Pain Control System in Siriraj Hospital Postanesthesia Care Unit (PACU)

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ABSTRACT

Objective: To determine the current postoperative pain status in the postanesthesia care unit (PACU) and nursing practices that may affect pain relief outcomes.

Methods: We performed a prospective observational study in 259 postsurgical patients who underwent general anesthesia only, and were admitted to 5 PACUs in Siriraj Hospital during official work hours. We silently observed the pattern of nursing management for postoperative pain according to the hospital work instructions (WIs). We interviewed the patients once about their pain scores (PSs) at the time they were discharged to wards. The manpower in each PACU was determined. All nurses working in 5 PACUs were asked to fill in the questionnaire.

Results: The PS after gaining consciousness, the overall PS, and the PS at discharge time were (mean±SD) 1.3±2.9, 4.1±2.7 and 3.1±2.4, respectively. The time to re-evaluate PS after each intravenous analgesic, to determine the adequacy of treatment, was longer than was recommended, so were the time of giving the additional doses which were 21.9±16.7 minutes, and 20.9±14.7 minutes, respectively. Other instructions in the WIs were followed in >75% of these patients. The Registered Nurse-to-patient care ratio was 1:1.5 (0.2-8.0). Nurses considered that to adjust manpower according to the varied numbers of patients during the day could improve their work. Nurses' attitude to intravenous analgesic administration was positive.

Conclusion: The overall PS was 4.1±2.7. Pain control system in Siriraj Hospital PACU was mostly in accordance with the hospital WIs, except that the time to re-evaluate the adequacy of analgesia was too long. Adjusting the manpower to suit the varying workload during the day was suggested to improve their work.

Keywords: PACU, pain, work instruction, workload

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INTRODUCTION

Pain management is one of the early cares that the postanesthesia care unit (PACU) personnel provide for the inpatients until they are ready to be discharged to their wards. Up to now there has been no study showing the quality of regular postoperative pain management in Siriraj PACU. There was a report[1] showing that the incidence of moderate to severe postoperative pain (numerical rating pain scale of 6.1±2.8; 0 = no pain, 10 = the worst pain imaginable) on the wards in Siriraj Hospital was 85% compared with 31-88% in other

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reports.[2,3] If pain in the PACU is adequately treated, it can result in a better analgesia on the ward.[4]

Siriraj Hospital is a 2,600-bed hospital with 60 operating rooms (OR) in 19 different surgical units and approximately 4,000 anesthetic administrations performed monthly. There are 5 PACUs in 5 different surgical areas, *i.e.*, Obstetric and Gynecological (OBGYN) PACU; Trauma Surgery PACU; Syamindra floor 3 (SM 3) PACU for Orthopedic and Ophthalmologic patients; Syamindra floor 4 (SM 4) PACU for Otolaryngologic, Plastic, Neuro-, and Cardio-Thoracic surgical patients; and Syamindra floor 5 (SM 5) PACU for General, Vascular, Urology, Head-Neck and Breast, and Pediatric surgical patients. All PACUs have 24-hour service and co-operate with anesthesia teams and surgeons. Each PACU is operated by nurses under Nursing Department and is responsible to manage its own manpower. At present Siriraj Hospital has already set the work instructions (WI, an instruction of a definite work for a specific group of personnel) on patient care in PACU, and on intravenous (IV) opioid administration for postoperative pain, to be followed.

The PACU practice, according to the two WIs, includes recording PS on arrival and continue to record pain regularly at least every 30 minutes. Whenever patients complain of pain, nurses need to evaluate sedation score (SS), respiratory rate (RR), blood pressure (BP), and PS, before making decision to give analgesics (maximum 3 doses), and to re-evaluate whether more additional doses are needed, at about 5 minutes after each IV analgesic.

Performing a preliminary survey to find whether pain was a problem in Siriraj PACU, we asked 15 patients from each PACU at the time they were discharged to wards and found that 44% of them had an overall PS ≥ 4 during their PACU stay. Pain in PACU might come from OR, or PACU's work system might have a role. Thus, we wanted to determine the pain status in Siriraj's PACUs and to study the pain control system and nurses' performance, which had never been studied before in Siriraj Hospital.

