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3 **Impact of the Clinico-pathological Conferences as a teaching**
4 **modality on medical students' performance in Endocrine Course**

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9
10 **Abstract**

11 **Objective:** To evaluate the impact of introducing clinico-pathological
12 conferences in the endocrine block on student performance.

13 **Method:** The retrospective pilot study was conducted at the College of
14 Medicine, Alfaisal University, Riyadh, Saudi Arabia, and comprised medical
15 students' examination scores in the endocrine course from 2012 to 2016. The
16 2012 batch was not exposed to clinico-pathological conferences and represented
17 the control group, whereas batches from 2013 to 2016 had consistent exposure.
18 The assessment for each batch had been done annually using a standardised
19 format of multiple-choice questions and short-answer questions. The data
20 collected was analysed using SPSS 19.

21 **Results:** Of the 645 students whose records were evaluated, 62(9.6%) were
22 controls in the 2012 batch, while 583(90.3%) were in batches from 2013 to
23 2016. The intervention group with exposure to clinico-pathological conferences
24 performed better than the controls ($p<0.001$).

25 **Conclusion:** The students who were exposed to clinico-pathological
26 conferences tended to achieve high examination score compared to those who
27 were not exposed.

28 **Key Words:** Clinico-pathological conference, Medical students, Endocrine
29 course, Teaching modality.

30

31 **Introduction**

32 Adult learning is based on certain assumptions, including the notion that they
33 are more interested in learning with a problem-centred approach rather than
34 subject-centred one.¹ There are various methods to promote problem-centred
35 learning, such as problem-based learning (PBL), team-based learning (TBL)
36 and clinico-pathological conference (CPC) sessions. The Alfaisal University has
37 adapted a spiral curriculum where student-centred approach, such as PBL and
38 TBL, plays a central role. Various themes/topics are together integrated into
39 organ-system courses. Recently, the institution introduced CPCs to improve
40 correlation between basic and clinical characteristics of a disease or problem.
41 CPC has been used in the United States and the United Kingdom at a few places
42 despite its observed benefits.² This approach was started at Harvard Medical
43 School in 1900 by Walter B. Cannon, a renowned physiologist.^{3,4} While more
44 than a century has passed and although, in most medical schools and hospitals,
45 CPC has gradually diminished in its importance, it still remains a significant
46 part of not only training for medical students, interns and residents, but also
47 serves as a quality-control tool for bedside clinical decision-making.⁵

48 Problem-solving in the context of a clinical case with laboratory and clinical
49 imaging data and biopsy photomicrographs has been the most reported format.
50 The introduction of this instructional strategy has shown positive impact to
51 integrate morphology with clinical features, and disease processes. The good
52 thing about it is that CPC can be conducted in small groups using TBL formats.⁶

53 A well-prepared and thoughtfully-presented CPC continues to be a great tool of
54 teaching which not only offers clinico-pathological correlation, but also serves
55 to build clinico-pathological competency.⁷ In medical practice, professionals,
56 particularly those involved in teaching roles, never stop learning and exploring

57 new effective ways, and, for them, a carefully-prepared CPC provides a good
58 platform for intellectual interaction with updated information.⁸ The pre-
59 requisites of a good CPC include selecting the right case, carefully preparing
60 and thoughtfully presenting the case, engaging the students in the discussion
61 and encouraging them to share their thoughts and reasons, and, finally,
62 presenting the ultimate diagnosis with reasons and a closing case discussion.⁹
63 When designed appropriately, students value this strategy and learn from it.¹⁰
64 The current study was planned to evaluate the impact of introducing CPC in the
65 endocrine block on student exam scores.

66

67 **Subjects and Methods**

68 The retrospective pilot study was conducted at the Department of Pathology,
69 College of Medicine, Alfaisal University, Riyadh, Saudi Arabia, and comprised
70 medical students' examination scores in the endocrine course from 2012 to
71 2016. The 2012 batch was not exposed to CPCs and represented the control
72 group, whereas batches from 2013 to 2016 had consistent exposure and together
73 represented the CPC group. After approval from the institutional ethics review
74 board, records of exam scores were retrieved of both male and female students
75 using convenience sampling technique.

76 While conducting CPC sessions, after segregating boys and girls, the class is
77 further divided into two large groups of about 40 students each. Each class is
78 taken by separate tutors. The CPC sessions are further divided into four small
79 groups of approximately 8-10 students who are required to work in teams. This
80 modified and improved CPC format requires the facilitator to show cases to the
81 students three times. During the first phase, the students are shown 6-8 cases on
82 a large screen, and then each individual student is required to answer the
83 questions by writing an individual readiness assurance test (IRAT) to assess the
84 basic understanding of the facts and concepts related to the objectives. Each
85 case consists of one multiple choice question (MCQ) and 3-4 short-answer

86 questions (SAQs). After completing the IRAT, the questionnaire is collected by
87 the facilitators. In the second phase, on the same cases, a separate set of answer
88 sheet is given to the group. The facilitator again shows the cases one by one,
89 and this time the students are asked to work in group by writing a Group
90 Readiness Assurance Test (GRAT) to resolve the problem after discussing as a
91 team and reaching consensus about each answer. After completing the GRAT,
92 the team reports back its consensus findings to the facilitator. Five to six minutes
93 are given to each team for each case. In the third phase, the group findings of
94 each case are reported by relevant groups, and an open discussion is held. If
95 they are not able to come up with the desired response, as planned by the
96 facilitator, then the facilitator thoroughly explains those important aspects and
97 ensures that they clearly understand those very aspects of the case. In the
98 current study, all the exam scores were noted on a proforma.

