNTC	60
	7th	140	129	55	115	7	4	25	31	5	68	17	16
19	2nd	52	TNTC	16	43	15	95	45	119	32	7	18	35
	4th	60	55	32	44	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC
	7th	TNTC	200	150	TNTC	17	3	6	19	75	23	22	9
20	2nd	81	100	101	200	10	15	TNTC	TNTC	24	75	51	40
	4th	115	200	TNTC	TNTC	12	40	7	180	42	TNTC	110	TNTC
	7th	43	32	137	123	19	CONT	60	108	90	53	25	75

All plates with more than 200 colonies were labelled, "too numerous to count" (TNTC); those contaminated as, "CONT".

taining G-11 in the daily toilet is desirable, particularly among hospital personnel.

In this group it was notable with several participants to whom body odor had been a problem, that the body odor disappeared with the use of the G-11 soap and the accompanying reduction in bacterial count. It was especially notable with subject number 13, who naturally seemed to have a very high count and along with this a problem of body odor. This latter problem became insignificant during the time she used Dial soap and returned when she reverted to other toilet soaps as the skin bacterial count increased. No evidence of skin irritation was noted among any of the subjects at any time during the experimental testing period. A few reports of skin sensitiveness have appeared in the literature.

PART III

The last part of our work was devoted to a surgical scrub experiment. The purpose was to determine the effectiveness of a G-11 bar soap when used as the scrubbing agent as compared to the routine scrub with ordinary soap now used at this institution.

Materials and Methods

The eight subjects of this experiment were senior medical students. The following plan of scrubs was performed:

1. Variations were made on the time of the scrub and in the scrubbing agent.
 - a. On the first day the subjects scrubbed their hands and arms with bar wool fat soap and brushes for the

- ten-minute period routinely used here. Following the scrub all rinsed their hands and arms in 70% alcohol.
- b. On the second day, the subjects soaped hands and arms thoroughly with 2% G-11 soap for ten minutes. No brush or gauze sponges were used to build the lather. Nails were cleaned during the first minute. No alcohol rinse followed the scrub. The lather was rinsed off in running tap water.
 - c. On the third day 2% G-11 bar soap was again used as in (b.), but the time of soaping shortened to five minutes. Again no brushes, sponges, or alcohol rinse were used.
 - d. On the fourth day, the routine was again as in (b.) and (c.), except the time was shortened to two minutes.
2. At the conclusion of all scrubs the scrubbed areas were dried on sterile towels, and powdered and sterile rubber gloves donned. The gloves were worn for one hour by the subjects.
 3. At the end of the hour the gloves were stripped off and, using our spot culture plate technique, the approximate remaining bacterial flora determined. One plate was applied to the palm and one to the dorsum of the hand. Plates were left in contact for fifteen minutes, removed, and incubated for forty-eight hours at 37.5^o C. when colonies were counted.

DISCUSSION

In general we feel that the results of this experiment (Table VIII) were gratifying and significant. Subjects one through four had not been using a G-11 soap previous to the experiment and did not use it at any time during the experiment except to perform the prescribed scrub of the day. All of these scrubs were done on consecutive days. Subjects five through eight had been intermittently using a G-11 soap previous to the experiment; however, for three days prior to the first scrub they were asked not to use such a soap. After completion of the first scrub by the routine method in use here, these four persons were given G-11 bar soap (Dial) to take home and asked to use this soap exclusively for all toilet purposes in addition to the prescribed G-11 scrubs.

It can be noted (Table VIII) that as a result of a ten-minute scrub with the 2% G-11 soap, the bacterial flora was either definitely lowered as compared to the routine scrub or was equally good in all cases. The results of a five-minute soaping were about on a par with the routine scrub in the cases of the four persons not using a G-11 soap except at scrub, and better than routine in the persons using G-11 soap exclusively. These latter four show equally low counts from the five-minute scrub with a G-11 soap as from the ten-minute scrub with the same soap. Probably the most interesting feature is the tabulation of extremely low counts obtained from all personnel on the fourth and last day of the scrubs when the 2% G-11 soap was used for only two minutes. The counts of

TABLE VIII

A comparison was done of colony counts after a routine ten-minute scrub with control soap using brush and followed by an alcohol rinse with ten-, five-, and two-minute scrubs with a bar soap containing hexachlorophene and no brush or alcohol rinse. The four subjects of group A did not use bar soap containing hexachlorophene in the daily toilet. The four subjects in group B used a hexachlorophene bar soap in the daily toilet. Studies were made at intervals of a day or more. The advantage of the bar soap containing hexachlorophene without the scrub brush or alcohol rinse is evident. The two-minute scrub appears as effective as the ten-minute scrub.