The primary objective of this study was to determine the overall postoperative PS during the admission in the PACU. The secondary objectives were to find out the first PS in PACU after gaining consciousness and being able to answer questions properly, and to check nursing practices according to the WIs which may affect the pain relief outcome.

MATERIALS & METHODS

The study was performed during May 2008 to November 2010, after obtaining an Institutional Review Board (IRB) approval and patient verbal informed consent. This study was divided into 2 parts. The first was a prospective observational study in postsurgical patients admitted to the 5 PACUs in Siriraj Hospital. The inclusion criteria were the patients aged ≥ 18 years old undergoing elective surgery under general anesthesia (no regional block combined at all), and the postanesthesia care activities were finished within official time. The exclusion criteria were a history of psychiatric or neurological problems, communication problems, and undergoing operations which had taken less than 30 minutes or as follows: the OBGYN PACU – curettage, loop electrosurgical excision procedure (LEEP), diagnostic laparoscopy, tubal sterilization, and manual removal of placenta; Trauma PACU – K-wire removal, reduction of dislocation of joint without fracture, and closed reduction of all fractures except nose fracture; SM 3 PACU – limb surgeries; SM 4 – direct laryngoscopic (DL)-Laser, DL-bronchoscopy, DL-biopsy, and foreign body removal; and SM 5 – transurethral surgeries.

The mean and standard deviation (SD) of patients' overall PSs during their PACU stay, which were recorded for one month during July-August 2007, were used to calculate sample size. To make the results accurate at an acceptable level and applicable to each unit, the calculated sample size of patients for OBGYN,

Trauma, SM 3, SM 4, and SM 5 PACUs were 70, 41, 42, 16, and 73, respectively. We compensated about 10% in round numbers, so the numbers of patients in each PACU were 80, 50, 50, 20, and 80, respectively.

We performed a study at each PACU by observing nurses' performance silently and interviewing the patients without any intervention. In the morning, one of the observer team was notified for the potential cases by the investigator in each surgical area. In the PACU, the observer screened for the eligible criteria and obtained the oral informed consent when the patient had become fully conscious, The observers were nurses who were not in the investigator team and did not work in the PACU, *i.e.*, ICU nurses, ward nurses, or nurse anesthetists not involved in that PACU. All of them had experience in taking care of postoperative and critically ill patients. They were instructed how to observe and interview in the same manner and used a provided manual for recording data. Data were obtained from Pre-Anesthesia Evaluation Form, Anesthesia Record, Postoperative Nursing Record in PACU, and from observation of nurses' practice. The patients were interviewed once at the time they were considered ready for PACU discharge to wards.

The second part of the study was performed after the first part had been completed. We asked for co-operation from all the nurses who worked in these 5 PACUs to fill in the questionnaire. To express their opinion, they graded their agreement or frequency of the events they had met in numerical rating scale 0-4: 0 = totally disagree/not at all, 1 = rather disagree/very few, 2 = have no idea to slightly agree/some, 3 = agree/many, 4 = strongly agree/most.

Statistical analysis

Descriptive analysis was used and presented as mean±SD [min-max], ratios, and 95% confidence interval (CI). Any differences among the PACUs in quantitative variables, if present, were statistically analyzed using One-way ANOVA. Categorical data were analyzed using Pearson Chi-square tests. Confidence interval, post-hoc analysis adjusted with Bonferroni, and factor analysis were done. Using SPSS 17.0 for all statistics, we considered a p value < 0.05 as statistically significant.

RESULTS

We found two limitations which caused delays in our study. Firstly, as general anesthesia techniques for major elective operations at Siriraj Hospital in the official work hours are now more and more combined with regional blockade for postoperative analgesia purpose, whereas one of our inclusion criteria was general anesthesia per se, so the number of cases in accordance with our selection criteria was decreasing. Secondly, when there were potential cases, there were no observers available. Thus, there were 80, 32, 47, 20, and 80 patients from OBGYN, Trauma, SM 3, SM 4, and SM 5 PACUs, respectively. Although the number of patients in Trauma PACU was less than the calculated size, we found that all of them were managed similarly, and the uncompensated sample size had already been reached, so we decided to discontinue the study.

We analyzed data according to the area of PACU to compare with each other, but reported in the Tables as the results of all PACUs. Table 1 has shown the overall patient characteristics. As each surgical area served different groups of patients, there were statistically significant differences among PACUs in age, sex, history of chronic pain and pain medication, and analgesics used in the ORs, otherwise they were similar.