99 The data was analysed using SPSS 19. The findings were expressed as
100 frequencies and percentages, and mean \pm standard deviation (SD). Analysis of
101 Variance (ANOVA) was used to compare quantitative variables with a post-hoc
102 Tukey's honestly significant difference (HSD) test. The grade trend was
103 analysed with Jonckheere-Terpstra test. $P < 0.05$ was considered significant.

104

105 **Results**

106 Of the 645 students whose records were evaluated, 62(9.6%) were controls, and
107 583(90.3%) were in the CPC group (Table 1). The CPC group performed better
108 than the controls with MCQs, SAQs and overall scores (Table 2). There was a
109 consistent increase in the number of students achieving higher grades in the
110 CPC group batches compared to the control 2012 batch (Figure).

111

112 **Discussion**

113 CPC is an important learning method that enables understanding of the subject
114 and relationship of various pieces of knowledge in a clinical scenario.¹¹ the

115 current study explored the role of this important strategy in improving learning
116 of medical students at undergraduate level. Students who underwent CPC
117 sessions performed significantly better in their final assessment compared to the
118 non-CPC group. Among the control group, the mean examination scores varied.
119 The majority fell in grades B or C and there were some students even in grade
120 D. After introducing CPC, students tended to score better, with none falling in
121 grade D. In other words, students who would have fallen in a lower grade
122 improved by crossing into a better grade. Also, there was a consistent increase
123 in the number of students getting grade A. Similarly, there was a consistent
124 decrease in the number of students with grade C in the CPC group.

125 The results are similar to those reported by Koles et al.¹² and Kolluru et al.¹³
126 who found that participation in an activity that correlates clinical and basic
127 sciences would improve command over course content as well as exam scores.
128 The results also support Vasan et al,¹⁴, who found that TBL-based anatomy
129 teaching correlated with consistent pattern of higher national board examination
130 scores than those for lecture-based anatomy. Similarly, another study suggested
131 that TBL-based teaching improved learning and thereby exam performance in
132 cardio-respiratory pathophysiology.¹⁵

133 In contrast, some studies report no observed advantage in terms of exam scores
134 between students taught with easy-to-manage traditional lectures and those
135 taught with resource-intense strategies such as seen with TBL or CPCs. For
136 example, it has been reported¹⁶⁻¹⁸ that students taught through integrated
137 teaching approaches, such as TBL sessions, remain at a disadvantage in
138 attempting recall questions, whereas attempting essay-type question or those
139 requiring application of knowledge, yielded no differences between the two
140 groups. One can argue that this lack of advantage may reflect gaps in
141 knowledge, but others argue that adoption of such strategies may improve
142 students' ability in terms of day-to-day preparedness and group problem-solving
143 skills which is an important aspect in clinical practice and patient care, and such

144 skills can be improved with the adoption of integrated teaching methods, such
145 as CPCs.¹⁹

146

147 **Conclusion**

148 Supplementing didactic lectures with CPCs has the ability to enhance students'
149 understanding of the subject and better performance in examinations. Based on
150 findings, the institution will implement CPC on a trial basis as a supplement to,
151 and not replacement for, didactic lectures.

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156

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205 **Table 1: The number of students (N) in each year. The frequency**
 206 **represents actual number whereas the percent refers to that in the entire**
 207 **cohort.**

Year	N	Percent
2012	62	9.6
2013	138	21.4
2014	146	22.6
2015	151	23.4
2016	148	22.9
Total	645	100.0

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210 **Table 2: Analysis of variance (ANOVA) showing difference between**
 211 **students' mean examination scores achieved in intervention groups (Batch**
 212 **2013-2016) compared to control group (Batch 2012). The number of**
 213 **students is denoted as 'N' and standard deviation is denoted as 'SD'.**

