

## Benefit of Sequential Audit Cycles in Improving Management of Vitamin D Deficiency in the HIV Infected Paediatric Population

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### Abstract

#### *Aims*

Lifelong HIV infection has an unknown impact on bone health in children. In view of this, we aimed to improve management of vitamin D deficiency.

#### *Methods*

Three audits over 8 years (2009-2017) were performed with interventions introduced intermittently in an effort to improve vitamin D deficiency. The interventions included education, a change in vitamin D dose and brand to increase compliance and a shift to nursing led management.

#### *Results*

The most striking result was the eradication of patients with deficient vitamin D levels (<25nmol/L) in 2017. In 2009 and 2015, 15% and 9% were deficient. In the earlier two studies, only 15% had 'sufficient' (>50nmol) vitamin D levels. This increased to 71% in 2017. 10% of patients had levels greater than >120nmol/L, increasing risk of vitamin D toxicity. 67% of patients with insufficient vit D (25-50nmol/L) were prescribed a stat high dose vitamin D (120,000 IU) to help avoid adherence issues.

#### *Conclusions*

Sequential audits along with a shift to nurse led management were the most likely reasons for sustained improvement. Similar projects in all medical departments could improve clinical outcomes.

Lifelong HIV infection and prolonged antiretroviral (ARV) treatment has an unknown impact on bone health in youth.<sup>1</sup> Patients with low serum concentrations of vitamin D have been shown to suffer from increased disease morbidity.<sup>2</sup> In the last eight years, using a 'plan-do-study-act' audit cycle approach, the management of vitamin D status in HIV infected children and adolescents attending the department has improved. This has been accomplished through the use of serial audits in conjunction with empowerment of nursing staff to lead management of patients' vitamin D status.

Three vitamin D management audits in the paediatric HIV infected cohort were performed between 2009 and 2017. The CHIVA's (Children's HIV Association of the UK and Ireland) recommendation for annual autumnal vitamin D level measurement and vitamin D management guideline were adopted as the desired standard.<sup>3,4</sup> Data collected included demographics, vitamin D levels, season when measured and vitamin D status (deficient (<25nmol/L), insufficient (25-

50nmol/L), adequate (>50nmol/L), risk of toxicity (>120nmol/L). Chi squared analysis was used to compare the results of the 2009 or the 2015 audit with 2017.

The demographics of paediatric HIV infection in children in Ireland has remained largely unchanged over the study period (**Table 1**).

	2009 (n=66)	2015 (n=56)	2017 (n=42)
<u>Age (Years)</u>			
Median	11	11	12
Range	1-17	3-18	1-18
<u>Sex</u>			
Male	31 (47%)	33 (59%)	24 (57%)
Female	35 (53%)	23 (41%)	18 (43%)
<u>Ethnicity</u>			
African	52 (79%)	48 (86%)	36 (85%)
Caucasian	11 (17%)	6 (11%)	4 (10%)
Asian	0	1 (1.5%)	2 (5%)
Mixed Race	3 (4%)	1 (1.5%)	0
<u>Vitamin D Levels</u>			
Deficient <25nmol/L	10(15%)	5(9%)	0
Insufficient 25-50nmol/L	38(58%)	35(62%)	8(19%)
Normal 50-120nmol/L	18(27%)	15(27%)	30(71%)
Risk of toxicity >120nmol/L	0	0	4(10%)
Not tested	0	1(2%)	
Autumnal Testing	40 (61%)	32 (57%)	39 (93%)
Prescribed Maintenance Vit D	Not available	49 (88%)	41(98%)
Treated with high dose vitamin D if insufficiency/deficiency at some point during the year	Not available	Not available	67% (12)

The overall number of HIV infected children attending the clinic has declined, from 66 in 2009 to 42 in 2017, reflecting the success of interventions to prevent perinatal transmission and transition of the HIV infected cohort to adult services.

The results of sequential audit are also shown in Table 1. Ninety-three percent of patients had an autumnal vitamin D level in 2017 compared with 57% in 2015 (p 0.0001). The proportion of patients with insufficient (58% vs 19%, p 0.0001) and deficient (15% vs 0%, p 0.0094) autumnal vitamin D levels had declined significantly in the third compared with the first audit. Prescriptions for maintenance therapy increased over time with 98% of patients prescribed maintenance therapy in 2017. While the numbers of patients deficient in vitamin D reduced at autumnal screening, 18/42 (43%) patients had an insufficient level documented at some other time during the year, often in late winter or spring that prompted additional supplementation. Of note, in 2017, 4/42 (10%) had a level >120nmol/L and thus were potentially at risk for toxicity.

Annual review of audit results permitted identification of target areas for improvement e.g. timing of assessment, acceptability of formulations and adherence to prescribed regimen. In our clinical practice, clinical audit resulted in stepwise changes that have contributed to the improvements. These included increasing maintenance vitamin D dose and a change in formulation to an oral spray (Dlux™) that was more acceptable to people and did not add to pill burden. Treatment doses of vitamin D, when indicated, were frequently administered as a stat dose, given in hospital under supervision, which also may have improved compliance.

It is worth noting that over the study period, the continued development of HIV paediatric services along with advances in ARV medications have impacted positively on the general health of these young patients which may also have contributed to improved bone health. The use of audit to improve clinical outcomes is well recognised in surgical and intensive care units. Possibly the most important intervention to improve vitamin D status in our cohort was the fact that serial audits were being performed. This maintained awareness of the importance of vitamin D status,

enabled evaluation of management strategy and set targets for the team to achieve. The empowerment of the department's clinical nurse specialists to lead management of vitamin D status in this cohort was a further intervention that enhanced overall performance. Non-consultant hospital doctors in Ireland generally rotate on a 6 to 12 monthly basis through subspecialties and may change hospital. While many trainees complete audit cycles over a six month period, sustained change in departments would more likely occur with the use of serial audit and multidisciplinary team involvement, including further empowerment of clinical nurse specialists. This study clearly demonstrates the value of sequential audits in enhancing clinical care.

**Conflicts of Interest Statement:**

The authors have no conflicts of interest to declare.

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