The number of patient who already had PS ≥ 4 on arrival to PACU was small. The time they had received the last dose of analgesics in the OR and needed the first dose in the PACU have been shown in Table 2. There were no differences between those with overall PS ≤ 3 and ≥ 4. About half of the patients in each PACU, 121 patients (46.7%) in all PACUs, needed IV analgesics, mostly at 30 minutes after admis-

TABLE 1. Patient demographics and intraoperative data.

		Overall (n = 259)
Age (yr)		45.1 ± 15.3 [16-81]
Body weight (kg)		58.8 ± 12.2 [34.5-132]
Sex Male:Female		86:173
ASA class 1:2:3:4		138:99:21:1
History of previous operation (yes)		112 (43.2)
Number of previous operation		1.4 ± 1.0 [1-8]
Number of patient who had chronic pain		65 (25.1)
Number of patient receiving pain medications > 1 week before surgery		67 (25.9)
Operative time (min):		107.9 ± 62.2 [30-365]
	Open surgery (n = 172)	109.2 ± 62.1 [30-365]
	Endoscopic/Laparoscopic surgery (n = 87)	105.4 ± 62.7 [30-290]
Site of operation:	Lower abdomen/flank	109 (42.0)
	Head/neck/breast/chest wall	62 (24.0)
	Upper/lower extremities	35 (13.5)
	Spine	31 (12.0)
	Upper abdomen	22 (8.5)
Number of patients receiving morphine		130 (50.2)
	pethidine	48 (18.5)
	fentanyl	115 (44.4)
	parecoxib	19 (7.3)
Total amount of intraoperative analgesics:	morphine (mg)	7.1 ± 2.7 [2-16]
	pethidine (mg)	48.4 ± 13.8 [20-100]
	fentanyl (mcg)	40.8 ± 51.2 [0-200]
	parecoxib (mg)	40 [40-40]

Values are mean ± SD [min-max], and number (%) or number/number recorded (%).

sion except four patients that needed them later. Patients with PS ≥ 4 after re-evaluations received another dose of analgesic. About 40% of trauma and orthopedic patients needed 3 doses of analgesics. However, the total amount of analgesics was small. Morphine was used in the majority of cases. Durations of stay in SM 4 and SM 5 PACUs (87±40 minutes and 98±24 minutes, respectively) were statistically significantly shorter than in Trauma PACU (122±54 minutes, $p < 0.001$). The length of stay in PACU for those who received analgesics was statistically significantly longer than those who did not ($p < 0.001$).

The registered nurses (RN)-to-patient care ratio was found to be one nurse to 1.5 postanesthesia patients. The ratios were significantly different among the PACUs ($p < 0.001$). There were one nurse to (median [min-max]) 2.0 [1.0-8.0], 1.0 [0.3-3.0], 1.0 [0.4-4.0], 1.5 [0.5-5.0], and 1.25 [0.2-3.5] patients in OB-GYN, Trauma, SM 3, SM 4, and SM 5 PACUs, respectively.

The first PS after gaining consciousness in the PACU was low (Table 3) and increased later. The overall PSs during the PACU stay inquired by the interviewers were in an acceptable range. Nevertheless 17.8% of patients experienced PS ≥ 7. At discharge time there were 63.4% (by interviews) to 88.1% (in the PACU records) of patients that had PS ≤ 3. There were some differences between the discharge PSs in the PACU records and those which were inquired directly by interviewers. The 95% CI for the differences within 2 scores between the PSs in the PACU records and those

TABLE 2. Duration of each period, number of patients with pain, analgesics receiving, and workload in the postanesthesia care unit (PACU), with subgroup analysis.