Students' Score	Batch (Year)	N	Mean	SD	95% Confidence Interval		p value*
					Lower Bound	Upper Bound	
Total Score (percent)	2012	62	75.28	10.63	72.58	77.98	
	2013	138	71.95	10.84	70.13	73.77	0.13
	2014	146	79.72	9.37	78.18	81.25	0.01
	2015	151	79.90	8.23	78.57	81.22	<0.01
	2016	148	79.94	7.82	78.67	81.21	<0.01
MCQ Score (percent)	2012	62	73.83	11.97	70.79	76.87	
	2013	138	67.05	12.69	64.91	69.19	<0.01
	2014	146	75.42	11.84	73.49	77.36	0.88
	2015	151	74.22	10.37	72.56	75.89	0.99
	2016	148	76.91	9.25	75.40	78.41	0.36
SAQ Score (percent)	2012	62	77.40	12.97	74.11	80.70	
	2013	138	68.35	15.63	65.71	70.98	<0.01
	2014	146	77.58	13.03	75.45	79.71	0.99
	2015	151	81.06	11.80	79.16	82.96	0.36
	2016	148	73.23	12.41	71.21	75.24	0.23

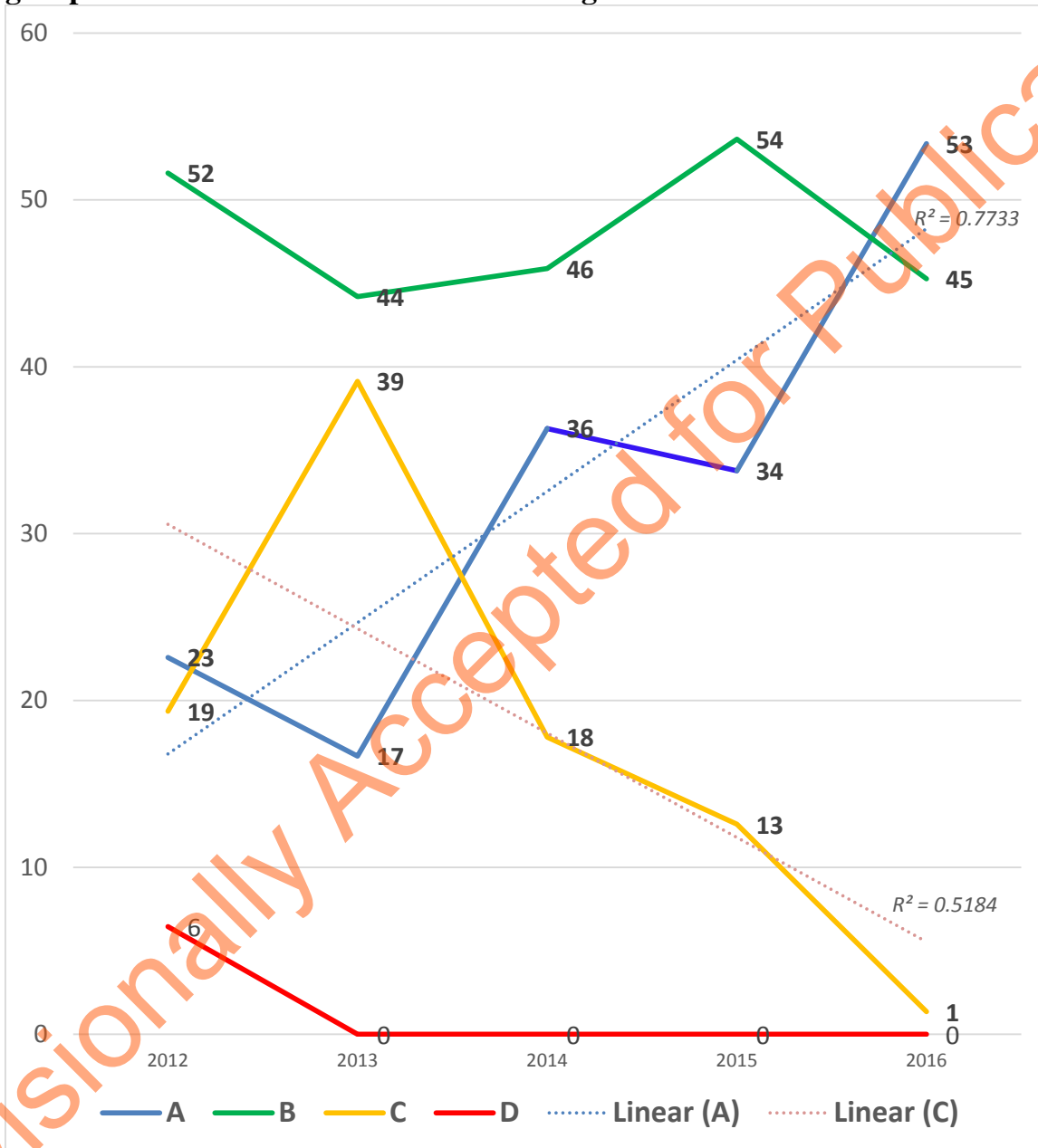
214 * P-value when compared to corresponding scores in 2012

215 MCQ: Multiple-choice question; SAQ: Short-answer question.

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218 **Figure: Line graph showing frequencies and percentages of students**
 219 **achieving various A, B, C and D grades; where A is the highest).** They are
 220 **grouped in batches. The trend lines with significant R^2 values are shown.**



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