Group A - Hexachlorophene Bar Soap not Used in Daily Toilet									
Subj. No.	Control Scrub 10 Min.		G-11 Scrub 10 Min.		G-11 Scrub 5 Min.		G-11 Scrub 2 Min.		
	Palm	Dorsum	Palm	Dorsum	Palm	Dorsum	Palm	Dorsum	
1	8	11	1	1	1	0	1	2	
2	27	32	4	4	32	1	4	2	
3*	36	13	8	26	46	1	0	2	
4	3	8	11	12	29	0	0	2	
Group B - Hexachlorophene Bar Soap Used in Daily Toilet									
Subj. No.	Control Scrub 10 Min.		G-11 Scrub 10 Min.		G-11 Scrub 5 Min.		G-11 Scrub 2 Min.		
	Palm	Dorsum	Palm	Dorsum	Palm	Dorsum	Palm	Dorsum	
5	1	8	1	3	2	2	2	0	
6	3	9	1	2	3	2	3	1	
7	9	7	2	1	11	1	0	3	
8	33	2	2	3	0	1	1	2	

* Subject No. 3 worked daily in an animal room cleaning cages.

the first four subjects dropped to extremely low levels as compared to their previous counts, and the last four maintained their same low levels as in previous G-11 scrubs. We feel this supports the observations of earlier investigators and by us, in Part II of this paper, that it is possible to maintain a very low level of skin bacterial flora by the daily exclusive use of a soap containing G-11. If this is done, only a very brief surgical scrub need be employed by a surgical team in preparation for surgical procedures. As mentioned earlier in this paper, Seastone, in 1947, suggested that operating room personnel need not use a G-11 soap as their exclusive toilet soap providing they scrubbed daily with such a soap or did not allow more than two days to elapse between scrubs. As one observes the downward trend of the bacterial counts of the four subjects who used the G-11 soap only for their surgical scrub to a level equal to that of those using G-11 soap exclusively, this contention would seem to be borne out.

We believe the ideal situation would be for operating room personnel and members of a surgical team to use a G-11 soap daily for all toilet purposes as well as for their surgical scrub soap. This would be especially desirable if such persons did not scrub daily in surgery so that their skin flora would constantly be at a low level. However, if these persons were to scrub daily in surgery with a G-11 soap with no more than a day elapsing between scrubs, it appears that it would be unnecessary to use this soap exclusively outside. In either case, the use of a G-11

soap can materially reduce the time necessary for a surgical scrub and eliminate the scrub brush and irritating alcoholic rinses.

SUMMARY

The effectiveness of the compound hexachlorophene, G-11, incorporated in a bar soap (Dial) as a bacteriostatic agent has been studied. Part I of the work was devoted to a study of the bacteriostatic effectiveness of this G-11 bar soap in the preparation of a skin site for elective surgery as compared to other ordinary bar soaps. Along with this study, observations were made of the effect of an alcoholic rinse on a G-11 scrub. Part II was devoted to a study of the cumulative effectiveness of this soap with its continued use. Part III was given to a comparison of the effectiveness of this G-11 bar soap used in a shortened surgical scrub to that of the routine ten-minute scrub used in this institution.

CONCLUSIONS

1. Hexachlorophene, G-11 or AT-7, incorporated in a bar soap does more effectively reduce the bacterial flora of the skin than an ordinary bar soap.
2. There is a cumulative factor of hexachlorophene which is important in maintaining a low skin bacterial flora.
3. An alcoholic rinse counteracts the bacteriostatic effectiveness of a G-11 soap.

4. The use of a G-11 soap can materially reduce the time necessary for a surgical scrub and eliminate the scrub brush and irritating alcoholic rinses.
5. A sufficient time for a surgical scrub, using a soap containing G-11 is 3 minutes. This time should be lengthened two minutes if a G-11 soap is not used daily for scrubbing or in the daily toilet.
6. Liquid soap containing hexachlorophene has been studied by other investigators and similar conclusions regarding its effectiveness can be drawn.
7. In general, all liquid soaps are more irritating to the skin than bar soap because of their potash content. If liquid soap containing hexachlorophene is irritating to the skin, it is recommended that bar soap containing hexachlorophene be used. The cost and waste factor is greater with bar soap than with liquid.

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