	Overall
Time from the last dose of analgesics in OR to PACU arrival (min)	92.6 ± 55.6 [2-385]
In patients with overall PS in the PACU ≤ 3	94.2 ± 57.9 [2-385]
In patients with overall PS in the PACU ≥ 4	90.9 ± 53.8 [2-315]
Time from the end of surgery to the 1st dose of analgesics in PACU (min)	52.7 ± 28.2 [10-117]
In patients with overall PS in the PACU ≤ 3	52.9 ± 26.5 [15-95]
In patients with overall PS in the PACU ≥ 4	53.1 ± 28.5 [10-117]
Time from PACU arrival to the 1st dose of analgesics in PACU (min)	39.8 ± 26.7 [0-105]
In patients with overall PS in the PACU ≤ 3	42.1 ± 24.7 [5-80]
In patients with overall PS in the PACU ≥ 4	39.8 ± 27.1 [0-105]
Number of patient who already had PS ≥ 4 on arrival to PACU	7 (2.7)
Number of patient who had ≥ 1 episode of PS ≥ 4 during PACU stay	98/206 (47.6)
Number of patient who received IV analgesic at 30 min in PACU	117/259 (45.2)
60 min in PACU	56/259 (21.6)
90 min in PACU	27/259 (10.4)
Number of patient who received 1 dose of IV analgesics	66/121 (54.6)
2 doses of IV analgesics	31/121 (25.6)
3 doses of IV analgesics	24/121 (19.8)
Number of patients receiving morphine	90/121 (74.4)
pethidine	22/121 (18.2)
fentanyl	9/121 (7.4)
parecoxib	2/121 (1.7)
Total amount of analgesics in the PACU: morphine (mg)	2.7 ± 1.6 [0.5-6.0]
pethidine (mg)	23.4 ± 12.5 [10-60]
fentanyl (mcg)	25.6 ± 15.3 [10-55]
parecoxib (mg)	40 [40-40]
Duration of the PACU stay (n = 259) (min)	103.8 ± 31.8 [25-275]
Patients undergoing	
Open surgeries (n = 172)	104.9 ± 35.4 [25-275]
Endoscopic/laparoscopic surgeries (n = 87)	101.6 ± 23.2 [55-210]
Received analgesics during the PACU stay*	
Yes (n = 121)	114.3 ± 35.5 [25-275]
No (n = 138)	94.7 ± 24.9 [35-195]
During each interview: number of patients staying in the PACU	5 [1-16]
number of Registered Nurse working in the PACU	3 [1-8]
number of Practical Nurse working in the PACU	2 [0-4]
registered Nurse-to-patient care ratio	1:1.5 [0.2-8.0]

OR: operating room; PS: pain score.
Values are mean ± SD [min-max], number/number recorded (%), or median [min-max].
*Significantly different between those who received and not received analgesics ($p < 0.001$).

from direct interview were 79.5% (73.1% to 84.7%). We found that the numbers of patients with PS ≥ 4 when the nurses' workload was either optimum or overloaded were not different ($p = 0.535$).

The pattern of nurse practice observed in the PACU was generally in accordance with the hospital WIs (Table 4), although not in 100% of patients. On arrival to the PACU, PS was recorded in 84.6% of patients. In 91.5%

TABLE 3. Pain scores (PSs) in the postanesthesia care unit (PACU), with subgroup analysis.

	n	Overall PS	Number of patient with pain scores		
			0-3	4-6	7-10
PS after gaining consciousness in the PACU	219	1.3 ± 2.9 [0-10]			
Interviewed overall PS	258	4.1 ± 2.7 [0-10]	120 (46.5)	92 (35.7)	46 (17.8)
PS interviewed at discharge time	257	3.1 ± 2.4 [0-10]	163 (63.4)	71 (27.6)	23 (9.0)
PS noted in the PACU discharge record	185	1.7 ± 1.9 [0-10]	163 (88.1)	18 (9.7)	4 (2.2)
Patients with overall PS ≥ 4					
during RN-to-patient care ratio 1: <1-2				106/202	(52.5)
during RN-to-patient care ratio 1: >2				32/56	(57.1)

RN: Registered Nurse.
Values are mean ± SD [min-max], number (%), or number/number recorded (%).

of those who had PS ≤ 3 on arrival, nurses continued to record PS regularly. Nearly all of the patients in Trauma and SM 5 PACUs had their SS, RR, BP recorded and PS asked before each dose of IV analgesic. Patients' PSs were re-evaluated at about 20 (5-60) minutes after previous injections, and so were the intervals between each analgesic dose.

Seventy-eight PACU nurses (96.3%) responded to questionnaire. Thirty-five percent of PACU nurses worked permanently in the PACU. The others worked in rotation, mostly in monthly-periods. About 90% of nurses were orientated by senior PACU nurses from the beginning of their jobs. About 70% and 80% of them regularly attended educational and administrative meetings, respectively. They reported that they could access both the WI of "administration of IV opioids" and the WI of "patient care in PACU" easily. They had applied both WIs to their work and strongly agreed that nurses should learn their contents from the beginning of their work. About 60% of the nurses used the WIs and the orientation instructions as their guidance for taking care of patients. Interestingly, the majority of nurses with > 5 years of working experience in PACU preferred WIs whereas the majority of those with < 5 years experience preferred orientation session (data not shown).

For the most effective means for work improvement, PACU nurses 46.2%, and 34.6% selected the choices "to distribute manpower to suit each period of workload", and "to increase manpower", respectively, with the scores have been shown in Table 5. Of the PACU nurses 21% reported that they had given IV analgesic for every request for more than 2 years whereas 58% reported "not to every request". Their ideas for not giving injections have been presented as the weighted mean scores (Table 5). The only reason was that they needed to be trained first, especially those with < 2 years experience. PACU nurses considered that adequate pain relief in the PACU had very much effect on the efficiency of postoperative analgesia.

DISCUSSION

As we were concerned about the Hawthorne effect (the tendency of some people to work harder and perform better when they are participants in an experiment) on the PACU nurses, we did not ask for the written informed consent from the patients in this study and used the nurses from other workplaces to observe the performance silently.

TABLE 4. Observed practice in postanesthesia care unit (PACU), including evaluation, recording, administration of analgesics, and re-evaluation.

	Overall
Number of patient who had:	
- their PS evaluated and documented at the time admitted to PACU	219/259 (84.6)
- their first PS evaluated and documented later	19/259 (7.3)
- no PS documented and no analgesics	15/259 (5.8)
- got analgesics but no PS documented	6/259 (2.3)
- their PS continued to be recorded every 30 minutes although PS ≤ 3	204/223 (91.5)
- their SS recorded at	
the 1st complaint of pain	108/127 (85.0)
the 2nd complaint of pain	59/70 (84.3)
the 3rd complaint of pain	28/28 (100.0)
- their RR recorded at	
the 1st complaint of pain	103/127 (81.1)
the 2nd complaint of pain	53/70 (75.7)
the 3rd complaint of pain	21/28 (75.0)
- their BP recorded at	
the 1st complaint of pain	109/127 (85.8)
the 2nd complaint of pain	53/70 (75.7)
the 3rd complaint of pain	22/28 (78.6)
- their PS asked at	
the 1st complaint of pain	116/127 (91.3)
the 2nd complaint of pain	61/70 (77.1)
the 3rd complaint of pain	27/27 (100.0)
- their PS recorded after	
the 1st analgesic/evaluation	106/127 (83.5)
the 2nd analgesic/evaluation	54/70 (77.1)
the 3rd analgesic/evaluation	26/29 (89.7)
No analgesic received after	
their 1st complaint of pain	11/127 (8.7)
their 2nd complaint of pain	14/70 (20.0)
their 3rd complaint of pain	2/29 (6.9)
Time to re-evaluate and record PS after giving	
the 1st dose (min)	16.8 ± 10.6 [5-60]
the 2nd dose (min)	19.5 ± 11.7 [5-60]
the 3rd dose (min)	16.2 ± 13.2 [5-60]
Interval between	
the 1st and the 2nd doses of analgesics (min)	21.9 ± 16.7 [5-90]
the 2nd and the 3rd doses of analgesics (min)	20.9 ± 14.7 [5-70]

PS: pain score; SS: sedation score; RR: respiratory rate; BP: blood pressure.
Values are number/number recorded (%) or mean ± SD [min-max].

TABLE 5. Nurses' opinions and attitude to their work.

	Score [range]
Means for work improvement, scored by PACU nurses (score 0-4)*:	
- To distribute manpower to suit each period of workload	3.6 [2-4]
- To increase manpower	3.6 [2-4]
- To increase knowledge	3.5 [2-4]
- To instruct "Work Instruction"	3.3 [1-4]
- To increase monitoring equipments	3.2 [0-4]
- To do pre-test before starting to work	3.0 [1-4]
- Having order-checklists to follow	3.0 [0-4]
Nurses' ideas/reasons for not giving injection (score 0-4)*:	
- Giving IV analgesics should be a job for those who underwent training only	2.7 [0-4]
- Had a fear that complications from the injections will happen	1.8 [0-4]
- Sedation score assessment is difficult	1.2 [0-3]
- Rather wait for the patient's request	1.2 [0-4]
- No need to give analgesics when patient's pain has just begun	1.1 [0-3]
- There are many other issues rather than pain to take care of	1.0 [0-4]
- Need to be accompanied by a more experienced nurse	1.0 [0-4]
- To assess patient after injection is cumbersome	1.0 [0-3]
- Preparing IV injection is inconvenient	0.8 [0-4]
- Giving an IV injection is cumbersome	0.6 [0-4]

*Values are weighted mean scores [min-max]: 0 = totally disagree, 1 = rather disagree, 2 = have no idea to slightly agree, 3 = agree, and 4 = strongly agree.

During the PACU stay, 17.8% of our patients had an overall PS ≥ 7 compared with 24% in the study of Pavlin *et al.*[5] These meant that postoperative analgesia in Siriraj PACU was in an acceptable situation, but should be further improved.

The large number of patients with PS ≤ 3 on arrival to the PACU suggested that, at the beginning, analgesia from general anesthesia was adequate in the majority of cases. However, the degree of pain varied depending on the PACU. Trauma PACU was the only PACU that got patients who already had their PS ≥ 4 on arrival. They gave the 1st dose of analgesics sooner than other PACUs although their patients had just received the analgesics from OR. These patients might have more severe pain and the intraoperative analgesics might be inadequate.

The patients who did not need analgesics were discharged to ward earlier; so the faster the pain was controlled, the shorter the length of PACU stay would be. We found that the interval between the IV injection and the re-evaluation of the adequacy of analgesia after each injection was too long (20 [5-60] minutes). If the patients were re-evaluated earlier, *i.e.*, at about 5 minutes after IV injection as recommended in the WI, we could give an additional analgesic faster. Then the overall PS and the number of patients with PS ≥ 4 at discharge time would have been smaller. Further study of factors affecting PS in each PACU should be performed.

The manpower might influence the frequency of evaluation. Malasai *et al.*[6] reported that working system, especially a shortage of PACU nurses, influenced non-compliance with pain algorithm in PACU. Our overall RN-to-patient care ratio in PACUs was comparable to the "average" nurse-to-patient care ratios for PACU according to the American Society of Perianesthesia Nurses (ASPAN), which is 1:2 (one nurse to 2 uncomplicated postanesthesia

patients),[7] although the proportion for university hospital should be 1:1 according to the standards of nursing and midwifery services for university hospital.[8] However, our manpower was not matching to the workload in some periods. In this study we found that different manpower did not affect the number of patients with much pain, but we could not demonstrate whether it affected the time to re-evaluate the adequacy of analgesia after each dose of analgesic.

Giving IV opioid to relieve pain in the PACU instead of giving the first dose on the ward has been suggested to yield a better outcomes.[4] The amount of analgesics given in PACU in this study was very small compared with 10.6±10.4 mg of morphine equivalents in the study of Frasco *et al.*[9] Accordingly, we may give a larger dose of opioid injection, so the PS may reduced to ≤ 3 faster.

The reason for not giving analgesic that "the patient had just got the analgesic from OR" was a misconception and caused a delay in pain treatment. When making a decision whether to give opioids for postoperative pain, nurses need to evaluate SS, RR, BP and PS, and not depend on the duration from administration of the last dose in OR.

To treat pain, personnel should have a good attitude. Our PACU nurses considered that adequate pain relief commencing in PACU was important to the efficiency of postoperative analgesia. They had a positive attitude towards pain service.

CONCLUSION

The first PS after gaining consciousness, the overall PS in the PACU, and the PS at discharge time were (mean±SD) 1.3±2.9, 4.1±2.7, and 3.1±2.4, respectively. The pain control system in Siriraj Hospital postanesthesia care unit was mostly in accordance with the hospital work instructions, except the time to re-evaluate adequacy of pain relief after each dose of analgesic was longer than was recommended. For work improvement, PACU nurses suggested adjusting the manpower to suit the varying workload during the day.

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